Electrical Engineering, B.S.E.

Electrical engineers develop technologies and systems for a wide variety of applications ranging from telecommunications to medical imaging. They play a central role in the design and implementation of any technology that is powered by electricity as well as the generation and distribution of electric power. Topics covered in the electrical engineering curriculum include: design of electronic circuits, communication systems, control systems, and semiconductor devices. Students may opt to specialize in any of these areas as well as others that include electrical power generation and distribution, medical image processing, computer systems, or design of micro- and nano-scale optical and electronic devices.

Educational Objectives

Graduates of the electrical engineering program will:

- exhibit leadership and vision in contributing to the technical and policy decisions of industry, government, and research enterprises;
- demonstrate problem-solving abilities that permit them to contribute in a variety of technical, business, and academic careers;
- thrive in diverse, global, and multidisciplinary environments;
- possess the ability to communicate effectively and participate collaboratively in interactions with engineers and other professionals; and
- understand the importance of participating in lifelong learning activities that enhance their professional and personal development.

Requirements

The Bachelor of Science in Engineering (B.S.E.) with a major in electrical engineering requires a minimum of 128 s.h. Students must have a g.p.a. of at least 2.00 on all college work used to satisfy degree requirements as well as on all work undertaken at the University of Iowa.

The major provides technical depth and breadth as well as flexibility and the opportunity for students to customize their programs according to their own goals. Students choose one of several elective focus areas (EFAs) according to the type of job or research they plan to pursue. More than 20 EFAs are available; see ‘Elective Focus Area Courses’ below. Students also have the opportunity to work with their academic advisor to build an EFA plan that adheres to their goals and objectives.

Students complete the B.S.E. core requirements, which include RHET:1030 Rhetoric; ENGR:1100 Introduction to Engineering Problem Solving and ENGR:1300 Introduction to Engineering Computing; and courses in chemistry, engineering mathematics and fundamentals, and physics. Students also complete the curriculum designed for their major program, which covers four major stems: mathematics and basic sciences, engineering topics, an elective focus area, and the general education component. For information about the curriculum stems, see the Bachelor of Science in Engineering in the Catalog.

The curriculum is built on a common core of electrical and computer engineering courses taken by all students.

Beginning in their sophomore year, students select either the electrical or computer curricular track and begin taking more specialized courses. The electrical track is intended to provide a broad background in electrical engineering concepts and practice that prepares students for graduate study or electrical engineering careers in a wide range of industries and organizations. The computer track provides focus and depth for students preparing for graduate study, or a career in computer hardware or software engineering. Students begin taking track and EFA courses in their third year.

Students must complete core courses; math, science, and communication courses; required electrical engineering program courses; electrical or computer track courses; one depth elective; one breadth elective; approved elective focus area (EFA) courses; general education component (GEC) courses; and a two-semester capstone design sequence.

The B.S.E. with a major in electrical engineering requires the following coursework.

Core Engineering Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR:1000</td>
<td>Engineering Success for First-Year Students</td>
<td>1</td>
</tr>
<tr>
<td>ENGR:1100</td>
<td>Introduction to Engineering Problem Solving</td>
<td>3</td>
</tr>
<tr>
<td>ENGR:1300</td>
<td>Introduction to Engineering Computing</td>
<td>3</td>
</tr>
<tr>
<td>ENGR:2110</td>
<td>Engineering Fundamentals I: Statics</td>
<td>2</td>
</tr>
<tr>
<td>ENGR:2120</td>
<td>Engineering Fundamentals II: Electrical Circuits</td>
<td>3</td>
</tr>
<tr>
<td>ENGR:2130</td>
<td>Engineering Fundamentals III: Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR:2730</td>
<td>Computers in Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

