CHEMISTRY (CHEM)

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 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: carbohydrates, 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 I. 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 or CHEM 324.

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 or ENGR 145.

CHEM 302. Introductory Physical Chemistry II. 3 Units.
Continuation of CHEM 301. Chemical kinetics and catalysis. Introductory quantum chemistry. Spectroscopy. Statistical thermodynamics. Prereq: CHEM 301 or CHEM 335.

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 or ENGR 145) 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 a SAGES Departmental Seminar course. Prereq: CHEM 301 and CHEM 304 or CHEM 335. Or Prereq or Coreq: CHEM 302 or CHEM 336.

CHEM 306. Biochemistry Laboratory. 3 Units.
Comprehensive examination of techniques in protein purification and analysis in this all encompassing course, guiding students through extraction and purification of the enzyme lysozyme and its biochemical characterization. Students will engage in hands-on experiences with techniques ranging from ion exchange & size exclusion chromatography and SDS-PAGE to Western Blotting and ELISA assays. The course seamlessly integrates wet-lab practices with computational explorations, including pdb protein structure examinations and molecular docking simulations. Emphasis is on both technique mastery and their broader biochemical relevance. Counts as a SAGES Departmental Seminar course. Prereq: CHEM 328 and (CHEM 234 or CHEM 322).

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 224 or CHEM 324.

CHEM 314. Innovation and French Science: Past, Present, and Future. 3 Units.
The French scientific enterprise over the past 250 years has been buffeted by politics, war, civil unrest, and economic and societal changes. This study abroad course examines the evolution of science in France in light of these influences, how women have play an outsized role relative to the U.S., and the centrality of the French to humanity's scientific endeavor over the centuries. Students will visit many important scientific venues, both historical and modern, around Paris and elsewhere in the country. Readings from a variety of sources -- scientific, literary, historical -- and informal meetings with French scientists, engineers, and students will provide a comprehensive portrait of French science and scientific history from a variety of perspectives. The course will be conducted in English, although there is ample opportunity to interact in French if the student desires. The course meets the CAS Global & Cultural Diversity Requirement and may meet breadth requirements in certain programs. Not available for credit to students who have completed FRCH 328/428, PHYS 333, WGST 333, or WLIT 353/453. Offered as CHEM 314, HSTY 314, PHYS 314, and WGST 314. Counts as a CAS Global & Cultural Diversity course.

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: Declared major in Chemistry or Chemical Biology.

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 323 and a declared major in Chemistry or Chemical Biology.

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.
A survey of biochemistry with a strong emphasis on the chemical logic underlying the structure, function, and evolution of biomolecules. Amino acids and protein structure, purification, and analysis. DNA, RNA, genes, and genomes. DNA replication, repair, and recombination. RNA synthesis and processing. Protein synthesis and turnover, control of gene expression. Hemoglobin. Drug development. Enzyme kinetics, catalytic and regulatory strategies. Carbohydrates. Offered as CHEM 328 and CHEM 428. Prereq: CHEM 224 or CHEM 323.

CHEM 329. Biochemistry II: Living Systems. 3 Units.
A survey of biochemical systems exploring their molecular circuitry and architecture. Lipids, cell membranes, channels and pumps. Signal transduction and receptors. Glycolysis, gluconeogenesis, citric acid cycle, and glycogen metabolism. Redox processes, electron transport, and photosynthesis. Fatty acid and amino acid biosynthesis and degradation. Nucleotide, lipid, and steroid biosynthesis. Sensory and immune systems. Molecular motors. Offered as CHEM 329 and CHEM 429. Prereq: CHEM 328.

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.
Modern techniques of physicochemical measurement, including, kinetics, spectroscopy, and electrochemistry and the use of statistical methods for the analysis of experimental data. Seminar discussions and disciplinary writing of results. Counts as a SAGES Departmental Seminar course. Prereq: CHEM 304. Prereq or Coreq: CHEM 336.

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.
First of a two-semester sequence of physical chemistry for chemistry majors and others with career goals in the physical sciences or engineering. Thermodynamics and its application to chemical systems: First Law, Heat, Work, internal energy, State functions, Thermochemistry, Entropy, 2nd and 3rd law of thermodynamics, Chemical equilibrium, Real Gases, Phase diagrams, ideal and real solutions, Electrolyte solutions, and Electrochemical cells, batteries and fuel cells. Introduction to chemical kinetics. This class is taught using the flipped classroom strategy, where students are expected to learn the basic concepts before class by reading relevant notes and textbook sections, as well as watching videos and answering pre-class questions. In class, students work on exercises and solving problems. Students have ample opportunities to clarify concepts, ask questions, and learn from both peers (in group settings) and the teacher. Recommended preparation: One year each of undergraduate physics and calculus, including partial derivatives. Prereq: CHEM 106 or ENGR 145.

CHEM 336. Physical Chemistry II. 3 Units.
Continuation of CHEM 335. Reaction kinetics and catalysis. Reaction dynamics. Chemical quantum mechanics. Statistical mechanics and thermodynamics. Spectroscopy. Prereq: CHEM 335 or Chemical Engineering Major with at least Junior standing.

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 337 and CHEM 446. Prereq: CHEM 336.

