ELECTRICAL ENGINEERING, BS

for the degree of Bachelor of Science in Electrical Engineering

Electrical Engineering is a multifaceted discipline that has produced an astounding progression of technological innovations related to energy and information that continues to shape virtually every aspect of modern life. Electrical engineers need a broad and solid foundation in mathematics and physics to support their education in the engineering principles of analysis, synthesis, design, implementation, and testing of the devices and systems that provide the bedrock of modern energy, communication, sensing, computing, medical, security, and defense infrastructures. Within each subdiscipline one can find application domains that strongly rely on hands-on experimental work or that are based on theoretical, mathematical, and computational approaches. The multidisciplinary nature of the electrical engineering education addresses the growing demand for the innovation and design of sensing, communication, computing, and decision-making systems of increasing complexity in consumer, defense, and medical applications.

The curriculum starts with a core of fundamental courses on circuits, electromagnetics, solid-state electronics, and computer systems, leading to a comprehensive array of specialized courses and laboratories in all the important areas of modern electrical engineering.

Current Program Educational Objectives

for the degree of Bachelor of Science in Electrical Engineering

Graduation Requirements

Minimum Technical GPA (https://go.grainger.illinois.edu/TechnicalGPA/): 2.0

TGPA is required for ECE courses (except ECE 316). See Technical GPA (https://go.grainger.illinois.edu/TechnicalGPA/) to clarify requirements.

Minimum Overall GPA: 2.0

Minimum hours required for graduation: 128 hours

General education: Students must complete the Campus General Education (https://courses.illinois.edu/gened/DEFAULT/DEFAULT/) requirements including the campus general education language requirement. ECE 445 or combination of ECE 496 & ECE 499 satisfies a technical core requirement and the Campus General Education Advanced Composition requirement.

Orientation and Professional Development

Code Title Hours
ENG 100 Grainger Engineering Orientation Seminar (External transfer students take ENG 300 instead.) 1

Total Hours 1

Foundational Mathematics and Science

Code Title Hours
CHEM 102 General Chemistry I 3
CHEM 103 General Chemistry Lab I 1

MATH 221 Calculus I (MATH 220 may be substituted. MATH 220 is appropriate for students with no background in calculus. 4 of 5 credit hours count towards degree.) 4
MATH 231 Calculus II 3
MATH 241 Calculus III 4
MATH 257 Linear Algebra with Computational Applications or MATH 416 Abstract Linear Algebra 3
MATH 285 Intro Differential Equations 3
PHYS 211 University Physics: Mechanics 4
PHYS 212 University Physics: Elec & Mag 4
PHYS 213 Univ Physics: Thermal Physics 2
PHYS 214 Univ Physics: Quantum Physics 2

Total Hours 33

Electrical Engineering Technical Core

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<tr>
<th>Code</th>
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<td>ECE 120</td>
<td>Introduction to Computing</td>
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<td>ECE 220</td>
<td>Computer Systems &amp; Programming</td>
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<td>ECE 210</td>
<td>Analog Signal Processing</td>
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<td>ECE 313</td>
<td>Probability with Engrg Applic (STAT 410 may be substituted.)</td>
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<tr>
<td>ECE 329</td>
<td>Fields and Waves I</td>
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<td>ECE 340</td>
<td>Semiconductor Electronics</td>
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<tr>
<td>ECE 385</td>
<td>Digital Systems Laboratory</td>
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<tr>
<td>ECE 445</td>
<td>Senior Design Project Lab (Combination of ECE 496 and ECE 499 may be substituted.)</td>
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Total Hours 31

Technical Electives

From Departmentally Approved List of Technical Electives (below), to include: at least 6 hours of non-ECE electives, at least 21 hours of ECE electives, at least 3 Advanced Core Electives, at least 3 ECE Labs, where at least one must be a Hardware Lab.

Non-ECE courses from list below: 6

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<td>AE 311</td>
<td>Incompressible Flow</td>
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<td>AE 312</td>
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<td>AE 321</td>
<td>Mechs of Aerospace Structures</td>
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<td>Aerospace Dynamical Systems</td>
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<td>AE 353</td>
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<td>AE 403</td>
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<td>AE 412</td>
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Information listed in this catalog is current as of 06/2023
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<td>Extraterrestrial Life</td>
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<td>The Big Bang, Black Holes, and the End of the Universe</td>
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<td>BIOE 480</td>
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<td>Momentum and Heat Transfer</td>
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<td>CHBE 424</td>
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<td>CHBE 451</td>
<td>Transport Phenomena</td>
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<td>CHBE 452</td>
<td>Chemical Kinetics &amp; Catalysis</td>
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<td>CHBE 453</td>
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<td>CHBE 456</td>
<td>Polymer Science &amp; Engineering</td>
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<td>CHBE 471</td>
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<td>CHBE 473</td>
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<td>CHBE 474</td>
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<td>CHEM 104</td>
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Chemistry (CHEM): All 200, 300 and 400 level except 397, 497, and 499. Exceptions also include seminars and special topics, which may be reviewed in the Advising Office.

