Bachelor of Arts (BA) Degree with a Major in Electrical and Computer Engineering

Program Learning Outcomes for the Bachelor of Arts Degree (BA) with a Major in Electrical and Computer Engineering

Upon completing the BA degree with a major in Electrical and Computer Engineering, students will be able to demonstrate:

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 develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
6. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Requirements for the BA Degree with a Major in Electrical and Computer Engineering

For general university requirements, see Graduation Requirements (https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/). Students pursuing the BA degree with a major in Electrical and Computer Engineering must complete:

- A minimum of 21-23 courses (63 credit hours) to satisfy major requirements.
- A minimum of 120 credit hours to satisfy degree requirements.
- A minimum of 8 courses (24 credit hours) taken at the 300-level or above.
- The requirements for one area of specialization (see below for areas of specialization). When students declare the major (https://ga.rice.edu/undergraduate-students/academic-opportunities/majors-minors-certificates/#text) in Electrical and Computer Engineering, students must additionally identify and declare one of four areas of specialization, either in:
  - Computer Engineering (p. 2): provides a broad background in computer systems engineering, including computer architecture, digital hardware engineering, software engineering, and computer systems performance analysis, or
  - Data Science/Systems (p. 3): integrates the foundations, tools and techniques involving data acquisition, data analytics, data storage and computing infrastructure in order to enable meaningful extraction of actionable information from diverse and potentially massive data sources. Applications include wireless communication systems, digital signal processing, image processing, and networking, or
  - Neuroengineering (p. 3): exploits engineering techniques to understand, repair, manipulate, or treat the diseases of human neural systems and networks, or
  - Photonics, Electronics, and Nano-devices (p. 4): encompasses studies of electronic materials, including nanomaterials, semiconductor and optoelectronic devices, lasers and their applications.

Because of the common core requirements, it is possible for students to change their area of specialization at any time, even after initially declaring the major. To do so, please contact the Office of the Registrar (registrar@rice.edu).

The BA degree provides a basic technical foundation in electrical and computer engineering through a subset of the core and specialization courses offered by the department. The program leading to the BA degree is not accredited by the EAC of ABET and is often pursued by students as a component of a double major or dual degree program. A course can satisfy only one program requirement within the major. Students who place out of required courses without transcript credit must substitute other approved courses in the same area.

Planning sheets and degree plan forms may be found on the Electrical and Computer Engineering website (http://www.ece.rice.edu/).

The courses listed below satisfy the requirements for this major. In certain instances, courses not on this official list may be substituted upon approval of the major’s academic advisor, or where applicable, the department’s Director of Undergraduate Studies. (Course substitutions must be formally applied and entered into Degree Works by the major’s Official Certifier (https://registrar.rice.edu/facstaff/degeworks/officialcertifier/ ).) Students and their academic advisors should identify and clearly document the courses to be taken.

Summary

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>Total Credit Hours Required for the Major in Electrical and Computer Engineering</td>
<td></td>
<td>63</td>
</tr>
<tr>
<td>Total Credit Hours Required for the BA Degree with a Major in Electrical and Computer Engineering</td>
<td></td>
<td>120</td>
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Degree Requirements

<table>
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<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>Core Requirements</td>
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<tr>
<td>Mathematics and Science Courses</td>
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<tr>
<td>ELEC 261</td>
<td>INTRODUCTION TO PHYSICAL ELECTRONICS I</td>
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<tr>
<td>ELEC 303</td>
<td>RANDOM SIGNALS IN ELECTRICAL ENGINEERING SYSTEMS</td>
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<tr>
<td>MATH 101</td>
<td>SINGLE VARIABLE CALCULUS I</td>
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<tr>
<td>or MATH 105</td>
<td>AP/OTH CREDIT IN CALCULUS I</td>
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MATH 102  SINGLE VARIABLE CALCULUS II  3
or MATH 106  AP/OTH CREDIT IN CALCULUS II
MATH 212  MULTIVARIABLE CALCULUS  3
or MATH 221  HONORS CALCULUS III

Select 1 course from the following:  3
CAAM 334  MATRIX ANALYSIS FOR DATA SCIENCE
CAAM 335  MATRIX ANALYSIS
MATH 354  HONORS LINEAR ALGEBRA
MATH 355  LINEAR ALGEBRA

Select 1 course from the following:  4
PHYS 101  MECHANICS (WITH LAB)
& PHYS 103  and MECHANICS DISCUSSION 1
PHYS 111  HONORS MECHANICS (WITH LAB)
& PHYS 103  and MECHANICS DISCUSSION 1

Select 1 course from the following:  4
PHYS 102  ELECTRICITY & MAGNETISM (WITH LAB)
& PHYS 104  and ELECTRICITY AND MAGNETISM DISCUSSION 1
PHYS 112  HONORS ELECTRICITY & MAGNETISM (WITH LAB) 1

