

ELECTRICAL AND COMPUTER ENGINEERING

Faculty: Professors: Lu (Chair), Malinowski, Shastry; Associate Professors: Imtiaz, Miah; Emeritus Professors: Anakwa, Schertz, Stewart; Emeritus Associate Professors: Huggins, Jetton; Emerits Staff: Mattus; Assistant Professor in Residence: Gutschlag (Emeritus)

The department offers undergraduate degree programs in Electrical Engineering (BSEE) (<https://catalog.bradley.edu/undergraduate/programs/electrical-engineering-major/>), Electrical Engineering with Computer option (BSEE) (<https://catalog.bradley.edu/undergraduate/programs/electrical-engineering-computer-option-concentration/>), and Robotics and Controls concentration (BSEE) (<https://catalog.bradley.edu/undergraduate/programs/electrical-engineering-robotics-controls-concentration/>), a minor in Electrical and Computer Engineering (<https://catalog.bradley.edu/undergraduate/programs/electrical-and-computer-engineering-minor/>), and an accelerated 4+1 program leading to a Master of Science in Electrical Engineering (BSEE/MSEE) (<https://catalog.bradley.edu/undergraduate/programs/bachelor-science-electrical-engineeringmaster-science-electrical-engineering-bseemsee-41-program/>).

Department Mission and Educational Objectives

Department Mission: the mission of the Electrical and Computer Engineering Department is to educate the next generation of electrical and computer engineers to meet the challenges of the future, and empower electrical engineering graduates for immediate and sustained success in their professional practice.

Program Educational Objectives: The ECE faculty recognize that there are a number of common elements inherent to the success in the profession, which include the following: ability to acquire, generate, and use new knowledge; ability to complete complex electrical engineering projects; critical thinking, experience, knowledge, skills, and capabilities relevant to profession. These elements required for success in the profession translate into these educational objectives of the program. It is the expectation of the ECE faculty that graduates of the EE program will attain the following goals within a few years of graduation,

1. Are applying their education to their professional work in the public or private sectors or obtaining an advanced degree in electrical engineering or related areas;
2. Are engaging in lifelong learning using their education as a foundation.
3. Are productive while demonstrating professional growth and assuming positions of increasing responsibility.

Student Outcomes

In order to meet these program educational objectives, students graduating from Bradley's electrical engineering program will attain the following outcomes.

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 function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

The goal of the ECE department is to provide the intellectual and physical learning environment in which students achieve these outcomes. The intellectual component of this environment is supplied by the ECE faculty members, in their roles as mentors, advisors, and engineering professionals, as well as by the curriculum they establish for the programs. The physical component consists of quality facilities equipped with state-of-art instrumentation, equipment, computers, and professional software.

Undergraduate Degree Programs

By providing intelligent devices, circuits, and systems, ECE has been the driving force behind most modern technological innovations used to address societal challenges, issues, and needs. The efficiency and ecological demands associated with virtually every product or system produced in the world today requires a significant ECE component. Bradley ECE graduates are now working in many different areas including robotics and controls, machine learning and artificial intelligence (AI), Internet of Things (IoT) and cybersecurity, embedded systems, software development, wireless communication, high performance computing, signal processing, power electronics and energy conversion systems, power systems, medical and healthcare technologies, transportation, and integrated electronics.

In this dynamic profession, the Bradley ECE faculty recognize that each student's career path is unique, depending upon the individual's ambitions and interests. By combining the focus on student-centric undergraduate education, depth of faculty expertise, small student-to-faculty ratio, and design projects, the ECE faculty can respond to the needs and interests of each ECE student. It takes special pride in the particularly close student-faculty relationships developed over the years.

The department offers the following programs:

- Electrical Engineering (<https://catalog.bradley.edu/undergraduate/programs/electrical-engineering-major/>) Major (<https://catalog.bradley.edu/undergraduate/programs/electrical-engineering-major/>)
- Electrical Engineering with Computer Option (<https://catalog.bradley.edu/undergraduate/programs/electrical-engineering-computer-option-concentration/>)
- Electrical Engineering with Robotics and Controls Concentration (<https://catalog.bradley.edu/undergraduate/programs/electrical-engineering-robotics-controls-concentration/>)

- Electrical Engineering Minor (<https://catalog.bradley.edu/undergraduate/programs/electrical-and-computer-engineering-minor/>)

In addition, for those students who are in our BSEE program, the department offers an accelerated 4+1 BSEE/MSEE program.

All ECE programs consist of several curricular components that give the student the opportunity to build a solid foundation of basic physical principles to obtain experience in design, and to acquire useful insight into the profession and practice of electrical engineering.

