

# Department of Electrical & Computer Engineering

---

**The baccalaureate program in electrical engineering is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone (410) 347-7700.**

**FACULTY** *Professors Anakwa, Schertz, Shastry, Stewart; Associate Professors Ahn, Dempsey, Huggins (chair), Irwin, Malinowski, V. Prasad; Instructors Gutschlag, Sanchez.*

The department offers degree programs in electrical engineering (B.S.E.E. and M.S.E.E.), and electrical engineering with computer option (B.S.E.E.). It takes special pride in the particularly close student-faculty relationships it has developed over the years. Entrance requirements can be obtained by contacting the chair of the ECE department.

## Educational Objectives and Department Mission

Society has been transformed dramatically by the widespread use of electrical and electronic devices and systems and it is certain that even more dramatic changes are in store. These changes are fast paced and are driven by electrical and computer engineers working in many different areas including bioengineering, communications, computers, controls, electronics, microprocessors, integrated circuits, signal and information processing, wireless components and systems, and software development. The engineering process is complex and practitioners perform many roles such as research, design, development, product application, manufacturing, and system integration as well as marketing, sales and management. Bradley electrical engineering graduates have been involved in all of these endeavors, and it is the goal of the Bradley ECE program to continue to educate the next generation of electrical and computer engineers to meet the challenges of the future.

In this dynamic profession, the Bradley ECE faculty recognize that each career path is unique, based on the individual's particular ambitions, capabilities and interests. By coupling the focus on undergraduate education and depth of faculty expertise with the small student-to-faculty ratio and design project sequence, the ECE faculty can respond to the needs and interest of each student in the electrical engineering program. However, the ECE faculty also recognize that there are common elements to success in the profession. These are the ability to acquire, generate, and use

new knowledge; the ability to complete complex electrical engineering projects; and the experience, knowledge, skills and capabilities to progress professionally. These common elements for success in the electrical engineering profession are the basis for the educational objectives of the program. These objectives are as follows.

1. Each graduate from the program will demonstrate the ability to acquire, apply, and synthesize new knowledge as required for success.
2. Each graduate from the program will be productive, demonstrate professional growth, and assume increasing responsibility or obtain an advanced degree in the first several years after graduating from the program.
3. A significant number of graduates will contribute to the profession or obtain leadership positions.

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

- i) A graduate from the program will demonstrate knowledge of the mathematical and scientific foundation of electrical engineering.
- ii) A graduate from the program will demonstrate knowledge of and the ability to apply techniques and technology of electrical engineering.
- iii) A graduate from the program will complete a design project sequence, culminating in a capstone project at or near the professional level.
- iv) A graduate from the program will demonstrate the ability to acquire new knowledge as needed for success in the electrical engineering profession.
- v) A graduate from the program will meet Bradley's general education requirements, which are based on the principles of liberal education.
- vi) A graduate from the program will have experience in communicating technical information and working on teams.
- vii) A graduate from the program will understand the importance of professional and ethical behavior.

It is the mission of the ECE Department to provide the intellectual and physical 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

## College of Engineering and Technology

programs. The physical component consists of quality facilities equipped with modern instrumentation, components, computers, and software.

### Curriculum

The electrical engineering program, including the computer option, consists of several curricular components that give the student the opportunity to build a solid foundation of basic physical principles and obtain experience in design as well as insight into the profession and practice of electrical engineering. The 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, programming in C++, analog and digital electronics, microprocessors, signals and systems, and electromagnetic fields. Furthermore, through elective courses in the last two semesters, the student can specialize in areas such as applied electromagnetics, communications, controls, digital signal processing, digital and computer systems, electromechanical systems, embedded systems, medical imaging, and wireless components and systems. For a student in the computer option, the electives must be in the digital area (see computer option in Programs of Study section.)

Though many design techniques are taught in the lecture courses, the student learns the practice of electrical engineering design primarily through the 15-hour laboratory and project sequence.

