BACHELOR OF ARTS (BA) DEGREE WITH A MAJOR IN ELECTRICAL ENGINEERING

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

Upon completing the BA degree with a major in Electrical 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 Engineering

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

- A minimum of 21-23 courses (63 credit hours) to satisfy major requirements.
- A minimum of 123 credit hours to satisfy degree requirements.
- A minimum of 60 credit hours outside of major 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). The BA degree with a major in Electrical Engineering major offers four areas of specialization:
  - Computer Engineering (p. ) provides a broad background in computer systems engineering, including computer architecture, digital hardware engineering, software engineering, and computer systems performance analysis, or
  - Data Science (p. ) 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. ): exploits engineering techniques to understand, repair, manipulate, or treat the diseases of human neural systems and networks, or
  - Photonics, Electronics, and Nano-devices (p. ): encompasses studies of electronic materials, including nanomaterials, semiconductor and optoelectronic devices, lasers and their applications.

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/degreeworks/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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Credit Hours Required for the Major in Electrical Engineering</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Total Credit Hours Required for the BA Degree with a Major in Electrical Engineering</td>
<td>123</td>
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Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td></td>
<td><strong>Core Requirements</strong></td>
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<tr>
<td></td>
<td>Mathematics and Science Courses</td>
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</tr>
<tr>
<td>ELEC 261</td>
<td>ELECTRONIC MATERIALS AND QUANTUM DEVICES</td>
<td>3</td>
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<tr>
<td>ELEC 303</td>
<td>RANDOM SIGNALS IN ELECTRICAL ENGINEERING SYSTEMS</td>
<td>3</td>
</tr>
<tr>
<td>MATH 101</td>
<td>SINGLE VARIABLE CALCULUS I</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 105</td>
<td>AP/OTH CREDIT IN CALCULUS I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 102</td>
<td>SINGLE VARIABLE CALCULUS II</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 106</td>
<td>AP/OTH CREDIT CALCULUS II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 212</td>
<td>MULTIVARIABLE CALCULUS</td>
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<tr>
<td>or MATH 221</td>
<td>HONORS CALCULUS III</td>
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<td><strong>Select 1 from the following:</strong></td>
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<tr>
<td>CAAM 335</td>
<td>MATRIX ANALYSIS</td>
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<tr>
<td>MATH 354</td>
<td>HONORS LINEAR ALGEBRA</td>
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<tr>
<td>MATH 355</td>
<td>LINEAR ALGEBRA</td>
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</tr>
<tr>
<td></td>
<td><strong>Select 1 from the following:</strong></td>
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</table>
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<tr>
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<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>PHYS 101 &amp; PHYS 103</td>
<td>MECHANICS (WITH LAB) and MECHANICS DISCUSSION</td>
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</tr>
<tr>
<td>PHYS 111</td>
<td>HONORS MECHANICS (WITH LAB)</td>
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<td>Select 1 from the following:</td>
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<tr>
<td>PHYS 102 &amp; PHYS 104</td>
<td>ELECTRICITY &amp; MAGNETISM (WITH LAB) and ELECTRICITY AND MAGNETISM DISCUSSION</td>
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<tr>
<td>PHYS 112</td>
<td>HONORS ELECTRICITY &amp; MAGNETISM (WITH LAB)</td>
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Electrical and Computer Engineering (ECE) Core Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>ELEC 220</td>
<td>FUNDAMENTALS OF COMPUTER ENGINEERING</td>
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<tr>
<td>ELEC 241 &amp; ELEC 240</td>
<td>FUNDAMENTALS OF ELECTRICAL ENGINEERING I and FUNDAMENTALS OF ELECTRICAL ENGINEERING I LABORATORY</td>
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<tr>
<td>ELEC 242 &amp; ELEC 244</td>
<td>FUNDAMENTALS OF ELECTRICAL ENGINEERING II and FUNDAMENTALS OF ELECTRICAL ENGINEERING II LABORATORY</td>
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<tr>
<td>ELEC 305</td>
<td>INTRODUCTION TO PHYSICAL ELECTRONICS</td>
<td></td>
</tr>
<tr>
<td>ELEC 326 / COMP 326</td>
<td>DIGITAL LOGIC DESIGN</td>
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</tbody>
</table>

