# 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, http://www.abet.org/.

The Department of Electrical, Computer, and Systems Engineering also offers a double major in Systems and Control Engineering and Electrical Engineering. Details of the double major can be found on the Program Requirements tab.

## 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

a. Graduates apply systems methodology to multi-disciplinary projects that include technical, social, environmental, and/or economic factors.
b. Graduates use systems understanding, thinking and problem-solving skills to analyze and design systems or processes that respond to technical and societal needs.
c. 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. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

## Undergraduate Policies

For undergraduate policies and procedures, please review the Office of Undergraduate Studies 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 Office of Undergraduate Studies 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 Engineering Projects II). 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 general requirements of the Case School of Engineering. Students completing this program as a secondary major while completing another

undergraduate degree program do not need to satisfy the latter set of requirements.

## Major Requirements

| Code | Title | Hours |
|---|---|---|
| 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 399 | Engineering Projects II | 3 |
| OPRE 332A | Spreadsheet and Business Process Simulation - I | 1.5 |
| OPRE 332B | Spreadsheet and Business Process Simulation - II | 1.5 |

Fifteen hours of approved technical electives including at least 9 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 * | 3 |

* STAT 333 Uncertainty in Engineering and Science may be substituted with approval of advisor

### Design Requirement

| Code | Title | Hours |
|---|---|---|
| ECSE 398 | Engineering Projects I | 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 | 4 |
| ECSE 281 | Logic Design and Computer Organization | 4 |
| ECSE 309 | Electromagnetic Fields I | 3 |
| ECSE 321 | Semiconductor Electronic Devices | 4 |
| And one of the following two courses: | | |
| ECSE 374 | Advanced Control and Energy Systems | 3 |
| or ECSE 375 | Applied Control | |

As the three courses ECSE 281, ECSE 245, and ECSE 321 are 4 credit-hours instead of 3, the three credit-hour “Open Elective” course in the original 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 three tracks/program concentration areas, namely energy systems, control systems and data analytics, listed below:

## Track 1: Energy Systems

| Code | Title | Hours |
|---|---|---|
| ECSE 368 | Power System Analysis I | 3 |
| ECSE 369 | Power System Analysis II | 3 |
| ECSE 374 | Advanced Control and Energy Systems | 3 |
| ECSE 375 | Applied Control | 3 |
| ECSE 281 | Logic Design and Computer Organization | 4 |

## Track 2: Control Systems

| Code | Title | Hours |
|---|---|---|
| ECSE 374 | Advanced Control and Energy Systems | 3 |
| ECSE 375 | Applied Control | 3 |
| ECSE 281 | Logic Design and Computer Organization | 4 |
| Technical Elective from the Energy Systems or Data Analytics tracks | | 3 |

## Track 3: Data Analytics

- CSDS 313 Introduction to Data Analysis
- **"Core Tools" list:**

| Code | Title | Hours |
|---|---|---|
| CSDS 435 | Data Mining | 3 |
| ECSE 452 | Random Signals | 3 |
| ECSE 490 | Digital Image Processing | 3 |
| OPRE 433 | Statistical Data Analytics for Supply Chain | 3 |
| STAT 325 | Data Analysis and Linear Models | 3 |
| STAT 326 | Multivariate Analysis and Data Mining | 3 |

- **"Application" lists:**

### Business/Manufacturing Analytics

| Code | Title | Hours |
|---|---|---|
| BAFI 361 | Empirical Analysis in Finance | 3 |
| ECSE 350 | Operations and Systems Design | 3 |
| ECSE 360 | Manufacturing and Automated Systems | 3 |
| ECSE 490 | Digital Image Processing | 3 |
| MKMR 310 | Marketing Analytics | 3 |
| OPMT 475 | Global Supply Chain Logistics | 3 |

### Healthcare Analytics

| Code | Title | Hours |
|---|---|---|
| BIOL 304 | Fitting Models to Data: Maximum Likelihood Methods and Model Selection | 3 |
| EBME 410 | Medical Imaging Fundamentals | 3 |
| ECSE 319 | Applied Probability and Stochastic Processes for Biology | 3 |
| MATH 378 | Computational Neuroscience | 3 |
| SYBB 421 | Fundamentals of Clinical Information Systems | 3 |

# 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** |
| SAGES First Year Seminar * | | 4 |
| CHEM 111 | Principles of Chemistry for Engineers ** | 4 |
| MATH 121 | Calculus for Science and Engineering I ** | 4 |
| ENGR 130 | Foundations of Engineering and Programming ** | 3 |
| Open elective | | 3 |
| PHED (2 half semester courses) * | | 0 |
| | **Hours** | **18** |
| **Spring** | | |
| SAGES University Seminar * | | 3 |
| PHYS 121 | General Physics I - Mechanics **,a | 4 |
| MATH 122 | Calculus for Science and Engineering II ** | 4 |
| ENGR 145 | Chemistry of Materials ** | 4 |
| PHED (2 half semester courses) * | | 0 |
| | **Hours** | **15** |
| **Second Year** | | |
| **Fall** | | |
| PHYS 122 | General Physics II - Electricity and Magnetism **,a | 4 |
| MATH 223 | Calculus for Science and Engineering III ** | 3 |
| ENGR 210 | Introduction to Circuits and Instrumentation ** | 4 |
| STAT 332 | Statistics for Signal Processing | 3 |
| SAGES University Seminar * | | 3 |
| | **Hours** | **17** |
| **Spring** | | |
| MATH 224 | Elementary Differential Equations ** | 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 |
| ECSE 216 | Fundamental System Concepts | 3 |
| | **Hours** | **16** |
| **Third Year** | | |
| **Fall** | | |
| Breadth elective ** | | 3 |
| Approved technical elective c | | 3 |
| ECSE 246 | Signals and Systems | 4 |
| ECSE 324 | Modeling and Simulation of Continuous Dynamical Systems | 3 |
| ECSE 342 | Introduction to Global Issues | 3 |
| | **Hours** | **16** |
| **Spring** | | |
| Breadth elective ** | | 3 |
| OPRE 332A | Spreadsheet and Business Process Simulation - I | 1.5 |
| OPRE 332B | Spreadsheet and Business Process Simulation - II | 1.5 |
| ECSE 304 | Control Engineering I with Laboratory | 3 |
| ECSE 305 | Control Engineering I Laboratory | 1 |
| ECSE 346 | Engineering Optimization | 3 |
| ECSE 313 | Signal Processing | 3 |
| | **Hours** | **16** |
| **Fourth Year** | | |
| **Fall** | | |
| Breadth elective ** | | 3 |
| ENGL 398 | Professional Communication for Engineers ** | 2 |
| ENGR 398 | Professional Communication for Engineers ** | 1 |
| Approved technical elective c | | 3 |
| ECSE 352 | Engineering Economics and Decision Analysis | 3 |
| ECSE 398 | Engineering Projects I | 4 |
| | **Hours** | **16** |
| **Spring** | | |
| Breadth elective ** | | 3 |
| Approved tehcnical elective c | | 3 |
| Approved tehcnical elective c | | 3 |
| Approved tehcnical elective c | | 3 |
| ECSE 399 | Engineering Projects II | 3 |
| | **Hours** | **15** |
| | **Total Hours** | **129** |

* University general education requirement.

** Engineering general education requirement.

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

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.

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 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 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.