The lab courses integrate material from the lecture courses and are taught by experienced faculty members. In addition, small numbers of students allow for close interaction with the instructor. 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 sophomore and junior labs (EE 206, EE 331, and EE 332). The student's design experience in these courses includes synthesis to meet specifications, analysis, construction, testing, and evaluation with respect to specifications. Furthermore, the 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 the formulation of design problem statements and criteria, the consideration of alternative solutions, and system descriptions.

The design project sequence culminates in the fourth year with the electronic product design project and the senior capstone project. The electronic product design is completed in the first half of the fall semester in EE 450 (Electronic Product Design.) The student works with a partner to design and implement a microprocessor-based system meeting particular specifications and requiring hardware design, software development, and laboratory work. The student then

builds on this experience in EE 402 (Senior Design Seminar) during the spring semester. In this course, 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 in EE 402 and, through the process, gains a broader view of the engineering profession.

Work on the senior capstone project begins at the start of the fall semester and the primary deliverables for the semester are to:

- choose a senior project and ECE faculty advisor,
- develop a detailed functional description of the project,
- develop a detailed system block diagram of the project and description of its operation,
- initiate experimental work,
- present a proposal covering a design and an implementation plan for the project, and
- establish a web page for the project.

In addition to the effort on the capstone project, the seniors work on teams to review and analyze the deliverables for other senior projects. Lab work associated with the capstone senior project starts in the last half of the fall semester in EE 451 and is completed in EE 452 the following semester.

The senior 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. Project advising is done on a distributed basis with the student choosing his/her project advisor from among the members of the ECE faculty.

The electrical engineering program, including the computer option, also requires the student to complete a 12-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. For example, the student can use the professional electives to obtain business skills by taking courses offered by the Foster College of Business Administration. Also, no more than 6 hours of EE courses can be applied toward the 12 hours of the professional elective stem. Additional information is available in an advising handout. The student must work with an academic advisor to identify the courses he/she will use to satisfy the professional elective stem and fill out the *Professional Elective Approval Form*. This form must be signed by the ECE Chairman and the courses approved to fill the professional elective stem constitute a requirement for the BSEE degree for the student.

In addition to the technical part of the program described above, the student must also meet the University General Education requirements (see "Academic Regulations" in this catalog.) As part of the General Education

requirement, the student gains effective communication skills via introductory and advanced English composition and a speech course. The General Education requirements also provide the foundation for a liberal education, which helps the student understand and participate in society as a responsible human being. Courses include Western Civilization (CIV 100, CIV 101, or CIV 102), Introduction to Economics (ECO 100), as well as selections from non-western civilization, social forces, human values, and fine arts. For these last four categories, the student chooses from a list of approved courses.

A wide range of career opportunities is 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 M.S.E.E. 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 Electronic 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 the co-op program. Finally, students can choose their general education 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, 130-hour program of study.)

In addition to professional development, students are urged to participate in a variety of activities and organizations to enhance personal growth. Employers like individuals who are well rounded and can effectively interact with different people. Bradley offers a wide range of experiences and, in the past, electrical engineering students have participated in many activities and organization such as intramurals, service groups, sport clubs, study abroad, theatre, tutoring, various Bradley musical groups, and volunteer activities. A complete list of registered student organizations is listed in this catalog in the Student Activities section.

**Programs of Study**

**Electrical Engineering**

Credit in the following courses must be obtained to meet degree requirements in electrical engineering, leading to the Bachelor of Science in Electrical Engineering.

