

ELECTRICAL AND COMPUTER ENGINEERING

THE GEORGE R. BROWN SCHOOL OF ENGINEERING

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The Department of Electrical and Computer Engineering (ECE) strives to provide high-quality degree programs that emphasize fundamental principles, respond to the changing demands and opportunities of new technology, challenge the exceptional abilities of Rice students, and prepare students for roles of leadership in their chosen careers. Undergraduate and graduate programs in ECE offer concentrations in areas that include system and control theory, communications, computer systems, signal processing, and photonics and nanoengineering. The latest information on the department's faculty, research areas, and degree programs and requirements can be found on the ECE website: www.ece.rice.edu/.

UNDERGRADUATE DEGREE PROGRAMS

The department offers two undergraduate degrees: the bachelor of arts (BA) and the bachelor of science in electrical engineering (BSEE). The BA degree

provides a basic foundation in electrical and computer engineering that the student can build on to construct a custom program. Because of its flexibility and large number of free electives, the BA can be combined easily with courses from other departments to create an interdisciplinary program. This may be particularly appropriate for students planning further study in law, business, or medicine.

The BSEE degree is the usual degree taken by those students planning a career of engineering practice. It is accredited by the Accreditation Board for Engineering and Technology (ABET*), and can reduce the time required to become a licensed professional engineer. The program for the BSEE requires more hours and greater depth than the BA degree but still provides considerable flexibility.

Both degrees are organized around a core of required courses and a selection of elective courses from three specialization areas: computer engineering; photonics and nanoengineering; and systems: control, communication, and signal processing. Each student's program must contain a depth sequence in one area and courses from at least two areas to provide breadth. The specialization electives provide the flexibility to create a focus that crosses traditional areas. Because of the number of options, students should consult early with departmental advisors to plan a program that meets their needs.

BSEE Degree Requirements—See Graduation Requirements (Undergraduate Student section, pages 2–5) for general university requirements.

A BSEE program must have a total of at least 134 semester hours and include the following courses. A course can satisfy only one program requirement. Students who place out of required courses without transcript credit must substitute other approved courses in the same area. Current degree requirements and planning sheets can be found on the ECE website: www.ece.rice.edu.

Mathematics and Science Courses

CHEM 121 *General Chemistry*

ELEC 261 *Electronic Materials and Quantum Devices*

ELEC 303 *Random Signals*

MATH 101 *Single Variable Calculus I*

MATH 102 *Single Variable Calculus II*

MATH 212 *Multivariable Calculus*

MATH 355 *Linear Algebra or CAAM 335 Matrix Analysis*

PHYS 101 *Mechanics*

PHYS 102 *Electricity and Magnetism*

Additional approved mathematics and science courses to bring the total to 32 hours.

ECE Core Courses

ELEC 220 *Fundamentals of Computer Engineering*

ELEC 241 *Fundamentals of Electrical Engineering I*

ELEC 242 *Fundamentals of Electrical Engineering II*

ELEC 301 *Introduction to Signals*

ELEC 305 *Introduction to Physical Electronics*

ELEC 326 *Digital Logic Design*

Computation Course: One from

CAAM 210 *Introduction to Engineering Computation*

COMP 140 *Computational Thinking*

Design Courses

ELEC 394 *Professional Issues and Project Management for Electrical Engineers*

ELEC 494 *Senior Design*

Design Laboratory: One from

ELEC 327 *Implementation of Digital Systems*

ELEC 332 *Electronic Systems: Principles and Practice*

ELEC 364 *Photonic Measurements: Principles and Practice*

BSEE Specialization Area Courses

Upper-level ECE courses are organized into three specialization areas: computer engineering; photonics and nanoengineering; and systems: control, communication, and signal processing. The computer engineering area provides a broad background in computer systems engineering, including computer architecture, digital hardware engineering, software engineering, and computer systems performance analysis. The systems area focuses on wireless communication systems, digital signal processing, image processing, and networking. The photonics and nanoengineering area encompasses studies of electronic materials, including nanomaterials, semiconductor and optoelectronic devices, lasers and their applications.

