

# SYSTEMS ENGINEERING AND DESIGN

## For the Degree of Bachelor of Science in Systems Engineering and Design (formerly General Engineering)

Systems Engineering and Design (SED) is a comprehensive, interdisciplinary program emphasizing interactions between parts of a whole. It brings together basic sciences, engineering analysis, and engineering design. The curriculum offers flexibility through a Secondary Field Option, while providing a broad background in engineering as a whole and decision-making that supports overall design. Systems Engineers understand how to coordinate interacting parts of a whole and to evaluate engineering within economic and physical constraints.

Design experience and project management are emphasized and integrated across the core with a focus on establishing critical problem-solving skills applied across disciplines, strong communication skills, and the ability to work effectively and get results in a team environment.

The capstone experience for Systems Engineering and Design undergraduates is the Senior Project Course. Students work collaboratively with industry and a team of faculty members on a real-world problem during their final semester. The results are documented in a final written report and a formal presentation at the end of the semester to the company so that the student recommendations may be implemented.

## Overview of Curricular Requirements

The curriculum requires 128 hours for graduation and is organized as shown below.

Note: Technical grade point average requirements for graduation and advanced-level course registration are being considered for this curriculum. If added, these rules will be summarized at the College of Engineering's Undergraduate Advising Website (<https://wiki.cites.illinois.edu/wiki/display/ugadvise/Technical+GPA+Requirements>).

### Orientation and Professional Development

These courses introduce the opportunities and resources your college, department, and curriculum can offer you as you work to achieve your career goals. They also provide the skills to work effectively and successfully in the engineering profession.

Code	Title	Hours
ENG 100	Engineering Orientation <sup>1</sup>	0
SE 100	Introduction to ISE	1
SE 290	ISE Undergraduate Seminar	0
Total Hours		1

<sup>1</sup> External transfer students take ENG 300 instead.

### Foundational Mathematics and Science

These courses stress the basic mathematical and scientific principles upon which the engineering discipline is based.

Code	Title	Hours
CHEM 102	General Chemistry I	3
CHEM 103	General Chemistry Lab I	1
MATH 221	Calculus I <sup>1</sup>	4
MATH 231	Calculus II	3
MATH 241	Calculus III	4
MATH 285	Intro Differential Equations	3
MATH 415	Applied Linear Algebra	3
PHYS 211	University Physics: Mechanics	4
PHYS 212	University Physics: Elec & Mag	4
PHYS 213	Univ Physics: Thermal Physics	2
Total Hours		31

<sup>1</sup> MATH 220 may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.

### Systems Engineering and Design Technical Core

These courses stress fundamental concepts and basic laboratory techniques that comprise the common intellectual understanding of systems engineering and design.

Code	Title	Hours
CS 101	Intro Computing: Engrg & Sci	3
ECE 110	Introduction to Electronics	3
ECE 211	Analog Circuits & Systems	2
SE 261	Business Side of Engineering	1
SE 310	Design of Structures and Mechanisms	3
SE 311	Engineering Design Analysis	3
SE 312	Instrumentation and Test Lab	1
SE 320	Control Systems	4
SE 424	State Space Design for Control	3
SE 495	Senior Engineering Project II	2
IE 300	Analysis of Data	3
IE 310	Deterministic Models in Optimization	3
TAM 211	Statics	3
TAM 212	Introductory Dynamics	3
TAM 251	Introductory Solid Mechanics	3
TAM 335	Introductory Fluid Mechanics	4
SE 101	Engineering Graphics & Design	3
SE 494	Senior Engineering Project I	3
Total Hours		50

### Secondary Field Option Electives

These courses enable the student to tailor the studies to one's interests and career goals in both technical and nontechnical areas.

Code	Title	Hours
Secondary field option electives selected from departmentally approved lists or by petition to the department. See the Secondary Field Options section below.		12

### Technical Electives

The design elective augments a student's knowledge in one or more subdisciplines of mechanics and structures, control systems, and

decision-making that support a systems approach to engineering. The engineering science elective extends the knowledge of that area.

Code	Title	Hours
	Design elective selected from the departmentally approved list of Design Electives.	3
	Engineering science elective selected from the departmentally approved list of Engineering Science Electives.	3
Total Hours		6

### Liberal Education

The liberal education courses (<https://wiki.cites.illinois.edu/wiki/display/ugadvise/Liberal+Education+Electives>) develop students' understanding of human culture and society, build skills of inquiry and critical thinking, and lay a foundation for civic engagement and lifelong learning.