Electrical and Computer Engineering (ECE) Core Courses
ELEC 220  FUNDAMENTALS OF COMPUTER ENGINEERING  4
ELEC 241  FUNDAMENTALS OF ELECTRICAL ENGINEERING I
& ELEC 240  and FUNDAMENTALS OF ELECTRICAL ENGINEERING I LABORATORY
ELEC 242  SIGNALS, SYSTEMS, AND TRANSFORMS
& ELEC 244  and ANALOG CIRCUITS LABORATORY
ELEC 305  INTRODUCTION TO PHYSICAL ELECTRONICS II  3
ELEC 326 / COMP 326  DIGITAL LOGIC DESIGN  3

Computation Course
COMP 140  COMPUTATIONAL THINKING  4
or COMP 130  ELEMENTS OF ALGORITHMS AND COMPUTATION
Design Laboratory 2

Select 1 course from the following:  3
ELEC 327  IMPLEMENTATION OF DIGITAL SYSTEMS
ELEC 332  ELECTRONIC SYSTEMS PRINCIPLES AND PRACTICE
ELEC 364  PHOTONICS MEASUREMENTS: PRINCIPLES AND PRACTICE

Area of Specialization
Select 1 from the following Areas of Specialization (see Areas of Specialization below):  12
  Computer Engineering
  Data Science/Systems
  Neuroengineering
  Photonics, Electronics, and Nano-devices

Total Credit Hours Required for the Major in Electrical and Computer Engineering  63

Additional Credit Hours to Complete Degree Requirements  26

University Graduation Requirements (https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/)  31

Total Credit Hours  120

Footnotes and Additional Information

* Note: University Graduation Requirements include 31 credit hours, comprised of Distribution Requirements (Groups I, II, and III), FWIS, and LPAP coursework. In some instances, courses satisfying FWIS or distribution requirements may additionally meet other requirements, such as the Analyzing Diversity (AD) requirement, or some of the student’s declared major, minor, or certificate requirements. Additional Credit Hours to Complete Degree Requirements include general electives, coursework completed as upper-level, residency (hours taken at Rice), and/or any other additional academic program requirements.

1 The Electrical and Computer Engineering department has determined that credit awarded for PHYS 141 CONCEPTS IN PHYSICS I and credit awarded for PHYS 142 CONCEPTS IN PHYSICS II are not eligible for meeting the requirements of the Electrical and Computer Engineering major.

2 Design Laboratory is typically taken in the junior year. The required Design Laboratory does not count as a specialization course. It is important to consult a departmental advisor when choosing the Design Laboratory course or if interested in taking a second one. Any Design Laboratory course taken above the one required course will count as a General Elective, not as a specialization course.

Areas of Specialization

Students must complete the requirements as listed for one of the following areas of specialization as offered by the Electrical and Computer Engineering major. A total of 4 courses (minimum of 12 credit hours) must be taken from at least two areas of specialization, including a minimum of 2 courses from one area of specialization, 1 course from an area of specialization outside of the student’s chosen specialization, and 1 course from any area of specialization. In addition, ELEC graduate coursework at the 500-level may be used to satisfy specialization requirements with permission. Consult departmental advisors and the Electrical and Computer Engineering (http://www.ece.rice.edu/) website for the latest information.

Area of Specialization: Computer Engineering

To fulfill the remaining Electrical and Computer Engineering major requirements, students pursuing the Computer Engineering area of specialization must complete:

• a minimum of 2 courses (6 credit hours) from the Computer Engineering area of specialization
• 1 course (3 credit hours) from any area of specialization outside Computer Engineering (from Data Science/Systems, Neuroengineering, or Photonics, Electronics, or Nano-devices)
• 1 course (3 credit hours) from any area of specialization (including Computer Engineering)

Code  Title  Credit Hours
COMP 321  INTRODUCTION TO COMPUTER SYSTEMS  6
COMP 382  REASONING ABOUT ALGORITHMS
COMP 430  INTRODUCTION TO DATABASE SYSTEMS
ELEC 323 / COMP 322  PRINCIPLES OF PARALLEL PROGRAMMING
ELEC 410 / COMP 436  SECURE AND CLOUD COMPUTING
ELEC 411  MICROWAVE ENGINEERING
ELEC 414  WIRELESS INTEGRATED CIRCUITS AND SYSTEMS
ELEC 421 / COMP 421  OPERATING SYSTEMS AND CONCURRENT PROGRAMMING
ELEC 422  VLSI SYSTEMS DESIGN
ELEC 423  DIGITAL INTEGRATED CIRCUITS
ELEC 424 / COMP 424  MOBILE AND EMBEDDED SYSTEM DESIGN AND APPLICATION
ELEC 425 / COMP 425  COMPUTER SYSTEMS ARCHITECTURE
ELEC 426  ADVANCED DIGITAL INTEGRATED CIRCUITS DESIGN
ELEC 429 / COMP 429  INTRODUCTION TO COMPUTER NETWORKS
ELEC 430  LINEAR ALGEBRA FOR DATA SCIENCE
ELEC 431  MODERN COMMUNICATION THEORY AND PRACTICE
ELEC 432  DIGITAL SIGNAL PROCESSING
ELEC 433  ARCHITECTURE FOR WIRELESS COMMUNICATIONS
ELEC 434  ADVANCED HIGH-SPEED SYSTEM DESIGN
ELEC 435 / MECH 435  INTRODUCTION TO ENERGY-EFFICIENT MECHATRONICS
ELEC 436 / MECH 420  FUNDAMENTALS OF CONTROL SYSTEMS
ELEC 437  INTRODUCTION TO COMMUNICATION NETWORKS
ELEC 439  DATA SCIENCE AND DYNAMICAL SYSTEMS
ELEC 447 / COMP 447  INTRODUCTION TO COMPUTER VISION
ELEC 448 / COMP 498 / MECH 498  INTRODUCTION TO ROBOTICS
ELEC 450 / COMP 450 / MECH 450  ALGORITHMIC ROBOTICS