**Freshman Year**

*First Semester*

|   |       |
|---|-------|
| EE 101 Intro. Electrical Engineering .....  | 1     |
| EE 102 Computer and Programming in EE.....  | 2     |
| MTH 121 Calculus I.....   | 4     |
| CHM 110 General Chemistry I.....  | 3     |
| CHM 111 General Chemistry I Lab .....   | 1     |
| ENG 101 English Composition.....  | 3     |
| Gen. Ed. – CIV 100, 101, or 102 Western Civilization<br>or ECO 100 Intro. to Economics..... | 3     |
|   | <hr/> |
|   | 17    |

*Second Semester*

|  |       |
|--|-------|
| COM 103 Oral Communication Process .....   | 3     |
| MTH 122 Calculus II.....   | 4     |
| PHY 110 University Physics I.....  | 4     |
| Gen. Ed. – Fine Arts .....   | 3     |
| Gen. Ed. – ECO 100 Intro. to Economics<br>or CIV 100, 101, or 102 Western Civilization ..... | 3     |
|  | <hr/> |
|  | 17    |

**Sophomore Year**

*First Semester*

|   |       |
|---|-------|
| EE 201 Digital Hardware Organization .....    | 2     |
| EE 205 Fundamentals of Circuit Analysis ..... | 4     |
| EE 221 Data Structures and OOP .....          | 3     |
| MTH 223 Calculus III .....                    | 4     |
| PHY 201 University Physics II.....            | 4     |
|   | <hr/> |
|   | 17    |

*Second Semester*

|   |       |
|---|-------|
| EE 206 Sophomore Laboratory .....                         | 2     |
| MTH 207 Elementary Linear Algebra with Applications ..... | 3     |
| MTH 224 Differential Equations .....                      | 4     |
| PHY 202 Applied Quantum Physics .....                     | 3     |
| Gen. Ed. - Social Forces.....                             | 3     |
|   | <hr/> |
|   | 15    |

**Junior Year**

*First Semester*

|   |       |
|---|-------|
| EE 301 Signals & Systems I .....                | 3     |
| EE 303 Principles of Electronics I.....         | 3     |
| EE 365 Microprocessors .....                    | 3     |
| EE 331 Junior Laboratory I.....                 | 3     |
| ENG 300, 301, 305, or 306 Advanced Writing..... | 3     |
|   | <hr/> |
|   | 15    |

15

## College of Engineering and Technology

### Second Semester

|  |    |
|--|----|
| EE 302 Signals and Systems II.....       | 3  |
| EE 304 Principles of Electronics II..... | 3  |
| EE 332 Junior Laboratory II .....        | 2  |
| EE 381 Electromagnetic Fields.....       | 3  |
| Approved Professional Elective.....      | 3  |
| Gen. Ed. – Human Values .....            | 3  |
| —  | —  |
|  | 17 |

### Senior Year

#### First Semester

|  |    |
|--|----|
| EE 450 Electronic Product Design ..... | 1  |
| EE 451 Senior Capstone Project I.....  | 3  |
| *Approved EE Electives .....           | 6  |
| Approved Professional Electives.....   | 6  |
| —                                      | —  |
|  | 16 |

#### Second Semester

|   |    |
|---|----|
| EE 402 Senior Design Seminar.....       | 1  |
| EE 452 Senior Capstone Project II.....  | 3  |
| *Approved EE Electives .....            | 6  |
| Approved Professional Elective.....     | 3  |
| Gen. Ed.—Non-Western Civilization ..... | 3  |
| —                                       | —  |
|   | 16 |

|             |     |
|-------------|-----|
| Total Hours | 130 |
|-------------|-----|

## Electrical Engineering with Computer Option

The demand for and continuing advances in computers and digital systems have created opportunities for professionals capable of not only designing computer systems but also applying these systems to a broad range of applications. Such fields as communications, automatic control, robotics, and signal processing have benefited greatly from developments in the digital area. Additionally, the development of modern computers requires a thorough understanding of the methodologies of software and hardware design.

The department offers an option to students desiring to specialize in this branch of electrical engineering and it requires students to take 23 semester hours of course work in the digital area. The required courses are digital hardware organization (EE 101 and EE 201), computational techniques for electrical engineering (EE 102), object-oriented programming (EE 221), and microprocessors (EE 365). Four EE electives must also be taken in the digital area which includes courses such as digital image processing (EE 533), digital signal processing (EE 534), neural networks (EE 535), logic design (EE 561), computer structures (EE 562), VLSI design (EE 563), microprocessor and PC architecture (EE 565), memory and interfacing (EE 566), and VHDL (EE 568). Also special topics courses are frequently offered that are EE digital electives. Finally, one of the EE digital electives must include coverage of computer architecture (EE 562, EE 565, or EE 566). See your advisor for a current list of approved EE digital electives.