Computation Course

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tr>
<td>COMP 140</td>
<td>COMPUTATIONAL THINKING</td>
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</tr>
<tr>
<td>or COMP 130</td>
<td>ELEMENTS OF ALGORITHMS AND COMPUTATION</td>
<td></td>
</tr>
<tr>
<td>Design Laboratory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select 1 from the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEC 327</td>
<td>IMPLEMENTATION OF DIGITAL SYSTEMS</td>
<td></td>
</tr>
<tr>
<td>ELEC 332</td>
<td>ELECTRONIC SYSTEMS PRINCIPLES AND PRACTICE</td>
<td></td>
</tr>
<tr>
<td>ELEC 364</td>
<td>PHOTONICS MEASUREMENTS: PRINCIPLES AND PRACTICE</td>
<td></td>
</tr>
</tbody>
</table>

Area of Specialization

Select 1 from the following Areas of Specialization (see Areas of Specialization below):

- Computer Engineering
- Data Science/Systems
- Neuroengineering
- Photonics, Electronics, and Nano-devices

Elective Requirements: BA Unrestricted Electives

Students must complete additional courses to meet the BA degree's minimum requirement of at least 123 semester hours.

Total Credit Hours Required for the Major in Electrical Engineering

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP 321</td>
<td>INTRODUCTION TO COMPUTER SYSTEMS</td>
<td></td>
</tr>
<tr>
<td>COMP 382</td>
<td>REASONING ABOUT ALGORITHMS</td>
<td></td>
</tr>
<tr>
<td>COMP 430</td>
<td>INTRODUCTION TO DATABASE SYSTEMS</td>
<td></td>
</tr>
<tr>
<td>ELEC 323 / COMP 322</td>
<td>PRINCIPLES OF PARALLEL PROGRAMMING</td>
<td></td>
</tr>
<tr>
<td>ELEC 421 / COMP 421</td>
<td>OPERATING SYSTEMS AND CONCURRENT PROGRAMMING</td>
<td></td>
</tr>
<tr>
<td>ELEC 422</td>
<td>VLSI SYSTEMS DESIGN</td>
<td></td>
</tr>
<tr>
<td>ELEC 423</td>
<td>DIGITAL INTEGRATED CIRCUITS</td>
<td></td>
</tr>
<tr>
<td>ELEC 424 / COMP 424</td>
<td>MOBILE AND EMBEDDED SYSTEM DESIGN AND APPLICATION</td>
<td></td>
</tr>
<tr>
<td>ELEC 425 / COMP 425</td>
<td>COMPUTER SYSTEMS ARCHITECTURE</td>
<td></td>
</tr>
<tr>
<td>ELEC 429 / COMP 429</td>
<td>INTRODUCTION TO COMPUTER NETWORKS</td>
<td></td>
</tr>
<tr>
<td>ELEC 446 / COMP 446</td>
<td>MOBILE DEVICE APPLICATIONS PROJECT</td>
<td></td>
</tr>
</tbody>
</table>

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

Footnotes and Additional Information

* Includes coursework completed as distribution credit, FWIS, LPAP, upper-level, residency (hours taken at Rice), 60 hours outside of the major (if applicable), and any additional academic program requirements. The "hours outside of the major" requirement may include all of the above university requirements.

1 The required Design Laboratory does not count 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 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 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)
Bachelor of Arts (BA) Degree with a Major in Electrical Engineering

Select 1 course from any Area of Specialization (including Computer Engineering) 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 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)

Code Title Credit Hours
Select a minimum of 2 from the following: 6
COMP 330 TOOLS AND MODELS FOR DATA SCIENCE
ELEC 301 SIGNALS, SYSTEMS, AND LEARNING
ELEC 302 INTRODUCTION TO SYSTEMS
ELEC 306 APPLIED ELECTROMAGNETICS
ELEC 430 DIGITAL COMMUNICATION
ELEC 431 DIGITAL SIGNAL PROCESSING
ELEC 432 MOBILE BIO-BEHAVIORAL SENSING
ELEC 433 ARCHITECTURE FOR WIRELESS COMMUNICATIONS
ELEC 435 / MECH 435 INTRODUCTION TO ENERGY-EFFICIENT MECHATRONICS
ELEC 436 / MECH 420 FUNDAMENTALS OF CONTROL SYSTEMS
ELEC 437 INTRODUCTION TO COMMUNICATION NETWORKS
ELEC 438 WIRELESS NETWORKING FOR UNDER-RESOURCED URBAN COMMUNITIES
ELEC 447 / COMP 447 INTRODUCTION TO COMPUTER VISION
ELEC 475 LEARNING FROM SENSOR DATA
ELEC 478 INTRODUCTION TO MACHINE LEARNING
ELEC 498 / COMP 498 / MECH 498 INTRODUCTION TO ROBOTICS
MECH 488 DESIGN OF MECHATRONIC SYSTEMS
STAT 413 INTRODUCTION TO STATISTICAL MACHINE LEARNING
Select 1 course from any Area of Specialization (including Data Science/Systems) 3