Math, Science, and Communication Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM:1110</td>
<td>Principles of Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>PHYS:1611</td>
<td>Introductory Physics I</td>
<td>4</td>
</tr>
<tr>
<td>PHYS:1612</td>
<td>Introductory Physics II</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1550</td>
<td>Engineering Mathematics I: Single Variable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1560</td>
<td>Engineering Mathematics II: Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH:2550</td>
<td>Engineering Mathematics III: Matrix Algebra</td>
<td>2</td>
</tr>
<tr>
<td>MATH:2560</td>
<td>Engineering Mathematics IV: Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH:3550</td>
<td>Engineering Mathematics V: Vector Calculus</td>
<td>3</td>
</tr>
<tr>
<td>RHET:1030</td>
<td>Rhetoric</td>
<td>4</td>
</tr>
<tr>
<td>STAT:2020</td>
<td>Probability and Statistics for the Engineering and Physical Sciences</td>
<td>3</td>
</tr>
</tbody>
</table>
## Required Program Courses

### Code | Title | Hours
--- | --- | ---
All of these: 
ECE:2400 | Linear Systems I | 3 
ECE:2410 | Principles of Electronic Instrumentation | 4 
ECE:3000 | Electrical and Computer Engineering Professional Seminar | 1 
ECE:3320 | Introduction to Digital Design | 3 
ECE:3360 | Embedded Systems | 3 
ECE:3410 | Electronic Circuits | 4 
ECE:3700 | Electromagnetic Theory | 3

## Track Courses

### Electrical Track Courses

Students in the electrical track complete these track courses.

### Code | Title | Hours
--- | --- | ---
All of these: 
ECE:3400 | Linear Systems II | 3 
ECE:3410 | Electronic Circuits | 4 
ECE:3500 | Communication Systems | 3 
ECE:3600 | Control Systems | 3 
ECE:3720 | Semiconductor Devices | 3

### Computer Track Courses

Students in the computer track complete these track courses.

### Code | Title | Hours
--- | --- | ---
All of these: 
ECE:3330 | Introduction to Software Design | 3 
ECE:3350 | Computer Architecture and Organization | 3 
CS:2210 | Discrete Structures | 3 
CS:2230 | Computer Science II: Data Structures | 4 
CS:3330 | Algorithms | 3

## Track Breadth and Depth Electives

Students complete one track breadth elective and one track depth elective.

Students in the computer track must choose their track breadth elective from the list of required electrical track courses above. Students in the electrical track must choose their track breadth elective from the list of required computer track courses. Students in either track may instead use ECE:3540 Communication Networks as their track breadth elective.

The track depth elective must be an advanced course, normally numbered 4000 or above, in a subject area within a student's track. For a complete list of depth electives for each track, consult the Department of Electrical and Computer Engineering website.

## Elective Focus Area Courses

Students select an elective focus area (EFA) to personalize their curriculum and to prepare them for certain jobs or research study they intend to seek. More than 20 EFAs are available, such as bioinformatics, business, communication systems, medical imaging, nanotechnology, power systems, and software engineering; see Elective Focus Areas on the Department of Electrical and Computer Engineering website. Students also may work with their academic advisor to create a customized plan tailored to their goals and objectives.

Students complete five elective focus area courses in addition to their track breadth and track depth courses, which they choose according to guidelines established by the department.

Students who choose their track, EFAs, and general education component carefully may be able to earn the Certificate in Sustainability, the Certificate in Technological Entrepreneurship, or one of several undergraduate minors offered by the University without taking courses beyond those required for the electrical engineering major. Students selecting the computer track satisfy the requirements for a minor in computer science. Students who take one additional advanced math course meet the requirements for a minor in mathematics.

## General Education Component

Students are required to take at least 15 s.h. of General Education Component (GEC) courses; see General Education Component on the College of Engineering website. The requirements are:

- Engineering Be Creative: complete 3 s.h.
  - A full list of approved courses can be found on the College of Engineering GEC Options: Be Creative Course List web page.
- GE CLAS Core: complete 3 s.h.
  - Students must complete 3 s.h. of coursework from one of the approved GE CLAS Core areas below.
    - Interpretation of Literature
    - Diversity and Inclusion
    - World Languages
    - Historical Perspectives
    - International and Global Issues
    - Literary, Visual, and Performing Arts
    - Social Sciences
    - Values and Culture
- Approved Course Subjects: complete 9 s.h.
  - See the College of Engineering GEC Options: Approved Course Subjects web page.

