Electrical and Computer Engineering

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Department Chair: Dr. Ravi Gorur

Mission

The mission of the Electrical and Computer Engineering Department is to develop and maintain high quality undergraduate and graduate programs in electrical, computer, and optical engineering to meet the needs of its constituents, and to participate in scholarly and productive research that contributes to the economic well being and quality of life for the residents of Huntsville, the State of Alabama, and the citizens of the United States of America.

Computer, Electrical & Optical Engineering Programs

The Department of Electrical and Computer Engineering (ECE) offers three undergraduate programs. The Computer Engineering program deals with the analysis, design and application of both computer hardware and software and computer systems through a blend of computer engineering, computer science, and electrical engineering courses. The Electrical Engineering program offers coursework enables students to pursue careers in any of the many diverse facets of electrical engineering such as electronics, networks, power systems, instrumentation, communications, and controls. The Optical Engineering program prepares students for careers in opto-electronics, including the design and application of systems for optical fiber communications, optical instrumentation, holography, image forming and processing, lasers and optical detection, as well as areas such as optical testing.

The Department of Computer, Electrical, and Optical Engineering offers the following degree programs:

- Bachelor of Science in Computer Engineering (http://catalog.uah.edu/archive/2015-2016/undergrad/colleges-departments/engineering/electrical-computer-engineering/computer-engineering-bscpe)
- Bachelor of Science in Electrical Engineering (http://catalog.uah.edu/archive/2015-2016/undergrad/colleges-departments/engineering/electrical-computer-engineering/electrical-engineering-bsee)
- Bachelor of Science in Optical Engineering (http://catalog.uah.edu/archive/2015-2016/undergrad/colleges-departments/engineering/electrical-computer-engineering/optical-engineering-bsoe)

Program Educational Objectives

Computer Engineering Alumni will be able to

- Demonstrate professional engineering competence by holding positions of increasing responsibility in industry, business, government and/or educational institutions
- Publish papers, reports, patents and/or technical presentations at local, national, international meetings or within their professional organization/company
- Continue to improve their technical skills, knowledge and understanding of computer engineering through continuing education, technological certification, pursuit of advanced degrees, and/or pursuit of a professional license

Electrical Engineering Alumni be able to

- Demonstrate professional engineering competence by holding positions of increasing responsibility in industry, business, government and/or educational institutions
- Publish papers, reports, patents and/or technical presentations at local, national, international meetings or within the professional organization/company that they are affiliated with
- Continue to improve their technical skills, knowledge and understanding through continuing education, pursuit of advanced degrees, and/or pursuit of professional license in their chosen profession

Optical Engineering Alumni will be able to

- Demonstrate professional engineering competence by holding positions of increasing responsibility in industry, business, government and/or educational institutions
- Publish papers, reports, patents and/or technical presentations at local, national, international meetings or within the professional organization/company that they are affiliated with
- Continue to improve their technical skills, knowledge and understanding through continuing education, pursuit of advanced degrees, and/or pursuit of a professional license in the OPE Discipline
ECE Majors in Electrical, Computer and Optical Engineering

- Computer Engineering, BScpE (http://catalog.uah.edu/archive/2015-2016/undergrad/colleges-departments/engineering/electrical-computer-engineering/computer-engineering-bscpe)
- Optical Engineering, BSOE (http://catalog.uah.edu/archive/2015-2016/undergrad/colleges-departments/engineering/electrical-computer-engineering/optical-engineering-bsoe)

CPE 112 - INTRO COMPUTER PROG FOR ENGR
Semester Hours: 3
Solution of engineering problems using a digital computer. Hardware structure of the stored program computer; programming in a high level language such as C or C++, engineering approximation of dynamic systems; top-down design and algorithms. Laboratory required. Prerequisites: MA 113, MA 115 or MA 171. Or Level 3 on Math Placement exam.

CPE 112L - LABORATORY
Semester Hours: 0
Students enrolling in CPE 112L must enroll concurrently in CPE 112.

CPE 212 - FUNDAMENTALS SOFTWARE ENGRG
Semester Hours: 3
Introduction to structured programming using C++. Search and sort algorithms. Introduction to data structures. Applications to engineering related problems. Prerequisite: CPE 112.

