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 (https://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 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 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 (p. 3)/Systems: 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/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>
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</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>120</td>
</tr>
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Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Core Requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mathematics and Science Courses</td>
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</tr>
<tr>
<td>ELEC 261</td>
<td>ELECTRONIC MATERIALS AND DEVICES</td>
<td>3</td>
</tr>
<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>
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<tr>
<td>or MATH 105</td>
<td>AP/OTH CREDIT IN CALCULUS I</td>
<td></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 IN CALCULUS II</td>
<td></td>
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<tr>
<td>MATH 212</td>
<td>MULTIVARIABLE CALCULUS</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 221</td>
<td>HONORS CALCULUS III</td>
<td></td>
</tr>
</tbody>
</table>
Bachelor of Arts (BA) Degree with a Major in Electrical Engineering

**University Graduation Requirements**

Additional Credit Hours to Complete Degree Requirements

**Engineering**

Total Credit Hours Required for the Major in Electrical Engineering

**Area of Specialization**

Select 1 from the following:

- 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:

- PHYS 101 MECHANICS (WITH LAB)
- & PHYS 103 and MECHANICS DISCUSSION
- PHYS 111 HONORS MECHANICS (WITH LAB)

Select 1 course from the following:

- PHYS 102 ELECTRICITY & MAGNETISM (WITH LAB)
- & PHYS 104 and ELECTRICITY AND MAGNETISM DISCUSSION
- PHYS 112 HONORS ELECTRICITY & MAGNETISM (WITH LAB)

Electrical and Computer Engineering (ECE) Core Courses

- ELEC 220 FUNDAMENTALS OF COMPUTER ENGINEERING
- 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
- ELEC 326 / COMP 326 DIGITAL LOGIC DESIGN

Computation Course

- COMP 140 COMPUTATIONAL THINKING
  or COMP 130 ELEMENTS OF ALGORITHMS AND COMPUTATION

Design Laboratory

Select 1 course from the following:

- 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):

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

Total Credit Hours Required for the Major in Electrical Engineering

**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 major requirements may additionally meet distribution 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 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 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)

**Code** | **Title** | **Credit Hours**
--- | --- | ---
COMP 321 | INTRODUCTION TO COMPUTER SYSTEMS | 6
COMP 382 | REASONING ABOUT ALGORITHMS | 4
COMP 430 | INTRODUCTION TO DATABASE SYSTEMS | 4
ELEC 323 | PRINCIPLES OF PARALLEL PROGRAMMING | 4
ELEC 421 | OPERATING SYSTEMS AND CONCURRENT PROGRAMMING | 4
ELEC 422 | VLSI SYSTEMS DESIGN | 4
ELEC 423 | DIGITAL INTEGRATED CIRCUITS | 4
ELEC 424 | MOBILE AND EMBEDDED SYSTEM DESIGN | 4
ELEC 425 | COMPUTER SYSTEMS ARCHITECTURE | 4
ELEC 426 | ADVANCED DIGITAL INTEGRATED CIRCUITS DESIGN | 4

Note:

- University Graduation Requirements (https://oa.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/) include 31 credit hours, comprised of Distribution Requirements (Groups I, II, and III), FWIS, and LPAP coursework. In some instances, courses satisfying major requirements may additionally meet distribution 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.
- 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.

**Total Credit Hours**

120
### Bachelor of Arts (BA) Degree with a Major in Electrical Engineering

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>ELEC 429 / COMP 429</td>
<td>INTRODUCTION TO COMPUTER NETWORKS</td>
<td></td>
</tr>
<tr>
<td>ELEC 434</td>
<td>ADVANCED HIGH-SPEED SYSTEM DESIGN</td>
<td></td>
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<tr>
<td>ELEC 437</td>
<td>INTRODUCTION TO COMMUNICATION NETWORKS</td>
<td></td>
</tr>
<tr>
<td>ELEC 442</td>
<td>INTRODUCTION TO ANALOG INTEGRATED CIRCUITS</td>
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</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)

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

Total Credit Hours: 12

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### 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)

