

SYSTEMS AND CONTROL ENGINEERING, BSE

Degree: Bachelor of Science in Engineering (BSE)

Major: Systems and Control Engineering

Program Overview

The Bachelor of Science in Engineering degree program with a major 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.

The Bachelor of Science in Engineering with a major in Systems and Control Engineering is accredited by the Engineering Accreditation Commission of ABET.

The Department of Electrical, Computer, and Systems Engineering also offers a double major in Systems and Control Engineering and Electrical Engineering.

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

- Graduates apply systems methodology to multi-disciplinary industrial-based projects that include technical, social, environmental, and/or economic factors.
- Graduates use systems understanding, critical thinking and problem-solving skills to analyze and design systems or processes that respond to technical and societal needs.
- Graduates use teamwork, leadership, communication, and management skills to facilitate multidisciplinary projects that bring together practitioners of various engineering fields in an effective, professional, and ethical manner.

Learning Outcomes

As preparation for achieving the above educational objectives, the Bachelor of Science in Engineering degree program with a major in Systems and Control Engineering is designed so that students attain:

- an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- an ability to communicate effectively with a range of audiences
- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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

Undergraduate Policies

For undergraduate policies and procedures, please review the Undergraduate Academics section of the General Bulletin.

Accelerated Master's Programs

Undergraduate students may participate in accelerated programs toward graduate or professional degrees. For more information and details of the policies and procedures related to accelerated studies, please visit the Undergraduate Academics section of the General Bulletin.

BS/MS Program in Systems and Control Engineering

The department encourages highly motivated and qualified students to apply for admission to the BS/MS Program in the junior year. This integrated program 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 3 credit hours of MS thesis work for ECSE 399). It also offers the opportunity to complete both the Bachelor of Science in Engineering and Master of Science degrees within five years.

Program Requirements

Students seeking to complete this major and degree program must meet the general requirements for bachelor's degrees and the Unified General Education Requirements. Students completing this program as a secondary major while completing another

undergraduate degree program do not need to satisfy the school-specific requirements associated with this major.

Program Requirements

Code	Title	Hours
Required Mathematics, Science and Engineering Courses:		
MATH 121	Calculus for Science and Engineering I	4
MATH 122	Calculus for Science and Engineering II	4
or MATH 124	Calculus II	
MATH 223	Calculus for Science and Engineering III	3
or MATH 227	Calculus III	
MATH 224	Elementary Differential Equations	3
or MATH 228	Differential Equations	
PHYS 121	General Physics I - Mechanics	4
or PHYS 123	Physics and Frontiers I - Mechanics	
PHYS 122	General Physics II - Electricity and Magnetism	4
or PHYS 124	Physics and Frontiers II - Electricity and Magnetism	
CHEM 111	Principles of Chemistry for Engineers	4
ENGR 130	Foundations of Engineering and Programming	3
ENGR 145	Chemistry of Materials	4
ENGR 200	Statics and Strength of Materials	3
ENGR 210	Introduction to Circuits and Instrumentation	4
ENGR 225	Thermodynamics, Fluid Dynamics, Heat and Mass Transfer	4
ENGR 399	Impact of Engineering on Society	3

Code	Title	Hours
Major Required Courses:		
ECSE 216	Fundamental System Concepts	3
ECSE 246	Signals and Systems	4
ECSE 304	Control Engineering I with Laboratory	3
ECSE 305	Control Engineering I Laboratory	1
ECSE 313	Signal Processing	3
ECSE 324	Modeling and Simulation of Continuous Dynamical Systems	3
ECSE 342	Introduction to Global Issues	3
ECSE 346	Engineering Optimization	3
ECSE 352	Engineering Economics and Decision Analysis	3
ECSE 395	Junior Engineering Design Seminar	3
OPRE 332A	Spreadsheet and Business Process Simulation - I	1.5
OPRE 332B	Spreadsheet and Business Process Simulation - II	1.5
Technical Electives ^a		15

a Includes at least nine credit hours of approved courses to constitute a depth of study.

Breadth Requirement

Code	Title	Hours
MATH 201	Introduction to Linear Algebra for Applications	3
STAT 332	Statistics for Signal Processing	3

Statistics Requirement

Code	Title	Hours
STAT 332	Statistics for Signal Processing ^b	3

b STAT 312 may be used as a substitute for STAT 332 with advisor approval.

Design Requirement

Code	Title	Hours
ECSE 398	Senior Engineering Design Projects	4

Double 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 four courses as Technical Electives in the S&CE program:

Code	Title	Hours
ECSE 245	Electronic Circuits ^c	4
ECSE 281	Logic Design and Computer Organization ^c	4
ECSE 309	Electromagnetic Fields I	3
ECSE 321	Semiconductor Electronic Devices ^c	4
Choose one of the following:		
ECSE 374	Advanced Control and Energy Systems	3
or ECSE 375	Applied Control	

c ECSE 245, ECSE 281, and ECSE 321 are 4 credit hours each, therefore the 3 credit hour "Open Elective" course in the S&CE program is not needed.