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<td>CEE 408</td>
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<td>CPSC 265</td>
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<td>Discrete Structures</td>
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<td>Programming Studio</td>
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<td>Numerical Methods I</td>
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<td>CS 412</td>
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<td>CS 413</td>
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<td>CS 418</td>
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<td>CS 423</td>
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<td>Deep Learning for Computer Vision</td>
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<td>ECE 395</td>
<td>Advanced Digital Projects Lab</td>
<td>2 or 3</td>
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<tr>
<td>ECE 396</td>
<td>Honors Project</td>
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<tr>
<td>ECE 397</td>
<td>Individual Study in ECE</td>
<td>0 to 4</td>
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<tr>
<td>ECE 402</td>
<td>Electronic Music Synthesis</td>
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<td>ECE 403</td>
<td>Audio Engineering</td>
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<td>ECE 407</td>
<td>Cryptography</td>
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<td>ECE 408</td>
<td>Applied Parallel Programming</td>
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<tr>
<td>ECE 411</td>
<td>Computer Organization &amp; Design</td>
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<tr>
<td>ECE 412</td>
<td>Microcomputer Laboratory</td>
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<tr>
<td>ECE 414</td>
<td>Biomedical Instrumentation</td>
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<td>ECE 415</td>
<td>Biomedical Instrumention Lab</td>
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<td>ECE 416</td>
<td>Biosensors</td>
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<tr>
<td>ECE 417</td>
<td>Multimedia Signal Processing</td>
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<tr>
<td>ECE 418</td>
<td>Image &amp; Video Processing</td>
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<td>ECE 419</td>
<td>Security Laboratory</td>
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<tr>
<td>ECE 420</td>
<td>Embedded DSP Laboratory</td>
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<tr>
<td>ECE 422</td>
<td>Computer Security I</td>
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<tr>
<td>ECE 424</td>
<td>Computer Security II</td>
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<tr>
<td>ECE 425</td>
<td>Intro to VLSI System Design</td>
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<tr>
<td>ECE 428</td>
<td>Distributed Systems</td>
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<tr>
<td>ECE 431</td>
<td>Electric Machinery</td>
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<tr>
<td>ECE 432</td>
<td>Advanced Electric Machinery</td>
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<tr>
<td>ECE 435</td>
<td>Computer Networking Laboratory</td>
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</tr>
<tr>
<td>ECE 437</td>
<td>Sensors and Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>ECE 438</td>
<td>Communication Networks</td>
<td>3 or 4</td>
</tr>
<tr>
<td>ECE 439</td>
<td>Wireless Networks</td>
<td>3 or 4</td>
</tr>
<tr>
<td>ECE 441</td>
<td>Physcs &amp; Modeling Semicond Dev</td>
<td>3</td>
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<tr>
<td>ECE 442</td>
<td>Silicon Photonics</td>
<td>3 or 4</td>
</tr>
<tr>
<td>ECE 443</td>
<td>LEDs and Solar Cells</td>
<td>4</td>
</tr>
<tr>
<td>ECE 444</td>
<td>IC Device Theory &amp; Fabrication</td>
<td>4</td>
</tr>
<tr>
<td>ECE 446</td>
<td>Principles of Experimental Research in Electrical Engineering</td>
<td>4</td>
</tr>
<tr>
<td>ECE 447</td>
<td>Active Microwave Okt Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE 448</td>
<td>Artificial Intelligence</td>
<td>3 or 4</td>
</tr>
<tr>
<td>ECE 451</td>
<td>Adv Microwave Measurements</td>
<td>3</td>
</tr>
<tr>
<td>ECE 452</td>
<td>Electromagnetic Fields</td>
<td>3</td>
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<tr>
<td>ECE 453</td>
<td>Wireless Communication Systems</td>
<td>4</td>
</tr>
<tr>
<td>ECE 454</td>
<td>Antennas</td>
<td>3</td>
</tr>
<tr>
<td>ECE 455</td>
<td>Optical Electronics</td>
<td>3 or 4</td>
</tr>
<tr>
<td>ECE 456</td>
<td>Global Nav Satellite Systems</td>
<td>4</td>
</tr>
<tr>
<td>ECE 457</td>
<td>Microwave Devices &amp; Circuits</td>
<td>3</td>
</tr>
<tr>
<td>ECE 458</td>
<td>Applic of Radio Wave Propag</td>
<td>3</td>
</tr>
<tr>
<td>ECE 459</td>
<td>Communications Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 460</td>
<td>Optical Imaging</td>
<td>4</td>
</tr>
<tr>
<td>ECE 461</td>
<td>Digital Communications</td>
<td>3</td>
</tr>
<tr>
<td>ECE 462</td>
<td>Logic Synthesis</td>
<td>3</td>
</tr>
<tr>
<td>ECE 463</td>
<td>Digital Communications Lab</td>
<td>2</td>
</tr>
<tr>
<td>ECE 464</td>
<td>Power Electronics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 465</td>
<td>Optical Communications Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 466</td>
<td>Optical Communications Lab</td>
<td>1</td>
</tr>
<tr>
<td>ECE 467</td>
<td>Biophotonics</td>
<td>3</td>
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<tr>
<td>ECE 468</td>
<td>Optical Remote Sensing</td>
<td>3</td>
</tr>
<tr>
<td>ECE 469</td>
<td>Power Electronics Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>ECE 470</td>
<td>Introduction to Robotics</td>
<td>4</td>
</tr>
<tr>
<td>ECE 472</td>
<td>Biomedical Ultrasound Imaging</td>
<td>3</td>
</tr>
<tr>
<td>ECE 473</td>
<td>Fund of Engrg Acoustics</td>
<td>3 or 4</td>
</tr>
<tr>
<td>ECE 476</td>
<td>Power System Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ECE 478</td>
<td>Formal Software Development Methods</td>
<td>3 or 4</td>
</tr>
<tr>
<td>ECE 479</td>
<td>IoT and Cognitive Computing</td>
<td>4</td>
</tr>
</tbody>
</table>
**ECE 395**