Students in the option are also required to complete a 12-hour professional elective stem. As previously discussed, 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. No more than 6 hours of EE courses can be applied toward the 12 hours of the professional elective stem. Additional information is available in an advising handout. The student must work with an academic advisor to identify the courses he/she will use to satisfy the professional elective stem and fill out the *Professional Elective Approval Form*. This form must be signed by the ECE Chairman and the courses approved to fill the professional elective stem constitute a requirement for the BSEE degree for the student.

The computer option of electrical engineering differs from the regular program in that it requires four EE digital electives. It is also expected that the students in the option focus their project work in the digital area. Credit in the following courses must be obtained to meet degree requirements in the computer option of electrical engineering, leading to the Bachelor of Science in Electrical Engineering.

### Freshman Year

#### First Semester

|  |    |
|--|----|
| EE 101 Intro. Electrical Engineering .....                 | 1  |
| EE 102 Computational Techniques for EE .....               | 2  |
| MTH 121 Calculus I.....                                    | 4  |
| CHM 110 General Chemistry I.....                           | 3  |
| CHM 111 General Chemistry I Lab .....                      | 1  |
| ENG 101 English Composition.....                           | 3  |
| Gen. Ed.—CIV 100, 101, or 102 Western Civ. or <sup>1</sup> |    |
| ECO 100 Intro. to Economics.....                           | 3  |
| —  | —  |
|  | 17 |

#### Second Semester

|  |    |
|--|----|
| COM 103 Oral Communication Process .....           | 3  |
| MTH 122 Calculus II.....                           | 4  |
| PHY 110 University Physics I.....                  | 4  |
| Gen. Ed.—Fine Arts.....                            | 3  |
| Gen. Ed.—ECO 100 Intro. to Economics <sup>1</sup>  |    |
| or CIV 100, 101, or 102 Western Civilization ..... | 3  |
| —  | —  |
|  | 17 |

<sup>1</sup> General education courses must be selected from an approved list for each category. They may be taken in any sequence, not necessarily in the semester indicated. Other university general education requirements are satisfied by specific courses required above.

\*Four EE electives are required and one must be from the control stem (EE 430, 431, or 432). A list of approved courses is available from your academic advisor

\*Four EE digital electives are required and one must include coverage of computer architecture (EE 562, 565, or 566). A list of approved courses is available from your academic advisor.

**Sophomore Year**

*First Semester*

|   |    |
|---|----|
| EE 201 Digital Hardware Organization .....                | 2  |
| EE 205 Fundamentals of Circuit Analysis .....             | 4  |
| EE 221 Data Structures & Object-Orientated Programming .. | 3  |
| MTH 223 Calculus III .....                                | 4  |
| PHY 201 University Physics II.....                        | 4  |
|   | —  |
|   | 17 |

*Second Semester*

|   |    |
|---|----|
| EE 206 Sophomore Laboratory .....                         | 2  |
| MTH 207 Elementary Linear Algebra with Applications ..... | 3  |
| MTH 224 Differential Equations .....                      | 4  |
| PHY 202 Applied Quantum Physics .....                     | 3  |
| Gen. Ed. - Social Forces .....                            | 3  |
|   | —  |
|   | 15 |

**Junior Year**

*First Semester*

|   |    |
|---|----|
| EE 301 Signals & Systems I .....                | 3  |
| EE 303 Principles of Electronics I.....         | 3  |
| EE 365 Microprocessors .....                    | 3  |
| EE 331 Junior Laboratory I.....                 | 3  |
| ENG 300, 301, 305, or 306 Advanced Writing..... | 3  |
|   | —  |
|   | 15 |