Code	Title	Hours
ECON 102 or ECON 103	Microeconomic Principles or Macroeconomic Principles	3
	Electives from the campus General Education Social and Behavioral Sciences list.	3
	Electives from the campus General Education Humanities and the Arts list.	6
	Electives either from a list approved by the college, or from the campus General Education lists for Social and Behavioral Sciences or Humanities and the Arts.	6
Total Hours		18

Students must also complete the campus cultural studies requirement by completing (i) one western/comparative culture(s) course and (ii) one non-western/U.S. minority culture(s) course from the General Education cultural studies lists. Most students select liberal education courses that simultaneously satisfy these cultural studies requirements. Courses from the western and non-western lists that fall into free electives or other categories may also be used satisfy the cultural studies requirements.

### Composition

These courses teach fundamentals of expository writing.

Code	Title	Hours
RHET 105	Writing and Research	4
	Advanced Composition (satisfied by completing the combination GE 494 + GE 495 in the Systems Engineering and Design Technical Core)	
Total Hours		4

### Free Electives

These unrestricted electives, subject to certain exceptions as noted at the College of Engineering Advising Website (<https://wiki.cites.illinois.edu/wiki/display/ugadvise/Free+Electives?src=search>), give the student the opportunity to explore any intellectual area of unique interest. This freedom plays a critical role in helping students to define research specialties or to complete minors.

Code	Title	Hours
	Free electives. Additional unrestricted course work, subject to certain exceptions as noted at the College of Engineering advising Web site, so that there are at least 128 credit hours earned toward the degree.	6

## Secondary Field Options

Secondary field options are of two types: preapproved and customized. Preapproved secondary fields have designated titles and a specified list of courses, from which several may be selected. Approval for the substitution of a course for one on the specified list may be requested via a petition form submitted to the department. Customized secondary fields may be created to achieve goals in areas not provided by pre-approved fields. To do this, a suitable title and all the courses must be petitioned for acceptance by the department. Petition approval is based on the merit of the secondary field and the coherence of the courses within it relative to the student's goals.

Pursuit of campus minors, dual degrees, and James Scholar contracts may be integrated with customized secondary field options. Courses taken may be applied to minors, dual degrees, or contracts as well as secondary field options.

### Preapproved Secondary Fields

Preapproved secondary fields are listed below. Approved courses for each are specified at the department's secondary field website (<http://ise.illinois.edu/undergraduate-programs/general-engineering-degree/secondary-field-option>). The following course substitutions may be used interchangeably to comply with prerequisites of specified courses in some of the secondary fields:

- CEE 202, IE 300, STAT 400
- CEE 201, IE 310
- MSE 406, CEE 300
- ECE 486, SE 320, ME 340

Students may petition to the department for inclusion of a course in the secondary fields listed below. The most likely classes to be accepted are non-permanent and experimental offerings relevant to the various fields. A current list of these may be found at the department's secondary field website (<http://ise.illinois.edu/undergraduate-programs/general-engineering-degree/secondary-field-option>).

- Automotive Engineering
- Bioengineering<sup>1</sup>
- Business Systems Integration and Consulting
- Civil Engineering Structures
- Communications and Computer Systems
- Computer Science<sup>1</sup>
- Construction
- Control Systems
- Digital Prototyping
- Engineering Administration
- Engineering Marketing
- Environmental Quality
- Internet of Things (IOT)
- Manufacturing Engineering<sup>1</sup>
- Nondestructive Testing and Evaluation

- Operations Research
- Quality Control
- Rehabilitation Engineering
- Robotics
- Theoretical and Applied Mechanics

<sup>1</sup> Students fulfilling the corresponding Campus Minor may simultaneously complete the requirements of this Systems Engineering and Design secondary field option.

## Customized Secondary Fields

Customized secondary fields differ from preapproved ones in that no sets of specified courses to choose from have been predefined. For all customized secondary field options, a course list must be constructed and submitted for approval by the department.

The following list contains examples of over fifty titles of customized secondary field options which have been approved. The complete list may be found at the department's secondary field website (<http://ise.illinois.edu/undergraduate-programs/general-engineering-degree/secondary-field-option>). Additional titles beyond those listed may be proposed.

- A foreign language (several)
- An engineering discipline (several)
- Audio Engineering
- Economics
- Entrepreneurship
- Finance
- Fluid Dynamics
- International Business
- Mathematics
- Pre-Law
- Pre-Med
- Renewable Energy

## Suggested Sequence

The schedule that follows is illustrative, showing the typical sequence in which courses would be taken by a student with no college course credit already earned and who intends to graduate in four years. Each individual's case may vary, but the position of required named courses is generally indicative of the order in which they should be taken.