Select a minimum of 2 from the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>COMP 330</td>
<td>TOOLS AND MODELS FOR DATA SCIENCE</td>
<td>6</td>
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<tr>
<td>DSCI 302</td>
<td>INTRODUCTION TO DATA SCIENCE TOOLS AND MODELS</td>
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<td>DSCI 303</td>
<td>MACHINE LEARNING FOR DATA SCIENCE</td>
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<td>ELEC 301</td>
<td>SIGNALS, SYSTEMS, AND LEARNING</td>
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<tr>
<td>ELEC 306</td>
<td>APPLIED ELECTROMAGNETICS</td>
<td></td>
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<tr>
<td>ELEC 430</td>
<td>MODERN COMMUNICATION THEORY AND PRACTICE</td>
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<tr>
<td>ELEC 431</td>
<td>DIGITAL SIGNAL PROCESSING</td>
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</tr>
<tr>
<td>ELEC 432</td>
<td>MOBILE BIO-BEHAVIORAL SENSING</td>
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<tr>
<td>ELEC 434</td>
<td>ADVANCED HIGH-SPEED SYSTEM DESIGN</td>
<td></td>
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<tr>
<td>ELEC 435 / MECH 435</td>
<td>INTRODUCTION TO ENERGY-EFFICIENT MECHATRONICS</td>
<td></td>
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<tr>
<td>ELEC 436 / MECH 420</td>
<td>FUNDAMENTALS OF CONTROL SYSTEMS</td>
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<tr>
<td>ELEC 437</td>
<td>INTRODUCTION TO COMMUNICATION NETWORKS</td>
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<tr>
<td>ELEC 438</td>
<td>WIRELESS NETWORKING FOR UNDER-RESOURCED URBAN COMMUNITIES</td>
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<tr>
<td>ELEC 439</td>
<td>DATA SCIENCE AND DYNAMICAL SYSTEMS</td>
<td></td>
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</tbody>
</table>

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

Select 1 course from any Area of Specialization (including Data Science/Systems)

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)

Select a minimum of 2 from the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>ELEC 380 / BIOE 380 / NEUR 383</td>
<td>INTRODUCTION TO NEUROENGINEERING: MEASURING AND MANIPULATING</td>
<td>6</td>
</tr>
<tr>
<td>ELEC 382 / NEUR 382</td>
<td>NEURAL ACTIVITY</td>
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<tr>
<td>ELEC 483</td>
<td>MACHINE LEARNING AND SIGNAL PROCESSING FOR NEURO ENGINEERING</td>
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<tr>
<td>ELEC 485 / BIOE 485 / COMP 485</td>
<td>FUNDAMENTALS OF MEDICAL IMAGING I</td>
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<tr>
<td>ELEC 486 / BIOE 486 / COMP 486</td>
<td>FUNDAMENTALS OF MEDICAL IMAGING II</td>
<td></td>
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<tr>
<td>ELEC 488 / CAAM 415 / NEUR 415</td>
<td>THEORETICAL NEUROSCIENCE: FROM CELLS TO LEARNING SYSTEMS</td>
<td></td>
</tr>
<tr>
<td>ELEC 489 / CAAM 416 / NEUR 416</td>
<td>NEURAL COMPUTATION</td>
<td></td>
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</tbody>
</table>

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

Select 1 course from any Area of Specialization (including Neuroengineering)

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:

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

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>ELEC 262</td>
<td>INTRODUCTION TO WAVES AND PHOTONICS</td>
<td>6</td>
</tr>
<tr>
<td>ELEC 306</td>
<td>APPLIED ELECTROMAGNETICS</td>
<td>3</td>
</tr>
<tr>
<td>or PHYS 302</td>
<td>INTERMEDIATE ELECTRODYNAMICS</td>
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</tr>
<tr>
<td>ELEC 361</td>
<td>QUANTUM MECHANICS FOR ENGINEERS</td>
<td>3</td>
</tr>
<tr>
<td>or PHYS 311</td>
<td>INTRODUCTION TO QUANTUM PHYSICS I</td>
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<tr>
<td>ELEC 365 / MSNE 365</td>
<td>NANOMATERIALS FOR ENERGY</td>
<td>3</td>
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<tr>
<td>ELEC 460</td>
<td>PHYSICS OF SENSOR MATERIALS AND NANOSENSOR TECHNOLOGY</td>
<td>3</td>
</tr>
<tr>
<td>or PHYS 412</td>
<td>SOLID STATE PHYSICS</td>
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<tr>
<td>ELEC 462</td>
<td>OPTOELECTRONIC DEVICES</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 416</td>
<td>COMPUTATIONAL PHYSICS</td>
<td>3</td>
</tr>
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</table>

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

Select 1 course from any Area of Specialization (including Photonics, Electronics, and Nano-devices) 3

Total Credit Hours 12

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 five faculty members who serve as major advisors.

Transfer Credit

For Rice University’s policy regarding transfer credit, see Transfer Credit (https://ga.rice.edu/undergraduate-students/academic-policies-procedures/transfer-credit/). Some departments and programs have additional restrictions on transfer credit. The Office of Academic Advising maintains the university's official list of transfer credit advisors on their website: https://oaa.rice.edu. 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 (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/university/). Some departments have department-specific Honors awards or designations.

Fifth-Year Master's Degree Option for Rice Undergraduate Students

Rice students have an option to pursue the Master of Electrical Engineering (MEE) degree by adding an additional fifth year to their four undergraduate years of science and engineering studies.

Advanced Rice undergraduate students in good academic standing may apply to the MEE 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 advisor and the MEE 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/).

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

(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.

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