Electrical and Computer Engineering

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Studies are designed to give the broad background necessary to apply electrical and computer engineering principles and methods to solve problems in an ever increasing range of applications. During the first two years, students receive intensive instruction in mathematics and basic physical sciences as well as fundamental principles and techniques of engineering. Students are introduced to the basic tools and problem solving techniques they will use throughout their career. The final two years are spent in a laboratory intensive environment. In the third year, students begin to apply their knowledge solving discipline-specific engineering problems. Project based courses begin to develop the ability to apply knowledge in open-ended problems. In the fourth year, more focused courses cover a broad spectrum of electrical and computer engineering topics. A completely open-ended design experience, where students can exercise creativity solving current engineering problems, spans the senior year. Designing, building, testing, and evaluating projects in such application areas as instrumentation and data acquisition, computer network control, SCADA systems security, robotics, wireless communication, and machinery controls is typical of this experience. Constraints such as economics, safety, reliability, aesthetics, ethics, and social impact are considered. This experience builds upon the fundamental concepts of mathematics, basic sciences, the humanities and social sciences, engineering topics, and communication skills developed earlier in the undergraduate experience. The design team experience allows close coordination with an individual faculty member. The scope of the project is designed to match the requirements of practice within the electrical and computer engineering discipline.

Mission:

Prepare students for the profession of Electrical and Computer Engineering to:

- Solve problems of substance through the application of fundamental principles, disciplined practices and modern method
- Instill the humility of contribution to ventures larger than themselves, and the generosity of their spirit in pursuit of such ventures
- Inspire an ethic of service to all mankind in the context of a global community.
- Instill a lifelong thirst for the knowledge of their craft.

The graduates of the Electrical and Computer Engineering programs will:

- Contribute to the engineering profession through the application of the requisite knowledge of engineering fundamentals, mathematics, science, and modern tools to conceive and implement solutions for problems in the electrical and computer engineering field.
- Effectively communicate the results of their work.
- Work professionally in team environments to design electrical/ computer systems.

- Maintain a positive outlook on professional life, and recognize the need for professionals and citizens in an evolving global society to pursue a course of life-long learning and continued professional development.
- Demonstrate initiative and perform leadership roles in an ethical manner.
- Perceive the impact on society of their professional decisions.

Outcomes:

Students in the Electrical and Computer Engineering programs will demonstrate an ability to:

- Apply knowledge of advanced mathematics, chemistry, physics, and engineering.
- Identify, formulate, and solve electrical engineering problems.
- Design and conduct experiments, as well as to analyze and interpret data.
- Apply the techniques, skills, and modern engineering test equipment and software applications necessary for engineering practice.
- Communicate effectively through written and verbal means.
- Contribute to multidisciplinary / multicultural teams.
- Recognize the need to engage in life-long learning.
- Demonstrate the leadership competencies of self-awareness, self-management, social-awareness, and relationship management.
- Demonstrate an understanding of professional and ethical responsibility.
- Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- Appreciate the impact of engineering solutions in a global, economic, environmental, and societal context.
- Demonstrate knowledge of contemporary issues.

Careers for this Major:

- Military
- Civilian professions
- Graduate school

Accreditation:

The Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012. Telephone: (410) 347-7700.