*Second Semester*

|  |    |
|--|----|
| EE 302 Signals and Systems II.....       | 3  |
| EE 304 Principles of Electronics II..... | 3  |
| EE 332 Junior Laboratory II .....        | 2  |
| EE 381 Electromagnetic Fields.....       | 3  |
| Approved Professional Elective.....      | 3  |
| Gen. Ed. – Human Values .....            | 3  |
|  | —  |
|  | 17 |

**Senior Year**

*First Semester*

|                                       |    |
|---------------------------------------|----|
| EE 450 Electronic Product .....       | 1  |
| EE 451 Senior Capstone Project I..... | 3  |
| EE Digital Electives .....            | 6  |
| Approved Professional Electives.....  | 6  |
|                                       | —  |
|                                       | 16 |

*Second Semester*

|   |    |
|---|----|
| EE 402 Senior Design Seminar.....         | 1  |
| EE 452 Senior Capstone Project II.....    | 3  |
| EE Digital Electives .....                | 6  |
| Approved Professional Elective.....       | 3  |
| Gen. Ed. – Non-Western Civilization ..... | 3  |
|   | —  |
|   | 16 |

|             |     |
|-------------|-----|
| Total Hours | 130 |
|-------------|-----|

**Elective Descriptions**

**EE electives** are available in the areas of applied electromagnetics, communications, controls, digital signal processing, digital and computer systems, embedded systems, wireless components and systems and VLSI design. Approved EE electives include all 400- and 500-level EE courses except for EE 450, EE 451, and EE 452. Special topic courses are often available. See your advisor for the most current list of approved electives.

**EE digital electives** include:

- EE 533 Digital Image Processing
- EE 534 Digital Signal Processing
- EE 535 Engineering Applications of Neural Networks
- EE 561 Digital Systems: Logic Design
- EE 562 Digital Systems: Computer Structures
- EE 563 Advanced Electronics VLSI System Design
- EE 565 Digital Systems: Microprocessor & PC Architecture
- EE 566 Digital Systems: Memory and Interfacing
- EE 567 Advance VLSI
- EE 568 VHDL

Special Topics: Object Oriented Programming for Emb. Sys.

Special Topics: Web-Based Control

Special Topics: Digital Communication Networks

Special Topics: Design Using FPGAs

Other special topics courses may also be approved. See your advisor for the most current list.

**Professional electives** allow 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. They can also be applied toward a minor or second major. (Note that certain minors and majors will add hours and/or time to the normal 8-semester, 130-hour program of study.) However, no more than 6 hours of EE courses can be applied toward the 12 hours of the professional elective stem. Additional information is available in an advising handout. The student must work with an academic advisor to identify the courses he/she will use to satisfy the professional elective stem and fill out the *Professional Elective Approval Form*. This form must be signed by the ECE Chairman and the courses approved to fill the professional elective stem constitute a requirement for the BSEE degree for the student.

## Course Descriptions

**EE 101 Introductory Electrical Engineering 1 hr.**  
Introductory course focusing on logic design on the following topics: fundamentals of Boolean algebra and minimization techniques, combinational logic realizations of SOP and POS functions, multiple function synthesis using PLDs. In addition, students view various presentations of significant historical electrical engineers and topics.

**EE 102 Computers and Programming in Electrical Engineering 2 hrs.**  
Introduction to computers and operating systems; introduction to programming in a high level language appropriate to electrical engineering.

**EE 200 Engineering Co-op 0 hrs.**  
Full-time cooperative education assignment for electrical engineering students who alternate periods of full-time school with periods of full-time academic or career-related work in industry. Satisfactory/Unsatisfactory. Prerequisites: Sophomore standing in the College of Engineering and Technology, 2.0 overall grade point average at Bradley, approval of engineering and technology Co-op coordinator and Co-op faculty advisor.

**EE 201 Digital Hardware Organization 2 hrs.**  
Continuation of EE 101 focusing on the following topics: sequential circuit elements, flip flops, counters and shift-registers, clock generation circuits, algorithmic state machine method of designing sequential circuits, and VHDL design and synthesis. Prerequisite: EE 101.