1. **Lecture sequence** consists mostly of required core courses through which the student learns about and acquires problem-solving and/or design skills in circuit analysis, digital design, programming in high- and low-level languages, electronics, microcontrollers, signals and systems, and electromagnetic fields.
2. **Laboratory and project design sequence:** Though many design techniques are taught in the lecture courses, the student learns the practice of electrical engineering design primarily through the laboratory and project sequence. Each year contains at least one design project experience. The lab courses integrate material from the lecture courses and are taught by experienced faculty members. The small student faculty ratio allows for close interactions between students and instructors. Furthermore, the laboratory facilities and equipment are modern and readily accessible. Many of the lecture courses and all of the lab courses require the use of computers as well as the oral and/or written presentation of technical material.

Several aspects of design are taught in the first year, sophomore, and junior labs (ECE 100 Introduction to Electrical and Computer Engineering, ECE 221 Circuits and Systems Laboratory, and ECE 322 Electronics and Interfacing Lab). The student's design experience in these courses includes synthesis to meet specifications, analysis, construction, testing, and evaluation with respect to specifications. Furthermore, the first year, sophomore, and junior design projects associated with these courses are particularly valuable and establish the foundation of the design project sequence. In addition to the implementation steps described above, the projects also require formulation of design problem statements and criteria, consideration of alternative solutions, and system descriptions.

The laboratory and project design sequence culminates with a yearlong senior capstone project (ECE 497 Capstone Project System Level Design, ECE 498 Senior Capstone Project I and ECE 499 Senior Capstone Project II). The capstone project is a major educational component of the program. It involves the student in design at or near the professional level and requires the formulation of design specifications, consideration of alternative solutions, feasibility considerations, time management, allocation of design responsibilities, and detailed system documentation.

The student builds on this capstone project experience in ECE 401 Undergraduate Design Seminar I and ECE 402 Undergraduate Design Seminar II during the senior year. In these courses, the student works on a multidisciplinary team to prepare a business plan delineating the development of a venture based on an electronic product. The student also explores other aspects of engineering and, through the process, gains a broader view of the engineering profession.

3. **Vertical Integrated Project(VIP) Course:**

The ECE 398 Vertical Integrated Project is introduced to extend project-based learning. Students are required to take ECE 398 Vertical Integrated Project at least for a semester before they take their senior capstone project. With this repeatable course, students can participate in the project course for up to 3 years until they get into their senior capstone design project. Students may begin taking ECE 398 Vertical Integrated Project courses as early as their first semester. Stackable ECE 398 Vertical Integrated Project hours can be counted towards Professional electives. Students have the opportunity to work on an interdisciplinary project in a multidisciplinary team of students, from various years, and backgrounds. It provides time and context to practice professional skills and gain deeper insights, make contributions to real-world projects early-on, experience different roles and build up leadership. It makes ambitious multi-year projects possible.

4. **Electrical and Computer Engineering (ECE) Electives:**

Through 15-hour ECE Elective courses (<https://catalog.bradley.edu/undergraduate/programs/electrical-engineering-major/>), the student can specialize in areas such as controls, communication, cyber physical and digital system, digital signal processing, electromechanical systems, embedded systems, mechatronics, power electronics and system, robotics, and wireless components and systems.

5. **Professional Electives:**

All ECE programs require the student to complete a 9-hour professional elective stem. This stem allows the student to take a coherent set of courses so as to enhance the student's competitiveness in the job market or better prepare for graduate or professional school. These 9-hour professional electives could be dual counted for the BSEE major program and the minor program at their choice. In another word, for students pursuing a minor program, they may use the 9-hour professional elective stem to take required courses from their minor program.

6. **Bradley Core Curriculum:** In addition to the technical part of the program described above, the student must also meet the Bradley Core Curriculum (BCC) requirements (see All-University Degree Requirements (<https://catalog.bradley.edu/undergraduate/academic-regulations/degree-requirements/>) in this catalog.) As part of the BCC requirements, the student gains effective communication skills via introductory and advanced English composition and a speech course. The BCC emphasizes eight "Areas of Inquiry" that will more deeply engage the student in the process of intellectual growth. The student chooses the required BCC courses from a list of approved courses.

A wide range of career opportunities are available to the electrical engineering graduate in many different technical areas and industries. For those who wish to continue their professional studies, details of the Master Science of Electrical Engineering (MSEE) program are given in the Bradley University Graduate Catalog.

Professional and Personal Growth

The electrical engineering lecture courses and lab/project sequence prepare students very well for success as design engineers in the electrical and computer engineering profession. The ECE faculty also urges students to participate in activities and take courses that promote professional growth. It is strongly recommended that students join the Bradley Student Branch of the Institute of Electrical and Electronics Engineers (IEEE). The IEEE is the world's leading professional association for the advancement of technology and promotes professional development through various activities. In addition, students are advised

to consider experiential education such as summer internships and co-op programs. Finally, students can choose their BCC courses and professional electives to put a distinctive stamp on their programs of study. For example, they can seek a minor appropriate to career goals or participate in a study abroad program. (Note that certain minors and study abroad program will add hours and/or time to the normal eight-semester program of study.)

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