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 course lists 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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<tbody>
<tr>
<td></td>
<td>Total Credit Hours Required for the Major in Electrical Engineering</td>
<td>63</td>
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<td>Total Credit Hours Required for the BA Degree with a Major in Electrical Engineering</td>
<td>120</td>
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Degree Requirements

<table>
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<tr>
<th>Code</th>
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<td>Core Requirements</td>
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<td>Mathematics and Science Courses</td>
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<tr>
<td>ELEC 261</td>
<td>INTRODUCTION TO PHYSICAL ELECTRONICS I</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>
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<tr>
<td>MATH 102</td>
<td>SINGLE VARIABLE CALCULUS II</td>
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</tr>
<tr>
<td>or MATH 106</td>
<td>AP/OTH CREDIT IN CALCULUS II</td>
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</tr>
<tr>
<td>MATH 212</td>
<td>MULTIVARIABLE CALCULUS</td>
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Bachelor of Arts (BA) Degree with a Major in Electrical Engineering

or MATH 221 HONORS CALCULUS III

Select 1 course 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 II
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 Area of Specialization below):

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

Total Credit Hours Required for the Major in Electrical 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 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)

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tr>
<td>COMP 321</td>
<td>INTRODUCTION TO COMPUTER SYSTEMS</td>
<td>6</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>
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<tr>
<td>ELEC 410 / COMP 436</td>
<td>SECURE AND CLOUD COMPUTING</td>
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<tr>
<td>ELEC 411</td>
<td>MICROWAVE ENGINEERING</td>
<td></td>
</tr>
<tr>
<td>ELEC 414</td>
<td>WIRELESS INTEGRATED CIRCUITS AND SYSTEMS</td>
<td></td>
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<tr>
<td>ELEC 421 / COMP 421</td>
<td>OPERATING SYSTEMS AND CONCURRENT PROGRAMMING</td>
<td></td>
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<tr>
<td>ELEC 422</td>
<td>VLSI SYSTEMS DESIGN</td>
<td></td>
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<tr>
<td>ELEC 423</td>
<td>DIGITAL INTEGRATED CIRCUITS</td>
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</tr>
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</table>
Bachelor of Arts (BA) Degree with a Major in Electrical Engineering

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>ELEC 424 / COMP 424</td>
<td>MOBILE AND EMBEDDED SYSTEM DESIGN AND APPLICATION</td>
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<tr>
<td>ELEC 425 / COMP 425</td>
<td>COMPUTER SYSTEMS ARCHITECTURE</td>
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<tr>
<td>ELEC 426</td>
<td>ADVANCED DIGITAL INTEGRATED CIRCUITS DESIGN</td>
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<tr>
<td>ELEC 429 / COMP 429</td>
<td>INTRODUCTION TO COMPUTER NETWORKS</td>
<td></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 437</td>
<td>INTRODUCTION TO COMMUNICATION NETWORKS</td>
<td></td>
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<tr>
<td>ELEC 442</td>
<td>INTRODUCTION TO ANALOG INTEGRATED CIRCUITS</td>
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<tr>
<td>ELEC 450 / COMP 450 / MECH 450</td>
<td>ALGORITHMIC ROBOTICS</td>
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</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

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 |
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<tbody>
<tr>
<td>COMP 330</td>
<td>TOOLS AND MODELS FOR DATA SCIENCE</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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<tr>
<td>ELEC 301</td>
<td>SIGNALS, SYSTEMS, AND LEARNING</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>
<td>ELEC 432</td>
<td>MOBILE BIO-BEHAVIORAL SENSING</td>
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<tr>
<td>ELEC 433</td>
<td>ARCHITECTURE FOR WIRELESS COMMUNICATIONS</td>
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<tr>
<td>ELEC 434</td>
<td>ADVANCED HIGH-SPEED SYSTEM DESIGN</td>
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<td>ELEC 435 / MECH 435</td>
<td>INTRODUCTION TO ENERGY-EFFICIENT MECHATRONICS</td>
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<td>ELEC 436 / MECH 420</td>
<td>FUNDAMENTALS OF CONTROL SYSTEMS</td>
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<td>ELEC 437</td>
<td>INTRODUCTION TO COMMUNICATION NETWORKS</td>
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<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>
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<tr>
<td>ELEC 447 / COMP 447</td>
<td>INTRODUCTION TO COMPUTER VISION</td>
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<td>ELEC 450 / COMP 450 / MECH 450</td>
<td>ALGORITHMIC ROBOTICS</td>
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<tr>
<td>MECH 488</td>
<td>DESIGN OF MECHATRONIC SYSTEMS</td>
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<tr>
<td>STAT 413</td>
<td>INTRODUCTION TO STATISTICAL MACHINE LEARNING</td>
<td></td>
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</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)

Code       | Title                                             | Credit Hours |
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<tr>
<td>ELEC 380 / BIOE 380 / NEUR 383</td>
<td>INTRODUCTION TO NEUROENGINEERING: MEASURING AND MANIPULATING NEURAL ACTIVITY</td>
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<tr>
<td>ELEC 382 / NEUR 382</td>
<td>INTRODUCTION TO COMPUTATIONAL NEUROSCIENCE</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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<td>ELEC 486 / BIOE 486 / COMP 486</td>
<td>FUNDAMENTALS OF MEDICAL IMAGING II</td>
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<tr>
<td>ELEC 487</td>
<td>IMAGING OPTICS</td>
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</tbody>
</table>

Select a minimum of 2 from the following:

Select a minimum of 2 from the following:
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.

**Program Restrictions and Exclusions**

Students pursuing the BA Degree with a Major in Electrical Engineering should be aware of the following program restriction:

- As noted in Majors, Minors, and Certificates (https://ga.rice.edu/undergraduate-students/academic-policies-procedures/transfer-credit/), under Declaring Majors, Minors and Certificates, students may not obtain both a BA and a BS in the same major. Students pursuing the BA Degree with a Major in Electrical Engineering may not additionally pursue the Bachelor of Science in Electrical Engineering (BSEE) Degree.

**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**

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.

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