Track Requirements

Each student must show a depth of competence in one technical area by taking at least three courses from one of the two tracks listed below.

Track 1: Energy and Control Systems

Code	Title	Hours
Choose three of the following:		
ECSE 374	Advanced Control and Energy Systems	
ECSE 375	Applied Control	
ECSE 408	Introduction to Linear Systems	
ECSE 416	Convex Optimization for Engineering	
ECSE 404	Digital Control Systems	
ECSE 281	Logic Design and Computer Organization	
EMAE 494 or Technical Elective from Data Analytics track		

Track 2: Data Analytics

Code	Title	Hours
Required Course:		
CSDS 313	Introduction to Data Analysis	3
Choose two of the following: ^d		
Core Tools courses:		
CSDS 435	Data Mining	
ECSE 452	Random Signals	
ECSE 490	Digital Image Processing	
OPRE 433	Statistical Data Analytics for Supply Chain	
STAT 325	Data Analysis and Linear Models	
STAT 326	Multivariate Analysis and Data Mining	

Application courses:

Business/Manufacturing Analytics courses:

BAFI 361	Empirical Analysis in Finance
ECSE 350	Operations and Systems Design
ECSE 360	Manufacturing and Automated Systems
ECSE 490	Digital Image Processing
MKMR 310	Marketing Analytics
OPMT 475	Global Supply Chain Logistics

Healthcare Analytics courses:

BIOL 304	Fitting Models to Data: Maximum Likelihood Methods and Model Selection
EBME 410	Medical Imaging Fundamentals
ECSE 319	Applied Probability and Stochastic Processes for Biology
MATH 378	Computational Neuroscience
SYBB 421	Fundamentals of Clinical Information Systems

- d Choose two courses from the Core Tools course list and/or the Applications course list.

Sample Plan of Study

The following is a suggested program of study. Current students should always consult their advisors and their individual graduation requirement plans as tracked in SIS.

First Year

Fall		Hours
CHEM 111	Principles of Chemistry for Engineers	4
ENGR 130	Foundations of Engineering and Programming	3
MATH 121	Calculus for Science and Engineering I	4
Academic Inquiry Seminar, Breadth, or Elective course ^a		3
Open elective		3
Hours		17

Spring

ENGR 145	Chemistry of Materials	4
MATH 122	Calculus for Science and Engineering II	4
PHYS 121	General Physics I - Mechanics ^b	4
Academic Inquiry Seminar, Breadth, or Elective course ^a		3
Hours		15

Second Year

Fall		Hours
ENGR 210	Introduction to Circuits and Instrumentation	4
MATH 223	Calculus for Science and Engineering III	3
PHYS 122	General Physics II - Electricity and Magnetism ^b	4
STAT 332	Statistics for Signal Processing	3
Breadth, or Elective course ^a		3
Hours		17

Spring

ECSE 216	Fundamental System Concepts	3
ENGR 200	Statics and Strength of Materials	3
ENGR 225	Thermodynamics, Fluid Dynamics, Heat and Mass Transfer	4

MATH 201	Introduction to Linear Algebra for Applications	3
MATH 224	Elementary Differential Equations	3
Hours		16

Third Year

Fall

ECSE 246	Signals and Systems	4
ECSE 324	Modeling and Simulation of Continuous Dynamical Systems	3
ECSE 342	Introduction to Global Issues	3
Breadth, or Elective course ^a		3
Technical Elective ^c		3
Hours		16

Spring

ECSE 304	Control Engineering I with Laboratory	3
ECSE 305	Control Engineering I Laboratory	1
ECSE 313	Signal Processing	3
ECSE 346	Engineering Optimization	3
ECSE 395	Junior Engineering Design Seminar	3
Breadth, or Elective course ^a		3
Hours		16

Fourth Year

Fall

ECSE 352	Engineering Economics and Decision Analysis	3
ECSE 398	Senior Engineering Design Projects	4
ENGR 399	Impact of Engineering on Society	3
Breadth, or Elective course ^a		3
Technical Elective ^c		3
Hours		16

Spring

OPRE 432A	Spreadsheet and Business Process Simulation - I	1.5
OPRE 432B	Spreadsheet and Business Process Simulation - II	1.5
Breadth, or Elective course ^a		3
Technical Elective ^c		3
Technical Elective ^c		3
Technical Elective ^c		3
Hours		15
Total Hours		128

^a Unified General Education Requirement.

^b Selected students may be invited to take PHYS 123 and PHYS 124 in place of PHYS 121 and PHYS 122.

^c **Technical electives** from approved list of courses in the two tracks/program concentration areas (Energy and Control systems, and Data Analytics) listed under "Depth Requirement". There are five technical elective courses available within the Bachelor of Science in Engineering degree program with a major in Systems and Control Engineering curriculum that represent a depth of the discipline. Students can satisfy these five technical elective requirements by choosing three courses from one of the two tracks (to meet the Depth Requirement) with the fourth and fifth

courses chosen from any of the two tracks listed under the Depth Requirement section above.