Total Credit Hours 12

Area of Specialization: Neuroengineering
To fulfill the remaining Electrical Engineering major requirements, students pursuing the Neuroengineering area of specialization must complete:

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

Code Title Credit Hours
Select a minimum of 2 from the following: 6
ELEC 380 / BIOE 380 / NEUR 383 INTRODUCTION TO NEUROENGINEERING: MEASURING AND MANIPULATING NEURAL ACTIVITY
ELEC 381 / BIOE 381 ELECTROPHYSIOLOGY
ELEC 382 / NEUR 382 NEUROSCIENCE
ELEC 481 / BIOE 481 / NEUR 481 COMPUTATIONAL NEUROSCIENCE AND NEURAL ENGINEERING
ELEC 482 / BIOE 482 PHYSIOLOGICAL CONTROL SYSTEMS
ELEC 483 MACHINE LEARNING AND SIGNAL PROCESSING FOR NEURO ENGINEERING
ELEC 485 / BIOE 485 / COMP 485 FUNDAMENTALS OF MEDICAL IMAGING I
ELEC 486 / BIOE 486 / COMP 486 FUNDAMENTALS OF MEDICAL IMAGING II
ELEC 488 / CAAM 415 / NEUR 415 THEORETICAL NEUROSCIENCE: FROM CELLS TO LEARNING SYSTEMS
ELEC 489 / CAAM 416 / NEUR 416 NEURAL COMPUTATION
Select 1 course from any Area of Specialization outside Neuroengineering 3
Neuroengineering (from Computer Engineering, Data Science/Systems, or Photonics, Electronics, and Nano-devices)
Select 1 course from any Area of Specialization (including Neuroengineering) 3

Total Credit Hours 12

Area of Specialization: Photonics, Electronics, and Nano-devices
To fulfill the remaining Electrical Engineering major requirements, students pursuing the Photonics, Electronics, and Nano-devices area of specialization must complete:
Policies for the BA Degree with a Major in Electrical Engineering

Advising

Rice University provides multiple avenues for undergraduate advising through the Office of Academic Advising, the Rice Residential College system, and academic departments. Although students may consult with their Divisional Advisors in their College during the freshman and sophomore years, they are welcome and encouraged to meet with a major advisor in the Electrical and Computer Engineering Department. In particular, ECE students are required to meet with a major advisor in ECE at least during their junior and senior years to discuss their ECE Specialization Area course selection and Design Courses. The ECE Undergraduate Committee currently has seven faculty members who serve as major advisors. More information on sample degree plans and the process for declaring ECE as a major is available on the ECE Department website at: https://www.ece.rice.edu/undergraduate-program. Students are encouraged to meet with their academic program’s transfer credit advisor when considering transfer credit possibilities.

Departmental Transfer Credit Guidelines

Students pursuing the major in Electrical Engineering should be aware of the following departmental transfer credit guidelines:

- Requests for transfer credit will be considered by the program director (and/or the program’s official transfer credit advisor) on an individual case-by-case basis.

Additional Information

For additional information, please see the Electrical and Computer Engineering website: https://www.ece.rice.edu/.

Opportunities for the BA Degree with a Major in Electrical Engineering

Academic Honors

The university recognizes academic excellence achieved over an undergraduate's academic history at Rice. For information on university honors, please see Latin Honors (ga.rice.edu/undergraduate-students/honors-distinctions/university) (summa cum laude, magna cum laude, and cum laude) and Distinction in Research and Creative Work (ga.rice.edu/undergraduate-students/honors-distinctions/university). Some departments have department-specific Honors awards or designations.

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://summer.rice.edu/academics/ugresearch. 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. For more information, see the ECE Department web page at: https://www.ece.rice.edu/undergraduate-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. Additional information is on the ECE Department website at: https://www.ece.rice.edu/undergraduate-study/resources/study-abroad.

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