**EE 205 Fundamentals of Circuit Analysis 4 hrs.**  
Analysis of electric circuits. Transient and steady-state phenomena. General analysis techniques: loop and nodal equations, network theorems, and matrix methods. Corequisites: MTH 223, PHY 201.

**EE 206 Sophomore Laboratory 2 hrs.**  
The student is introduced to experimental implementation of analysis techniques developed in EE 205 and EE 201/311 in order to verify circuit theory. In addition the student is introduced to the design of analog and digital circuitry focusing on top-down design methodology culminating in a student-chosen sequential digital design project. Prerequisites: EE 205, with a minimum grade of C. Corequisites: EE 201 or EE 311.

**EE 221 Data Structures and Object-Oriented Programming 3 hrs.**  
Introduction to data structures, object-oriented programming and abstract data types for programmers; data structures: arrays, vectors, lists, stacks, and queues; dynamic memory allocation; problems of efficiency and complexity of algorithms; searching and sorting; standard libraries dedicated to data structures and algorithms. Prerequisite: EE 102 or CS 106 with minimum grade of C.

**EE 301 Signals and Systems I 3 hrs.**  
Time and frequency domain analysis of linear systems. Lumped, distributed, time-varying, and discrete-time systems; network topology, state variable techniques; stability. Prerequisite: EE 206; EE or EEC major.

**EE 302 Signals and Systems II 3 hrs.**  
Sampling theorem, digital filters, probability theory, statistics, random variables, probability density functions, auto- and cross-correlation functions, power spectral density of random processes, analysis of linear time invariant systems with random inputs in time domain and in frequency domain, simulation of random experiments. Prerequisite: EE 301.

**EE 303 Principles of Electronics I 3 hrs.**  
Circuit analysis and design of macro-electronic circuits using operational amplifiers, diodes, and logic gates. Design process covering top-down methods and software simulation. Prerequisites: EE 206; EE or EEC major.

**EE 304 Principles of Electronics II 3 hrs.**  
Modeling of discrete bipolar and field effect transistors. Circuit analysis and design of macro-electronic circuits using discrete bipolar and field effect transistors. Design process covering top-down methods and software simulation. Prerequisite: EE 303 with minimum grade of C.

**EE 311 Digital Hardware Organization 3 hrs.**  
Introduction to logic design with focus on the following topics: fundamentals of Boolean algebra and minimization techniques, logic realizations of SOP and POS functions, multiple function synthesis using PLDs, combinational circuit design as it applies to computers, sequential circuit elements, flip flops, counters and shift-registers, clock generation circuits, algorithmic state machine method of designing sequential circuits, and VHDL design and synthesis. Not open to students with credit in EE 101 or EE 201.

**EE 327 Fundamentals of Electrical Engineering I 3 hrs.**  
Analysis of circuits; transient and steady state phenomena; general analysis techniques. Open to non-electrical engineering students only. Prerequisite: MTH 224.

**EE 328 Fundamentals of Electrical Engineering II 3 hrs.**  
Electronics; magnetic fields and circuits; magnetic coupling; energy conversion; electromechanics; rotating devices; digital techniques; control systems. Prerequisite: EE 327.

**EE 331 Junior Laboratory I 3 hrs.**  
The student performs top-down design and analysis of analog and digital electronic circuits. Integral to the design work is the use of software programs, and software simulation packages are used to verify their design. In addition, students develop hardware and software troubleshooting and testing skills. The design experience culminates in a multi-week task that requires the students to integrate information from EE 205, EE 206, and EE 303 to synthesize a multi-faceted, specification-driven project. Prerequisites: EE 206 with a minimum grade of C; EE or EEC major. Corequisites: EE 303, EE 365.