B.S. in Electrical and Computer Engineering - Curriculum Map

Freshman			
Fall	**Credits**	**Spring**	**Credits**
CH 103 General Chemistry I (General Education Lab Science)	4	EE 200 Engineering Programming	3
EG 109 Introduction to Engineering I	3	EG 110 Introduction to Engineering II	3
EN 101 Composition and Literature I	3	EN 102 Composition and Literature II	3
MA 121 Calculus I	4	MA 122 Calculus II (General Education Math)	4
		General Education History[1]	3
	14		**16**
Sophomore			
Fall	**Credits**	**Spring**	**Credits**
EE 204 Electrical Circuits I	3	EE 356 Electrical Circuits II	3
EE 215 Fundamentals of Digital Design	4	EG 206 Thermodynamics I	3
MA 223 Calculus III (General Education Math)	4	MA 224 Differential Equations	4
PS 211 University Physics I (General Education Lab Science)	4	PS 212 University Physics II	4
General Education Literature[1]	3		
	18		**14**
Junior			
Fall	**Credits**	**Spring**	**Credits**
EE 321 Embedded Systems	4	EE 303 Electromagnetic Field Theory I	3
EE 350 Linear Systems	3	EE 325 Computer Architecture and Operating Systems	3
EE 357 Electronics I	3	EE 366 Electronics II	4
EE 359 Electrical Engineering Laboratory	1	EE 373 Electrical Energy Conversion	4
MA 306 Discrete Mathematics	3	EN 204 Professional and Technical Writing	3
General Education Arts & Humanities[1]	3		
	17		**17**
Senior			
Fall	**Credits**	**Spring**	**Credits**
EE 491 Electrical System Design I	3	EE 411 Infrastructure Control Systems	4
EE 478 Control Systems	3	EE 459 Power Systems Analysis	3
MA 311 Statistical Methodology	3	EE 486 Digital Signal Processing	3
EE 463 Communication Systems	4	EE 487 Digital Signal Processing Lab	1
EG 450 Professional Issues	3	EE 494 Electrical System Design II	3
		General Education Social Science	3
	16		**17**
Total Credits: 129			

[1] General education requirements of History, Arts & Humanities, and Social Science can be completed in any of the three terms indicated; all three requirements must be met. .

Courses

EE 200 Engineering Programming 3 Credits
Introduction to a high level programming language such as C/C++. Topics include structure and organization of a computer program, variables and basic data types, flow of control, functions, file I/O, arrays and strings, computer memory, CPU and pointers, user defined structures, computer algortithms, modular design and documentation. Introduction to object oriented programming concepts. This course is offered once a year.

EE 204 Electrical Circuits I 3 Credits
A study of principles and methods of analysis of electric circuits with both direct and time varying sources in the steady state. KCL, KVL, mesh and nodal techniques. Network theorems are developed and applied to the analysis of networks. Energy storage elements. First order and second order circuits with forced and natural responses. Sinusoidal analysis, complex numbers, phasor diagrams. Power; average effective, and complex power in single phase systems. Classroom: 3 hours. Corequisite: MA 122.

EE 215 Fundamentals of Digital Design 4 Credits
An introductory course on formal design techniques for combinational and sequential logic circuits. Topics include combinational logic networks, minimization techniques, registers, synchronous sequential neworks, and control units. Applications of the concept developed in the classroom will be implemented in the laboratory. Classroom 3 hours, laboratory 2 hours.

EE 240 Electrical Concepts and Applications 3 Credits
A course on the theory and application of electrical devices and circuits. Discussions include magnetic circuits, transformers, electric machines, diodes, bipolar transistors, and field effect transistors. Integrated circuits are introduced. Digital switching circuits are treated, including logic gates, flip-flops, and counters. Operational amplifiers and their major applications are studied. Offered to qualified students not majoring in Electrical Engineering. Classroom 2 hours, laboratory 3 hours. Prerequisite: EE 204.

EE 242 Digital Systems Design 4 Credits
Topics are hierarchical design methods, design and debugging of digital hardware, determination of circuit behavior, control and timing, machine organization, control unit implementation, and interface design. A hardware design language will be used and students will acquire design experience implementing digital hard ware. Classroom 3 hours, laboratory 2 hours. Prerequisite: EE 215.

EE 303 Electromagnetic Field Theory I 3 Credits
Maxwell's Equations are developed from the experimental laws of electric and magnetic fields. Topics involving electric fields include Gauss's Law, divergence, energy, potential, conductors, dielectrics, and capacitance. Topics involving magnetic fields include the Biot-Savart Law, Ampere's Law, magnetic forces, magnetic materials, and inductance. Maxwell's Equations are used to describe wave motion in free space and in dielectric media. Classroom 3 hours. Prerequisites: MA 223, EE 204.