Select three courses from the following list of ECE labs. At least one must be a Hardware Lab.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 343</td>
<td>Electronic Circuits Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ECE 391</td>
<td>Computer Systems Engineering</td>
<td>4</td>
</tr>
<tr>
<td>ECE 395</td>
<td>Advanced Digital Projects Lab</td>
<td>2 or 3</td>
</tr>
</tbody>
</table>

**ECE 343**

Select three courses from the following list of Advanced Core ECE electives.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 391</td>
<td>Computer Systems Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CS 225</td>
<td>Data Structures</td>
<td></td>
</tr>
<tr>
<td>ECE 310</td>
<td>Digital Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>ECE 330</td>
<td>Power Ckts &amp; Electromechanics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 342</td>
<td>Electronic Circuits</td>
<td>3</td>
</tr>
<tr>
<td>ECE 350</td>
<td>Fields and Waves II</td>
<td>3</td>
</tr>
</tbody>
</table>

**ECE 395**

Select three courses from the following list of ECE labs. At least one must be a Hardware Lab.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 343</td>
<td>Electronic Circuits Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ECE 391</td>
<td>Computer Systems Engineering</td>
<td>4</td>
</tr>
<tr>
<td>ECE 395</td>
<td>Advanced Digital Projects Lab</td>
<td>2 or 3</td>
</tr>
</tbody>
</table>

**ECE 402**

Select three courses from the following list of Advanced Core ECE electives.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 402</td>
<td>Electronic Music Synthesis</td>
<td>3</td>
</tr>
<tr>
<td>ECE 420</td>
<td>Biomedical Instrumentation Lab</td>
<td>2</td>
</tr>
<tr>
<td>ECE 420</td>
<td>Embedded DSP Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>ECE 431</td>
<td>Electric Machinery</td>
<td>4</td>
</tr>
<tr>
<td>CS 436</td>
<td>Computer Networking Laboratory</td>
<td>3 or 4</td>
</tr>
<tr>
<td>ECE 437</td>
<td>Sensors and Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>ECE 438</td>
<td>Communication Networks</td>
<td>3 or 4</td>
</tr>
<tr>
<td>ECE 439</td>
<td>Wireless Networks</td>
<td>3 or 4</td>
</tr>
<tr>
<td>ECE 443</td>
<td>LEDs and Solar Cells</td>
<td>4</td>
</tr>
<tr>
<td>ECE 444</td>
<td>IC Device Theory &amp; Fabrication</td>
<td>4</td>
</tr>
<tr>
<td>ECE 446</td>
<td>Principles of Experimental Res. in Electrical Engineering</td>
<td>4</td>
</tr>
<tr>
<td>ECE 447</td>
<td>Active Microwave Ckt Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE 451</td>
<td>Adv Microwave Measurements</td>
<td>3</td>
</tr>
<tr>
<td>ECE 453</td>
<td>Wireless Communication Systems</td>
<td>4</td>
</tr>
<tr>
<td>ECE 456</td>
<td>Global Nav Satellite Systems</td>
<td>4</td>
</tr>
<tr>
<td>ECE 460</td>
<td>Optical Imaging</td>
<td>4</td>
</tr>
<tr>
<td>ECE 463</td>
<td>Digital Communications Lab</td>
<td>2</td>
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<tr>
<td>ECE 466</td>
<td>Optical Communications Lab</td>
<td>1</td>
</tr>
<tr>
<td>ECE 468</td>
<td>Optical Remote Sensing</td>
<td>3</td>
</tr>
<tr>
<td>ECE 469</td>
<td>Power Electronics Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>ECE 470</td>
<td>Introduction to Robotics</td>
<td>4</td>
</tr>
<tr>
<td>ECE 481</td>
<td>Nanotechnology</td>
<td>4</td>
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<tr>
<td>ECE 486</td>
<td>Control Systems</td>
<td>4</td>
</tr>
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<td>ECE 489</td>
<td>Robot Dynamics and Control</td>
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</tr>
<tr>
<td>ECE 495</td>
<td>Photonic Device Laboratory</td>
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</table>