Select 1 course from any Area of Specialization outside Computer Engineering (from Data Science/Systems, Neuroengineering, or Photonics, Electronics, and Nano-devices)  3
Select 1 course from any Area of Specialization (including Data Science/Systems)  3

Total Credit Hours  12

Footnotes and Additional Information
1 The sequence of COMP 140, COMP 182, and COMP 215 is recommended in addition for the Computer Engineering specialization as these courses are prerequisites for many of the Computer Science courses.

Area of Specialization: Data Science/Systems
To fulfill the remaining Electrical and Computer Engineering major requirements, students pursuing the Data Science/Systems area of specialization must complete:
- a minimum of 2 courses (6 credit hours) from the Data Science/Systems area of specialization
- 1 course (3 credit hours) from any area of specialization outside Data Science/Systems (from Computer Engineering, Neuroengineering, or Photonics, Electronics, and Nano-devices)
- 1 course (3 credit hours) from any area of specialization (including Data Science/Systems)

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<tr>
<td>COMP 330</td>
<td>TOOLS AND MODELS FOR DATA SCIENCE</td>
<td>6</td>
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</table>

Select a minimum of 2 from the following:

ELEC 380 / BIOE 380 / NEUR 383  INTRODUCTION TO NEUROENGINEERING: MEASURING AND MANIPULATING NEURAL ACTIVITY  6
The university recognizes academic excellence achieved over an undergraduate’s academic history at Rice. For information on university honors, please see Latin Honors (https://ga.rice.edu/undergraduate-students/honors-distinctions/university/) (summa cum laude, magna cum laude, and cum laude) and Distinction in Research and Creative Work (https://ga.rice.edu/undergraduate-students/honors-distinctions/)
Fifth-Year Master's Degree Option for Rice Undergraduate Students

In certain situations and with some terminal master's degree programs, Rice students have an option to pursue a master's degree by adding an additional fifth year to their four years of undergraduate studies.

Advanced Rice undergraduate students in good academic standing typically apply to the master's degree program during their junior or senior year. Upon acceptance, depending on course load, financial aid status, and other variables, they may then start taking some required courses of the master's degree program. A plan of study will need to be approved by the student's undergraduate major advisor and the master's degree program director.

As part of this option and opportunity, Rice undergraduate students:

• must complete the requirements for a bachelor's degree and the master's degree independently of each other (i.e. no course may be counted toward the fulfillment of both degrees).
• should be aware there could be financial aid implications if the conversion of undergraduate coursework to that of graduate level reduces their earned undergraduate credit for any semester below that of full-time status (12 credit hours).
• more information on this Undergraduate - Graduate Concurrent Enrollment opportunity, including specific information on the registration process can be found here (https://ga.rice.edu/undergraduate-students/academic-opportunities/undergraduate-graduate-concurrent-enrollment/).

Rice undergraduate students completing studies in science and engineering may have the option to pursue the Master of Electrical and Computer Engineering (MECE) degree. For additional information, students should contact their undergraduate major advisor and the MECE program director.

Independent Research

The ECE Department encourages our undergraduates to pursue research projects with the faculty. The ECE Department has several opportunities including the multi-year, team-oriented Vertically Integrated Projects (VIP) program through the ELEC 491 course and individual independent research with a faculty member through the ELEC 490 course. For information on taking an undergraduate summer research course tuition free, see: https://registrar.rice.edu/students/summersessions. Also, there are often summer research opportunities through the NSF funded Research Experience for Undergraduates (REU) program, through individual ECE faculty grants, or through the Smalley-Curl Institute REU Sites program.

Study Abroad

A semester of study abroad is a valuable experience to enhance an individual’s perspective on engineering and technology. The ECE Department encourages students to explore this option particularly for the spring semester of the sophomore or junior year. The ECE Department and the University Study Abroad office coordinate to review programs and courses appropriate for Rice engineering students.