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 348. Chemistry Fermentation Brewing: To Discern the Molecular Basis of Fermentation and Beer Brewing. 3 Units.
This course includes in-depth discussions of the chemistry and procedures underlying either an aspect of the brewing process or a style of beer in order to discern the molecular basis of fermentation and beer brewing. The biochemistry of yeast fermentation and hops, as well as mashing, lautering, boiling, conditioning, filtering, and packaging will be discussed. There is no lab component (such as brewing beer), although field trips to pubs including the Jolly-Scholar pub (located on campus) will be part of the course, as well as invited speakers who have set up local microbreweries. Each student will be expected to have basic background knowledge of chemistry, such as material taught in standard first year General Chemistry courses. Offered as CHEM 348 and CHEM 448. Prereq: CHEM 106 or ENGR 145.

CHEM 350. Modern Molecular Spectroscopy: Study of the Interactions Between Light and Matter. 3 Units.
This course is aimed to provide a modern treatment of molecular spectroscopy for physical chemists and for other related areas of interest. At the same time, it will attempt to serve the more generally interested science and engineering student to learn about the many interactions that light undergoes with matter. Offered as CHEM 350 and CHEM 450. Prereq: CHEM 302 or CHEM 310 or CHEM 336.

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 a SAGES Senior Capstone course.

CHEM 406. Chemical Kinetics. 3 Units.
Theory and characterization of chemical rate processes. Recommended preparation: Two semesters of undergraduate physical chemistry.

CHEM 408. Scientific Literature, Bibliometrics, and Ethics in Research and Publication. 3 Units.
This class aims to assist students in navigating scientific literature and bibliographic databases while gaining a deeper understanding of the scientific enterprise. Although science is often considered to be an objective endeavor with self-correcting mechanisms, these safeguards sometimes fail. We will explore the technical aspects of modern science publishing, the academic journal ecosystem, funding frameworks, and peer review. In addition, we will examine some of the more uncomfortable aspects of the scientific enterprise, such as questionable research practices, research misconduct, predatory publishing, and politicization of science. Offered as CHEM 408 and EMAC 408.

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 421. Advanced Organic Chemistry I. 3 Units.
Structure, bonding, and molecular orbital theory. Stereochemistry and conformational analysis. Reaction mechanisms. Aromaticity and aromatic substitution. Pericyclic reactions, orbital symmetry conservation, and free radical chemistry. Recommended preparation: Two semesters of undergraduate organic chemistry.

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.
A survey of biochemistry with a strong emphasis on the chemical logic underlying the structure, function, and evolution of biomolecules. Amino acids and protein structure, purification, and analysis. DNA, RNA, genes, and genomes. DNA replication, repair, and recombination. RNA synthesis and processing. Protein synthesis and turnover, control of gene expression. Hemoglobin. Drug development. Enzyme kinetics, catalytic and regulatory strategies. Carbohydrates. Offered as CHEM 328 and CHEM 428.

CHEM 429. Biochemistry II: Living Systems. 3 Units.
A survey of biochemical systems exploring their molecular circuitry and architecture. Lipids, cell membranes, channels and pumps. Signal transduction and receptors. Glycolysis, gluconeogenesis, citric acid cycle, and glycogen metabolism. Redox processes, electron transport, and photosynthesis. Fatty acid and amino acid biosynthesis and degradation. Nucleotide, lipid, and steroid biosynthesis. Sensory and immune systems. Molecular motors. Offered as CHEM 329 and CHEM 429.

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.
Systematic consideration of reactions involving functional group transformations and carbon-carbon bond formations used in modern organic synthesis. Recommended preparation: Two semesters of undergraduate organic chemistry.

CHEM 438. Bioorganic and Environmental Photochemistry. 3 Units.
This discusses the fundamental principles of molecular and supramolecular photochemistry. In particular, the fundamental paradigms of light absorption by molecules and the photochemical and photophysical mechanisms by which molecules dispose of the excess energy after light absorption will be described. The goal is to develop paradigms for understanding experimental and theoretical aspects of molecular photophysics relevant to bioorganic, supramolecular, and environmental photochemistry, as well as to other light-induced processes such as photosynthesis, photocatalysis, and photovoltaics. The paradigms for determining photochemical mechanisms, the theory of the fundamental photochemical primary processes, and examples of important photochemical primary processes will be reviewed. Selected experimental techniques and theoretical methods used to probe the dynamics of electronic excited states in molecules and their photoreactivity will be presented. Advanced photochemical applications for understanding the electronic relaxation pathways and photochemistry of selected families of bioorganic molecules and environmental pollutants in natural waters will be discussed. Recommended Preparation: Chemical Kinetics (CHEM 406 or equivalent) and Elementary Differential Equations (MATH 224 or equivalent). Prereq: CHEM 336 and MATH 124.

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.

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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 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 337 and CHEM 446.

CHEM 448. Chemistry Fermentation Brewing: To Discern the Molecular Basis of Fermentation and Beer Brewing. 3 Units.
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CHEM 450. Modern Molecular Spectroscopy: Study of the Interactions Between Light and Matter. 3 Units.
This course is aimed to provide a modern treatment of molecular spectroscopy for physical chemists and for other related areas of interest. At the same time, it will attempt to serve the more generally interested science and engineering student to learn about the many interactions that light undergoes with matter. Offered as CHEM 350 and CHEM 450. 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 BIOC 475, CHEM 475, PHOL 475, PHRM 475, and NEUR 475.

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.