- EE 332 Junior Laboratory II** **2 hrs.**  
Junior Laboratory II is a continuation of EE 331. In addition to the usual design efforts, a directed, microcomputer-based, multi-week task challenges the students to use a microcontroller in a project. The students' experience culminates in a multi-week, student-chosen project that showcases their design abilities. Prerequisites: EE 301, EE 303, EE 331, EE 365 each with a minimum grade of C. Corequisites: EE 302, EE 304, EE 381.
- EE 365 Microprocessors** **3 hrs.**  
Design of microprocessor-based systems applied to real situations; control and data acquisition. Programming practice on commercial microprocessors. Prerequisite: EE 201 or EE 311; EE 221 with a minimum grade of C.
- EE 381 Electromagnetic Fields** **3 hrs.**  
Static electric fields; steady current; static magnetic fields of electric currents and ferromagnetic materials; charged particles in electric and magnetic fields. Prerequisite: EE 206.
- EE 402 Senior Design Seminar** **1 hr.**  
Students work in teams on a large-scale electrical engineering project, considering technical and non-technical factors in seeking an optimal solution. Prerequisite: senior standing in EE or ECE.
- EE 409, 410 Special Topics** **1-6 hrs. each**  
Topics of special interest which may vary each time course is offered. Topic stated in current Schedule of Classes. Prerequisite: consent of instructor.
- EE 430 Electromechanical Systems** **3 hrs.**  
Introduction to dynamic systems analysis with emphasis on mathematical modeling of sensors and electromechanical devices for control system applications. Fundamentals of power and industrial electronics. Prerequisites: EE 301, EE 303
- EE 431, 432 Control System Theory** **3 hrs. each**  
Linear, non-linear, and discrete automatic control systems; classical and modern control theory; computer-aided design and simulation. Prerequisite: senior standing in EE.
- EE 450 Electronic Product Design** **1 hr.**  
Students work in teams to design, implement, test, and demonstrate an electronic product. The electronic product has stringent specifications emulating design in industry. The design process requires extensive documentation and a formal report. Prerequisites: EE 332 with a minimum grade of C.
- EE 451 Senior Capstone Project I** **3 hrs.**  
First of two courses devoted to the Senior Design Project. The primary goal of this course is to have the student (and partner) choose a senior project and use a top-down design approach prior to implementation in senior lab. In addition, the student will serve on a Design Review Team (DRT) that will analyze other senior projects. Prerequisites: credit in EE 301, 302, 303, 304, 331, 332, 365, and 381 with a grade of C or better in six of the courses; credit or concurrent enrollment in EE 450 and two EE or technical electives.
- EE 452 Senior Capstone Project II** **3 hrs.**  
Second of two courses devoted to the Senior Design Project. Requires an oral project presentation and a written report. Prerequisites: EE 450, 451.
- EE 530 Random Variables and Signals** **3 hrs.**  
Correlation functions; power-density spectra; transmission of random signals through linear and non-linear systems; linear mean square estimation. Prerequisite: EE 302 or graduate standing.
- EE 531 Communication Theory** **3 hrs.**  
Optimum filtering; analogue and digital communication; detection theory. Prerequisite: EE 530.
- EE 532 Information Theory** **3 hrs.**  
Coding theory; memory and memoryless systems. Prerequisite: EE 530.
- EE 533 Digital Image Processing** **3 hrs.**  
Design of computer-based imaging systems; multidimensional filtering and quantization methods for image enhancement, restoration, and pattern recognition. Prerequisite: EE 302 or MTH 325.
- EE 534 Digital Signal Processing** **3 hrs.**  
Representation and analysis of discrete time signals and systems. Finite and infinite impulse response filter design; computer-aided-design; Fast Fourier Transform; implementation of digital filters. Prerequisite: EE 302.
- EE 535 Engineering Applications of Neural Networks** **3 hrs.**  
Provides a working knowledge of the theory, design, and engineering applications of artificial neural networks. Emphasis will be directed to low-level implementation such as embedded microcontrollers and integrated circuits. Specific architectures such as correlation matrix memory, perceptron, adaline, multilayer networks, radial-basis function networks, and Hopfield networks will be examined as well as their corresponding learning rules. Prerequisite: EE 302 or graduate standing.
- EE 540 Dynamic Systems Analysis** **3 hrs.**  
Advanced techniques for analysis of electrical, mechanical and electromechanical systems. State function concepts are emphasized with applications for determining state equations, system stability, and control. Prerequisite: EE 302 or graduate standing.
- EE 550 Electromagnetic Theory** **3 hrs.**  
Time-varying electric and magnetic fields; Maxwell's equations; plane waves in conducting and dielectric media; transmission lines; wave guides; antennas. Prerequisite: EE 381.
- EE 551 Radio Frequency Circuits and Systems** **3 hrs.**  
Review of transmission lines, impedance matching and transformations, S-parameters, passive R.F. junctions, R.F. amplifier design, R.F. systems, and front end design. Prerequisites: EE 205, 206.