## Capstone Design Courses

In their senior year, students complete a two-semester capstone design sequence culminating in the development and implementation of a significant, original project. The capstone design experience emphasizes teamwork, professionalism, open-ended problem solving, and the ability to work within real-world constraints and engineering standards.
Double Major in Electrical Engineering/Computer Science and Engineering

Students may earn a double major in electrical engineering (EE) and computer science and engineering (CSE). They must satisfy all requirements of the electrical track of the EE major and all requirements of the CSE major. The double major may be achieved with as few as five additional courses.

The following list shows the required courses that are not in common between the EE and CSE majors. In addition to the courses below, students must take one ECE 5000-level course and an additional 5000-level course that is cross-listed in the Department of Electrical and Computer Engineering and the Department of Computer Science. For more information, contact the Department of Electrical and Computer Engineering.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE:3330</td>
<td>Introduction to Software Design (required for CSE, EE elective focus area)</td>
<td>3</td>
</tr>
<tr>
<td>ECE:3350</td>
<td>Computer Architecture and Organization (required for CSE, EE elective focus area)</td>
<td>3</td>
</tr>
<tr>
<td>ECE:3400</td>
<td>Linear Systems II (required for EE, CSE elective focus area elective)</td>
<td>3</td>
</tr>
<tr>
<td>ECE:3410</td>
<td>Electronic Circuits (required for EE, CSE elective focus area)</td>
<td>4</td>
</tr>
<tr>
<td>ECE:3500</td>
<td>Communication Systems (required for EE)</td>
<td>3</td>
</tr>
<tr>
<td>ECE:3540</td>
<td>Communication Networks (required for CSE, EE breadth elective)</td>
<td>3</td>
</tr>
<tr>
<td>ECE:3600</td>
<td>Control Systems (required for EE)</td>
<td>3</td>
</tr>
<tr>
<td>ECE:3700</td>
<td>Electromagnetic Theory (required for EE)</td>
<td>3</td>
</tr>
<tr>
<td>ECE:3720</td>
<td>Semiconductor Devices (required for EE)</td>
<td>3</td>
</tr>
<tr>
<td>EE depth elective (required for EE, CS theory elective if 5000 level-EE course selected from CS theory list)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS:3330</td>
<td>Algorithms (required for CSE)</td>
<td>3</td>
</tr>
<tr>
<td>CS:3620</td>
<td>Operating Systems (required for CSE)</td>
<td>3</td>
</tr>
<tr>
<td>CS:3820</td>
<td>Programming Language Concepts (required for CSE)</td>
<td>3</td>
</tr>
<tr>
<td>CS theory elective (required for CSE, EE depth elective if satisfied with 5000-level EE course from CS theory list)</td>
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<td></td>
</tr>
<tr>
<td>CS elective (required for CSE)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MATH:3550</td>
<td>Engineering Mathematics V: Vector Calculus (required for EE)</td>
<td>3</td>
</tr>
</tbody>
</table>

Combined Programs

B.S.E./M.S. in Electrical and Computer Engineering

The College of Engineering offers a Bachelor of Science in Engineering/Master of Science for electrical engineering undergraduate students who intend to earn a M.S. in electrical and computer engineering. B.S.E./M.S. students may take up to 12 s.h. of graduate-level coursework and do thesis-level research while they are still undergraduates. They may count 9 s.h. of graduate coursework toward both degrees. Once students complete the requirements for the bachelor’s degree, they are granted the B.S.E., and they normally complete the M.S. one year later.

To be admitted to the degree program, students must have completed at least 80 s.h., must have a cumulative g.p.a. of at least 3.25, and must submit a letter of application to the chair of the Department of Electrical and Computer Engineering. For more information, see Joint B.S./M.S. Degree on the Department of Electrical and Computer Engineering website.

Academic Plans

Sample Plans of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

Electrical Engineering, B.S.E.