### First Year

First Semester	Hours
CHEM 102 General Chemistry I	3
CHEM 103 General Chemistry Lab I	1
Liberal education elective <sup>3</sup>	3
ENG 100 Engineering Orientation	0
SE 101 Engineering Graphics Design or RHET 105 <sup>1</sup>	3-4
MATH 221 <sup>2</sup> Calculus I	4
SE 100 Introduction to ISE	1
Semester Hours	15-16

### Second Semester

ECE 110 Introduction to Electronics	3
PHYS 211 University Physics: Mechanics	4
MATH 231 Calculus II	3
CS 101 Intro Computing: Engrg Sci	3
RHET 105 Writing and Research or SE 101 <sup>1</sup>	4-3
Semester Hours	17-16

### Second Year

#### First Semester

MATH 241 Calculus III	4
PHYS 212 University Physics: Elec Mag	4
TAM 211 Statics	3
Liberal education elective <sup>3</sup>	3
SE 261 Business Side of Engineering	1
Semester Hours	15

#### Second Semester

IE 300 Analysis of Data	3
MATH 285 Intro Differential Equations	3
PHYS 213 Univ Physics: Thermal Physics	2
TAM 212 Introductory Dynamics	3
TAM 251 Introductory Solid Mechanics	3
SE 290 ISE Undergraduate Seminar	0
Liberal education elective <sup>3</sup>	3
Semester Hours	17

### Third Year

#### First Semester

ECE 211 Analog Circuits Systems	2
MATH 415 Applied Linear Algebra	3
Secondary field option elective <sup>4</sup>	3
SE 310 Design of Structures and Mechanisms	3
SE 320 Control Systems	4
Semester Hours	15

#### Second Semester

IE 310 Deterministic Models in Optimization	3
TAM 335 Introductory Fluid Mechanics	4
Liberal education elective <sup>3</sup>	3
SE 311 Engineering Design Analysis	3
SE 312 Instrumentation and Test Lab	1
SE 424 State Space Design for Control	3
Semester Hours	17

### Fourth Year

#### First Semester

Secondary field option elective <sup>4</sup>	3-5
OR	
SE 494 & SE 495 <sup>6</sup>	
Design elective <sup>7</sup>	3
Engineering science elective <sup>8</sup>	3
Secondary field option elective <sup>4</sup>	3

Liberal education elective <sup>3, 5</sup>	3
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Semester Hours	15-17
<b>Second Semester</b>	
SE 494 Senior Engineering Project I & SE 495 <sup>5,6</sup>	5-3
OR	
Secondary field option elective <sup>4</sup>	3
Liberal education elective <sup>3</sup>	3
Free electives	6
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Semester Hours	17-15
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Total Hours:	128

<sup>1</sup> RHET 105 may be taken in the first or second semester of the first year as authorized. The alternative is SE 101.

<sup>2</sup> MATH 220 may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.

<sup>3</sup> Liberal education electives (<https://wiki.cites.illinois.edu/wiki/display/ugadvice/Liberal+Education+Electives>) must include 6 hours of social & behavioral sciences and 6 hours of humanities & the arts course work from the campus General Education lists. ECON 102 or ECON 103 must be one of the social & behavioral sciences courses, highly recommended before the fourth semester. The remaining 6 hours may be selected from a list maintained by the college, or additional course work from the campus General Education lists for social & behavioral sciences or humanities & the arts. Students must also complete the campus cultural studies requirement by completing (i) one western/comparative culture(s) course and (ii) one non-western/U.S. minority culture(s) course from the General Education cultural studies lists. Most students select liberal education courses that simultaneously satisfy these cultural studies requirements. Courses from the western and non-western lists that fall into free electives or other categories may also be used satisfy the cultural studies requirements.

<sup>4</sup> Selected from the departmentally approved lists of Secondary Field Option Electives (<http://ise.illinois.edu/undergraduate-programs/general-engineering-degree/secondary-field-option/preapproved-secondary-field>) or by petition to the department.

<sup>5</sup> SE 494 and SE 495 may be taken in the first or second semester of the fourth year as authorized. The alternative is a liberal education elective.

<sup>6</sup> Combination satisfies the General Education Advanced Composition requirement.

<sup>7</sup> Selected from the departmentally approved list of Design Electives (<https://ise.illinois.edu/undergraduate/courses-curriculum.html>).

<sup>8</sup> Selected from the departmentally approved list of Engineering Science Electives (<https://ise.illinois.edu/undergraduate/courses-curriculum.html>).