## College of Engineering and Technology

**EE 555 Optical Fiber Communication 3 hrs.**  
EM wave propagation in silica glass and step index optical fibers, LP modes, multimode and singlemode fibers, optical transmitters and receivers, design of optical fiber communication systems meeting industry standards. Prerequisite: EE 381 or consent of instructor.

**EE 561 Digital Systems: Logic Design 3 hrs.**  
Boolean algebra; logical design; storing and switching phenomena. Prerequisite: EE 304 or graduate standing.

**EE 562 Digital Systems: Computer Structures 3 hrs.**  
Use of hardware programming language to design a small computer or other digital system: busing; control units; interfacing; transfer design. Prerequisite: EE 201.

**EE 563 Advanced Electronics—VLSI System Design 3 hrs.**  
Design and implementation of very-large-scale-integrated systems (VLSI). Integrated circuit devices, subsystems, and architecture. Computer-aided-design (CAD) and design testing. Prerequisite: EE 304 or graduate standing.

**EE 565 Digital Systems: Microprocessor and PC Architecture 3 hrs.**  
Architecture of PC-compatible computers; 32-bit processor architecture and assembly language programming; standard buses. Design of peripheral cards to interface with the standard PC bus architectures. Prerequisites: EE 365 or consent of instructor.

**EE 566 Digital Systems: Memory & Interfacing 3 hrs.**  
Design of single-board computers using 32-bit processors; processor architecture and assembly language programming. Introduction to RISC processors. Prerequisites: EE 365 or consent of instructor.

**EE 567 Advanced VLSI Design 3 hrs.**  
Addresses the testability of integrated systems, using very large scale integration or VLSI, which includes topics on devices, circuits, and digital subsystems in CMOS technology. Includes the concept and methodology for the design for testability of digital integrated systems. Prerequisite: EE 563

**EE 568 VHDL: Digital System Design 3 hrs.**  
A structured guide to the modeling of the design of digital systems, using VHDL, a hardware description language. VHDL is designed to fill a number of needs in the design process. It allows description of the structure of a system, and the specification of the function using familiar programming language forms. As a result it allows the design of a system to be simulated and synthesized.

**EE 575 Power Systems I 3 hrs. each**  
Analysis of electric power systems: fault studies; load flow; economic loading; stability; relaying; high voltage DC transmission; lightning and switching transients. Prerequisite: senior or graduate standing in EE.

**EE 582 Medical Imaging 3 hrs.**  
Introduction to the common methods and devices employed for medical imaging, including conventional x-ray imaging, x-ray computed tomography (CT), nuclear medicine (single photon planar imaging), single photon emission computed tomography (SPECT), and positron emission tomography (PET), magnetic resonance imaging (MRI), and ultra-sound imaging. The physics and design of systems, typical clinical applications, medical image processing, and tomographic reconstruction. Cross-listed as ME 582. Prerequisites: senior standing in engineering or consent of instructor.

## Electrical Engineering Technology

**EET 320 Electricity and Power 3 hrs.**  
Fundamentals of direct current and alternating circuits, transformers, rotating machinery, electrical and electronic control, and electrical energy. Not open to EE majors. Prerequisites: IMT 214; PHY 108 or equivalent.