**Free Electives**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 391</td>
<td>Computer Systems Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CS 225</td>
<td>Data Structures</td>
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<tr>
<td>ECE 310</td>
<td>Digital Signal Processing</td>
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</tr>
<tr>
<td>ECE 330</td>
<td>Power Ckts &amp; Electromechanics</td>
<td>3</td>
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<tr>
<td>ECE 342</td>
<td>Electronic Circuits</td>
<td>3</td>
</tr>
<tr>
<td>ECE 350</td>
<td>Fields and Waves II</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Hours of Curriculum to Graduate**

128

**Sample Sequence**

This sample sequence is intended to be used only as a guide for degree completion. All students should work individually with their academic advisors to decide the actual course selection and sequence that works best for them based on their academic preparation and goals. Enrichment programming such as study abroad, minors, internships, and so on may impact the structure of this four-year plan. Course availability is not guaranteed during the semester indicated in the sample sequence. The curriculum sequence can also be viewed via dynamic and static curricular maps (https://grainger.illinois.edu/academics/undergraduate/majors-and-minors/ee-map/), which include prerequisite sequencing.
Students must fulfill their Language Other Than English requirement by successfully completing a third level of a language other than English. See the corresponding section on the Degree and General Education Requirements (http://catalog.illinois.edu/general-information/degree-general-education-requirements/). ECE 445 or combination of ECE 496 & ECE 499 satisfies a technical core requirement and the Campus General Education Advanced Composition requirement.

Free Electives: Additional course work, subject to the Grainger College of Engineering restrictions to Free Electives (https://go.grainger.illinois.edu/FreeElectives/), so that there are at least 128 credit hours earned toward the degree.

<table>
<thead>
<tr>
<th>First Year</th>
<th>First Semester</th>
<th>Hours</th>
<th>Second Semester</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td>ECE 110</td>
<td>3</td>
<td>ECE 120</td>
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<td></td>
<td>MATH 221</td>
<td>4</td>
<td>MATH 231</td>
<td>3</td>
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<tr>
<td></td>
<td>(MATH 220 may be substituted)</td>
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<td></td>
<td>CHEM 102</td>
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<td>PHYS 211</td>
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<td>CHEM 103</td>
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<td>ENG 100</td>
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Composition I or General Education (Choose a Humanities or Social/Behavioral Science course) | 4-3 |

<table>
<thead>
<tr>
<th>Second Year</th>
<th>First Semester</th>
<th>Hours</th>
<th>Second Semester</th>
<th>Hours</th>
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<tr>
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<td>ECE 220</td>
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<td>ECE 210</td>
<td>4</td>
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<tr>
<td></td>
<td>MATH 241</td>
<td>4</td>
<td>MATH 285</td>
<td>3</td>
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<td></td>
<td>PHYS 212</td>
<td>4</td>
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<td>MATH 257</td>
<td>3</td>
<td>PHYS 214</td>
<td>2</td>
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<td>General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)</td>
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<td>Language Other Than English (3rd level) course</td>
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</table>

|            | 16 | 17 |

<table>
<thead>
<tr>
<th>Fourth Year</th>
<th>First Semester</th>
<th>Hours</th>
<th>Second Semester</th>
<th>Hours</th>
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<td>ECE 445</td>
<td>4</td>
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<tr>
<td></td>
<td>(Combination of ECE 496 and ECE 499 may be substituted.)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|           | 16 | 14 |

Total Hours 128

for the degree of Bachelor of Science Major in Electrical Engineering

Student learning outcomes are based on learning outcomes in line with the ABET accreditation process.

Electrical Engineering graduates will have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. 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.
3. An ability to communicate effectively with a range of audiences.
4. 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.
5. 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.

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

for the degree of Bachelor of Science in Electrical Engineering

Electrical & Computer Engineering Website (https://ece.illinois.edu/about/directory/faculty/)
Electrical & Computer Engineering Faculty

The Grainger College of Engineering Admissions (https://grainger.illinois.edu/)
The Grainger College of Engineering