For the BSEE Program, a minimum of six specialization area courses, including three or more in one area, and courses from at least two areas are required. Each course must be at least 3 semester hours. The department may add or delete courses from the areas, and graduate courses and equivalent courses from other departments may be used to satisfy area requirements with permission. Consult with advisors and the ECE website www.ece.rice.edu for the latest area courses. *NOTE: COMP 211 is recommended in addition for computer engineering. Graduate courses in the 500-level series often can count as specialization courses with advisor's approval.*

Computer engineering: ELEC 322, 327, 342, 421, 424, 425, and 429 and COMP 221 and 430

Photonics and nanoengineering: ELEC 262, 306, 342, 361, 364, and 462 and PHYS 302 and 311

Systems: Communications, control, networks and signal processing: ELEC 302, 306, 332, 381, 430, 431, 433, 434, 435, 436, 437, 438, 439, 446, 481, 482, 485, and 486

BSEE Design Requirement

All BSEE degree candidates must complete a design sequence of courses taken during the junior and senior years.

There are three related components to the BSEE Senior Design sequence: a design laboratory course, a seminar in professional issues and project management, and the actual design project. In the junior year, students choose one of the approved design laboratory courses, currently ELEC 327 *Implementation of Digital Systems*, ELEC 332 *Electronic Systems Principles and Practice*, or ELEC 364 *Photonic Measurements: Principles and Practice*. A seminar required to be taken in the spring of the junior year, ELEC 394 *Professional Issues and Project Management for Electrical Engineers*, provides instruction in professional engineering topics, and the nontechnical aspects of the design process, including ethics, design methodology, project planning, technical presentations, and documentation. *NOTE: The required design laboratory course does not count as specialization.*

Both semesters of the senior year are devoted to the team design project using the resources of the Oshman Engineering Design Kitchen through the ELEC 494 *Senior Design* course. In the fall semester of the senior year, students finalize their project topics in coordination with the faculty and begin the design project. In the spring semester, students continue in the laboratory to complete their design project. Several presentations and design contests within the ECE department and the School of Engineering occur in the spring in which to showcase the projects.

BSEE Unrestricted Electives

Additional courses to provide the BSEE minimum requirement of at least 134 semester hours.

BA Degree Requirements—See Graduation Requirements (Undergraduate Students section, pages 2–5) for general university requirements. A BA program must have a total of at least 121 semester hours and include the following courses. A course can satisfy only one program requirement, except for laboratory. Students who place out of required courses without transcript credit must substitute other approved courses in the same area. Current degree requirements and planning sheets may be found on the ECE website: www.ece.rice.edu.

Mathematics and Science Courses

ELEC 261 *Electronic Materials and Quantum Devices*

ELEC 303 *Random Signals* (Note: ELEC 303 is required for BA and must have instructor's approval)

MATH 101 *Single Variable Calculus I*

MATH 102 *Single Variable Calculus II*

MATH 212 *Multivariable Calculus*

MATH 355 *Linear Algebra* or CAAM 335 *Matrix Analysis*

PHYS 101 *Mechanics*

PHYS 102 *Electricity and Magnetism*

ECE Core Courses

ELEC 220 *Fundamentals of Computer Engineering*

ELEC 241 *Fundamentals of Electrical Engineering I*

ELEC 242 *Fundamentals of Electrical Engineering II*

BA Specialization Area Courses

For the BA Program, a minimum of four specialization area courses, including two or more in one area, and courses from at least two areas are required. Each course must be at least 3 semester hours. The department may add or delete courses from the areas, and graduate courses and equivalent courses from other departments may be used to satisfy area requirements with permission. Consult with department advisors and the ECE website www.ece.rice.edu for the latest area courses.

NOTE: Graduate courses in the 500-level series often can count as specialization courses with advisor's approval.