- Electrical Track [p. 3]
- Computer Track [p. 4]

Electrical Track

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>MATH:1550</td>
<td>Engineering Mathematics I: Single Variable Calculus a</td>
<td>4</td>
</tr>
<tr>
<td>ENGR:1100</td>
<td>Introduction to Engineering Problem Solving</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:1110</td>
<td>Principles of Chemistry I b</td>
<td>4</td>
</tr>
<tr>
<td>RHET:1030</td>
<td>Rhetoric</td>
<td>4</td>
</tr>
<tr>
<td>ENGR:1000</td>
<td>Engineering Success for First-Year Students</td>
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</tr>
<tr>
<td>CSI:1600</td>
<td>Success at Iowa</td>
<td>0</td>
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</table>
Spring
MATH:1560 Engineering Mathematics II: Multivariable Calculus 4
ENGR:1300 Introduction to Engineering Computing 3
PHYS:1611 Introductory Physics I 4
MATH:2550 Engineering Mathematics III: Matrix Algebra 2
GE: Engineering Be Creative 3

Second Year
Fall
MATH:2560 Engineering Mathematics IV: Differential Equations 3
PHYS:1612 Introductory Physics II 4
ENGR:2110 Engineering Fundamentals I: Statics 2
ENGR:2120 Engineering Fundamentals II: Electrical Circuits 3
ENGR:2130 Engineering Fundamentals III: Thermodynamics 3

Third Year
Fall
STAT:2020 Probability and Statistics for the Engineering and Physical Sciences 3
ECE:3320 Introduction to Digital Design 3
ECE:3400 Linear Systems II 3
ECE:3410 Electronic Circuits 4
ECE:3700 Electromagnetic Theory 3
ECE:3000 Electrical and Engineering Computer Seminar 1

Spring
ECE:3500 Communication Systems 3
ECE:3600 Control Systems 3
ECE:3720 Semiconductor Devices 3
ECE:3360 Embedded Systems 3
Elective Focus Area #1 3
GE: Approved Course Subjects 3

Fourth Year
Fall
ECE:4880 Principles of Electrical and Computer Engineering Design 3
Elective Focus Area #2 3
Elective Focus Area #3 3
Track Breadth Elective 3

GE: Approved Course Subjects 3

Spring
ECE:4890 Senior Electrical and Computer Engineering Design 3
Track Depth Elective 3
Elective Focus Area #4 3
Elective Focus Area #5 3
GE: Approved Course Subjects 3

Degree Application: apply on MyUI before deadline (typically in February for spring, September for fall)

Total Hours 128

Computer Track

First Year
Fall
MATH:1550 Engineering Mathematics I: Single Variable Calculus 4
ENGR:1100 Introduction to Engineering Problem Solving 3
CHEM:1110 Principles of Chemistry I 3
RHET:1030 Rhetoric 4
ENGR:1000 Engineering Success for First-Year Students 1
CSI:1600 Success at Iowa 0

Hours 16

Spring
MATH:1560 Engineering Mathematics II: Multivariable Calculus 4
ENGR:1300 Introduction to Engineering Computing 3
PHYS:1611 Introductory Physics I 4
MATH:2550 Engineering Mathematics III: Matrix Algebra 2
GE: Engineering Be Creative 3

Hours 16

a Enrollment in math courses requires completion of a placement exam.
b Enrollment in chemistry courses requires completion of a placement exam.
c Courses with prerequisites; students should complete a prerequisite waiver form.
d Students may select a course from all GE CLAS Core categories except Rhetoric, Quantitative or Formal Reasoning, and Natural Sciences.
e A full list of approved course subjects can be found on the College of Engineering General Education Component website.
f Track breadth elective must be chosen from Computer lists.
g Track depth elective must be an advanced course in a subject area within the track. Normally this is defined as a 3000-level course which has one of the required courses as a pre-requisite. See ECE Undergraduate Handbook.
h Please see Academic Calendar, Office of the Registrar website for current degree application deadlines. Students should apply for a degree for the session in which all requirements will be met. For any questions on appropriate timing, contact your academic advisor. For more information visit http://commencement.uiowa.edu/
Second Year

Fall
MATH:2560 Engineering Mathematics IV: Differential Equations 3
PHYS:1612 Introductory Physics II 4
ENGR:2110 Engineering Fundamentals I: Statics 2
ENGR:2120 Engineering Fundamentals II: Electrical Circuits 3
ENGR:2130 Engineering Fundamentals III: Thermodynamics 3