EE 315 Electrical Energy Systems 3 Credits
A course on the design and implementation of electrical energy systems. Topics include thermal, wind, solar, and hydro renewable electrical energy facilities, electric transmission and distribution systems, and electrical substations. Introductory topics include basic circuit analysis, transformers, motors and drive systems, and instrumentation. Includes hands-on demonstrations and experiments. Offered to qualified students not majoring in Electrical Engineering. Classroom 3 hours. Prerequisite: MA 122.

EE 321 Embedded Systems 4 Credits
The use of computing devices in embedded applications is introduced. Computer organization topics include the arithmetic logic unit, timing and control, memory, serial and parallel I/O ports, and the bus system. Programs are written and run in assembly language and higher-level languages. Additional topics include peripheral interface control, interrupts, cross assembly and applications. Classroom 3 hours, laboratory 2 hours. Prerequisite: EG 110 or IS 130.

EE 323 Computer Architecture 3 Credits
Compare different machine architectures – analyze machine performance relationships, do computer classifications, and compare different computer description languages. Consider alternative machine architectures and the software influences on computer design. Topics include digital logic, microarchitecture level, instruction set level, operating system level, assembly language level, parallel computer architectures. Examples are drawn from the Core i7, OMAP4430 and ATmega168, hardware as well as ARM and AVR instruction sets. Classroom 3 hours. Prerequiste: None.

EE 325 Computer Architecture and Operating Systems 3 Credits
Machine architecture - machine performance relationships, computer classification, and computer description languages. Consideration of alternative machine architectures. Software influences on computer design. Topics include digital logic, VLSI components, instruction sets, addressing schemes, memory hierarchy ache and virtual memories, integer and floating point arithmetic, control structures, , buses, RISC vs. CISC, multiprocessor and vector processing (pipelining) organizations. Examples are drawn from Pentium and Sparc microcomputers. The primary focus is on the attributes of a system visible to an assembly level programmer. This course also introduces the fundamentals of operating systems. Topics include concurrency, scheduling, memory and device management, file system structure, security, and system performance evaluation. Lecture 3 hours. Offered once per year.

EE 350 Linear Systems 3 Credits
This course provides the foundations of signal and system analysis. Linear, time-invariant, causal, and BIBO stable analog and digital systems are discussed. System input-output descriptions, convolution and the impulse response are covered. Additional topics include singularity functions, Fourier and Laplace circuit analysis, circuit transfer functions, Bode plots, ideal filters, and real filters including Butterworth, Chebyschev, and Elliptic. Discrete topics include the transform, difference equations, FIR and IIR filters, the bilinear transformation, the DTFT, the DFT, and the FFT. Classroom 3 hours. Prerequisite EE 356.

EE 356 Electrical Circuits II 3 Credits
This course is a continuation of Electric Circuits I (EE 204). The complete solutions of linear circuits by Laplace transforms are developed. The concepts of frequency response, resonance, network functions, two port networks including hybrid parameters are studied in depth. The concepts of transformers, power, coupled circuits, multi-phase circuits, and Fourier series are introduced. Computer-based circuit simulation is used throughout. Classroom 3 hours. Prerequisite: EE 204.

EE 357 Electronics I 3 Credits
The basic building blocks used in electronic engineering are studied. Diodes, bipolar transistors, and MOS transistors are modeled and then used to describe the operation of logic gates and amplifiers. Emphasis is placed on the operation and applications of standard integrated circuit chips. Classroom 3 hours. Prerequisite: EE 204.

EE 359 Electrical Engineering Laboratory 1 Credit
Implementation, analysis, and design of electric and electronic circuits involving resistors, inductors, capacitors, diodes, bipolar transistors, MOS transistors, operational amplifiers and filters. Study and practice in the use of standard electrical engineering laboratory instrumentation. Laboratory 2 hours. Prerequisite: EE 215; corequisites: EE 356, EE 357.

EE 366 Electronics II 4 Credits
This course is a continuation of Electronics I (EE 357). Analog and digital circuits are discussed. Analog topics include frequency response, real world applications of operational amplifiers, power amplifiers, filters, oscillators and A/D and D/A converters. Digital electronic building blocks are discussed, including flip-flops, counters, coding and decoding circuits and memory. Classroom 3 hours, laboratory 2 hours. Prerequisites: EE 357, EE 359.