Computer engineering: ELEC 322, 327, 342, 421, 424, 425, and 429 and COMP 221 and 430

Photonics and nanoengineering: ELEC 262, 306, 342, 361, 364, and 462 and PHYS 302 and 311

ELEC 305 *Introduction to Physical Electronics*

ELEC 326 *Digital Logic Design*

Computation Course: One from

CAAM 210 *Introduction to Engineering Computation*

COMP 140 *Computational Thinking*

Laboratory: One from

ELEC 327 *Implementation of Digital Systems*

ELEC 332 *Electronic Systems: Principles and Practice*

ELEC 342 *Electronic Circuits*

ELEC 364 *Photonic Measurements: Principles and Practice*

ELEC 433 *Architectures for Wireless Communications*

ELEC 434 *Digital Signal Processing Laboratory*

Systems: Communications, control, networks and signal processing: ELEC 301, 302, 306, 332, 381, 430, 431, 433, 434, 435, 436, 437, 438, 439, 446, 481, 482, 485, and 486

BA Unrestricted Electives

Additional courses to provide the BA minimum requirement of at least 121 semester hours.

GRADUATE DEGREE PROGRAMS

The ECE department offers two graduate degree programs. The master of electrical engineering (MEE) degree is a course-based program designed to increase a student's mastery of advanced subjects; no thesis is required. The MEE prepares a student to succeed and advance rapidly in today's competitive technical marketplace. A joint MBA/MEE degree is offered in conjunction with the Jesse H. Jones Graduate School of Management. The doctor of philosophy (PhD) program prepares students for a research career in academia or industry. The PhD program consists of formal courses and original research conducted under the guidance of a faculty advisor, leading to a dissertation. Students in the PhD program complete a master of science (MS) degree as part of their program; the ECE department does not admit students for a terminal MS degree.

Information on admission to graduate programs is available from the ECE Graduate Committee and on the ECE website. Students must achieve at least a B (3.0) average in the courses counted toward a graduate degree. In addition, no course in which the student earned a grade lower than a C may count toward a graduate degree.

MEE Degree Requirements—Students are admitted to the MEE program in both fall and spring semesters. MEE students must prepare a degree plan and have it approved by their ECE faculty advisor. The plan must include at least 30 semester hours of courses, all at the 300 level and above. The program should include a major area of specialization (18 semester hours), a minor area (six semester hours), plus free electives. At least seven of the major and minor area courses must be at the 400 level and above, and at least four must be at the 500 level or above. ELEC 590 or ELEC 599 may not count as major area courses; no more than three semester hours can be transfer credit from another university, and at most one 1-hour seminar course may be included in the plan. A MEE degree planning form and current requirements may be found on the ECE website.

PhD Degree Requirements—Students are admitted to the PhD program only in the fall semester. ECE PhD students move through the program in stages, starting as first-year student, advancing to MS candidate, PhD-qualified student, and PhD candidate; each advancement requires the approval of the ECE graduate committee. Students entering with previous graduate work may follow a hybrid program developed in consultation with the faculty and the graduate committee. The first academic year concentrates on foundation coursework and developing a research area. Each student must successfully complete a project, ELEC 599, in his or her chosen area of research in lieu of an oral or written qualifying exam. In addition to enabling the faculty to evaluate the student's research potential, the project encourages timely completion of the MS degree. The student must complete a master's thesis and successfully defend it in an oral examination. Students who have already acquired a master's degree elsewhere must also complete the ELEC 599 project, after which acceptance of their previous master's degree will be determined by the Graduate Committee.

A candidate for the PhD degree must demonstrate independent, original research in electrical and computer engineering. After successfully presenting a PhD research proposal and completion of all coursework, a student is eligible for PhD candidacy. The student then engages in full-time research, culminating in the completion and public defense of the PhD dissertation. Details of the PhD program requirements, the phases of study, and a timetable may be found on the ECE website.

See ELEC in the Courses of Instruction section for course descriptions.