Hours 15

Spring
MATH:3550 Engineering Mathematics V: Vector Calculus 3
ECE:2400 Linear Systems I 3
ECE:2410 Principles of Electronic Instrumentation 4
ENGR:2730 Computers in Engineering 3
GE: CLAS General Education Component 3

Hours 16

Third Year

Fall
STAT:2020 Probability and Statistics for the Engineering and Physical Sciences 3
ECE:3320 Introduction to Digital Design 3
CS:2210 Discrete Structures 3
ECE:3330 Introduction to Software Design 3
ECE:3700 Electromagnetic Theory 3
ECE:3000 Electrical and Computer Engineering Professional Seminar 1

Hours 16

Spring
CS:2230 Computer Science II: Data Structures 4
ECE:3350 Computer Architecture and Organization 3
ECE:3360 Embedded Systems 3
Elective Focus Area: #1 3
Elective Focus Area: #2 3
GE: Approved Course Subjects 3

Hours 19

Fourth Year

Fall
ECE:4880 Principles of Electrical and Computer Engineering Design 3
CS:3330 Algorithms 3
Elective Focus Area: #3 3
Track Breadth Elective 3
GE: Approved Course Subjects 3

Hours 15

Spring
ECE:4890 Senior Electrical and Computer Engineering Design 3
Track Depth Elective 3
Elective Focus Area: #4 3
Elective Focus Area: #5 3
GE: Approved Course Subjects 3

Hours 15

Degree Application: apply on MyUI before deadline (typically in February for spring, September for fall)

<table>
<thead>
<tr>
<th>Hours</th>
<th>Total Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>128</td>
</tr>
</tbody>
</table>

a. Enrollment in math courses requires completion of a placement exam.
b. Typically this course is offered in fall semesters only. Check MyUI for course availability since offerings are subject to change.
c. Enrollment in chemistry courses requires completion of a placement exam.
d. Typically this course is offered in fall and spring semesters. Check MyUI for course availability since offerings are subject to change.
e. Courses with prerequisites; students should complete a prerequisite waiver form.
f. Typically this course is offered in fall, spring, and summer semesters. Check MyUI for course availability since offerings are subject to change.
g. Typically this course is offered in spring semesters only. Check MyUI for course availability since offerings are subject to change.
h. Students may select a course from all GE CLAS Core categories except Rhetoric, Quantitative or Formal Reasoning, and Natural Sciences.
i. A full list of approved course subjects can be found on the College of Engineering General Education Component website.
j. Track breadth elective must be chosen from Electrical lists
k. Three required track courses
l. Track depth elective must be an advanced course in a subject area within the track. Normally this is defined as a 3000-level course which has one of the required courses as a pre-requisite.
m. Please see Academic Calendar, Office of the Registrar website for current degree application deadlines. Students should apply for a degree in the session in which all requirements will be met. For any questions on appropriate timing, contact your academic advisor. For more information visit http://commencement.uiowa.edu/

Career Advancement

The engineering profession is a foundation for a variety of careers in industry, medicine, law, government, and consulting. Engineering majors hold eight of the top ten spots on the list of top-paid majors for bachelor’s degree graduates, according to the National Association of Colleges and Employers (NACE). Electrical engineers find employment everywhere smart technology is employed. They consistently rank among the most sought after and highest-paid technology professionals. On average, 93-98 percent of graduates are employed in their field of study or pursuing advanced education within seven months of graduation.

Electrical engineers work in research, design, development, manufacturing, sales, market analysis, consulting, field service, and management. They are employed in computer, semiconductor, software, aerospace, telecommunication, medical, radio, television, and power industries.

Engineering Career Services develops and promotes experiential education and professional opportunities for students. Professional staff coordinate the college’s co-op and internship program, engage in employer outreach, and provide opportunities for students to network with employers, including an engineering career fair and other career-development programming each semester.

Engineering Career Services also offers individual advising and class presentations on résumé and cover letter preparation, job and internship search strategies, interviewing skills, and job offer evaluation.