EE 373 Electrical Energy Conversion 4 Credits
A course on principles of energy conversion in electromechanical devices and machines. Analysis of transformers, polyphase synchronous and asynchronous machines, single phase fractional horsepower machines, and DC machines. Classroom 3 hours, laboratory 2 hours. Prerequisite: EE 356; corequisite: MA 224.

EE 399 Electrical Engineering Topics 3 Credits

EE 411 Infrastructure Control Systems 4 Credits
This course deals with organization, operation and design of systems where the microprocessor controls special interfaces to non-standard devices and responds to external events in a timely fashion. Topics include interface of special purpose peripherals, data structures, control structures, program and data organization and real time operating systems. Application to communications, automated measurement, process and servo control are discussed. Classroom 3 hours, laboratory 2 hours.

EE 459 Power Systems Analysis 3 Credits
This course presents the foundations of electric power systems analysis after an initial review of single and three-phase power, complex power and transformers. Topics include per unit quantities, generators, transmission line models, transformer models, short-circuit analysis, load flow, and power systems economics. Lecture: 3 hours. Prerequisites: EE 356 and EE 373. Offered once per year.

EE 463 Communication Systems 4 Credits
Analog transmission of information signals by communication systems is analyzed. The component parts of transmitters and receivers including AM/FM modulators, filters, detectors and decoders are discussed. Mathematical concepts include the Fourier Series, Fourier Transform, dirac delta function and sinc function. Signal classification and digital modulation techniques such as ASK, FSK, PSK, PAM and QAM. Classroom 3 hours, laboratory 2 hours. Prerequisites: EE 356, EE 357, EE 359.

EE 468 Solid State Materials 3 Credits
Solid state materials, physics of electronic devices and integrated circuit design are studied. Topics include silicon crystal properties, diffusion, implantation, lithography and circuit fabrication. Device models are derived for junction diodes, bipolar and MOS transistors. Classroom 3 hours. Prerequisites: EE 303, EE 357.

EE 478 Control Systems 3 Credits
Analysis and design of continuous-time and discrete-time control systems using classical and state-space methods. Laplace transforms, transfer functions and block diagrams. Transient-response analysis, Routh-Hurwitz stability criterion, and steady-state error analysis. Analysis of control systems using the root-locus and frequency-response methods. Computer-aided design and analysis. Lecture: 3 hours. Prerequisites: EE 204 and MA 224. Offered once per year.

EE 486 Digital Signal Processing 3 Credits
An introductory level course that discusses the conversion of analog signals to discrete time signals. Emphasis will be on the processing of discrete signals using both time-domain and frequency-domain analysis. These techniques will be applied to the design of digital filters. Classroom 3 hours. Prerequisite: EE 350 or instructor's permission.

EE 487 Digital Signal Processing Lab 1 Credit
Implementation analysis and design of digital signal processing functions and techniques. Study and practice in the use of software and hardware platforms used for digital signal processing applications. Laboratory: 3 hours. Prerequisite: EE 350. Co-requisite: EE 486. This course is offered once a year.

EE 490 Advanced Topics 3 Credits
A course that provides advanced study in an area of the instructor's special competence. Courses that have been offered in the past include Power System Stability, Electrical Communications II, Microwave Theory and Techniques and Digital Systems. Offered as the occasion demands. Classroom 3 hours. Prerequisite: senior standing.

EE 491 Electrical System Design I 3 Credits
Introduction to design problems. Application of concepts of electrical engineering to a capstone design project. The first of a two-semester sequence, this course focuses on the problem statement, specification, preliminary design, design review and approval stages of the design processes, the design process involves exploring alternate solutions and design optimization and simulation. Economic constraints and human factors are considered in the design process. The course requires nine hours per week of directed reading, research and experimentation. Prerequisite: seventh semester standing and permission of the instructor.

EE 494 Electrical System Design II 3 Credits
This course is the second in the two-semester capstone design project sequence. It focuses on the final stages of the design process-finalized design, implementation and testing. A written project report and an oral presentation to students and faculty is required. Nine hours per week of directed readings, research, and experimentation. Prerequisite: EE 491.