CPE 221 - COMPUTER ORGANIZATION
Semester Hours: 3
Functional organization of stored-program digital computers including number representation, assembly language programming, computer hardware, micro-operations, and control logic; microprocessor architecture. Same as EE 321. Prerequisite: EE 202.

CPE 322 - DIGITAL HDWR DESIGN FUNDMNTLS
Semester Hours: 3
Advanced concepts in Boolean algebra, use of hardware description languages as a practical means to implement hybrid sequential and combinational designs, digital logic simulation, rapid prototyping techniques, and design for testability concepts. Focuses on the actual design and implementation of sizeable digital design problems using representative Computer Aided Design (CAD) tools. Laboratory required. Prerequisite: CPE 221.

CPE 323 - INTRO TO EMBEDDED COMPUTER SYS
Semester Hours: 3
Hardware and software aspects in building embedded computer systems. Includes methods to evaluate design tradeoffs of different technology choices and technology capabilities and limitations of system components necessary to design and implement an embedded system and interface it to the outside world. Laboratory required. Prerequisite: CPE 221.

CPE 324 - ADV LOGIC DESIGN LABORATORY
Semester Hour: 1
Laboratory component of CPE 322 includes experimentation of fundamental concepts in digital logic design. Use of hardware description languages as a practical means to implement hybrid sequential and combinational digital designs, digital logic simulation, and rapid prototyping techniques. Prerequisite: CPE 322.

CPE 325 - EMBEDDED SYSTEMS LAB
Semester Hour: 1
Laboratory component of CPE 323 includes experience working with modern integrated software development environments and hardware platforms to solve practical problems.

CPE 353 - SOFTWARE DESIGN & ENGINEERING
Semester Hours: 3
Hands-on experience developing a substantial software project using software design tools such as SQL database system and the Qt graphical interface development environment. Introduction to a software process including requirements elicitation and testing techniques. Prerequisites CPE 212 and CS 317 (with concurrency).
CPE 381 - FUND SIGNALS & SYS FOR COMP EN
Semester Hours: 3

Introduction to the fundamental concepts in continuous and discrete signals and systems, and methods of signal and system analysis for computer engineers. No credit for EE or OPE students. Prerequisites: EE 213 and MA 238.

CPE 412 - INTRO TO PARALLEL PROGRAMMING
Semester Hours: 3

Introduction to processing in parallel and distributed computing environments. Design and analysis of parallel algorithms. Parallel programming environments: Pthreads for shared memory multiprocessor systems and PVM/MPI for distributed networked computers. (Same as CPE 512) Prerequisites: CPE 212 and CS 317.

CPE 423 - HARDWARE/SOFTWARE CO-DESIGN
Semester Hours: 3

Study and design of Systems On A Chip (SOC). Emphasis on Field Programmable realizations of SOC systems. (Same as CPE 523) Prerequisites: CPE 322 and CPE 426.

CPE 426 - VLSI HARDWARE DESC LANG/MODL/S
Semester Hours: 3

Modern VLSI design techniques and tools, such as silicon compliers, (V)HDL modeling languages, placement and routing tools, synthesis tools, and simulators. Students will design, simulate, and layout using both programmable logic families and ASIC libraries. (Same as CPE 526) Prerequisites: EE 202 and EE 315.

CPE 427 - VLSI DESIGN I
Semester Hours: 3

Introduction to VLSI design using CAD tools, CMOS logic, switch level modeling, circuit characterization, logic design in CMOS, systems design methods, test subsystem design, design examples, student design project. Laboratory required. (Same as EE 427 and CPE 527) Prerequisites: EE 202 and EE 315.

CPE 427L - LABORATORY
Semester Hours: 0

Students enrolling in CPE 427L must enroll concurrently in CPE 427.

CPE 428L - LABORATORY
Semester Hours: 0

Students enrolling in CPE 428L must enroll concurrently in CPE 428.

CPE 431 - INTRO COMPUTER ARCHITECTURE
Semester Hours: 3

Study of existing computer structures. Computer organization with emphasis on busing systems, storage systems, and instruction sets. Performance models and measures, pipelining, cache and virtual memory, introduction to parallel processing. (Same as CPE 531) Prerequisites: CPE 322 and CPE 323.

CPE 434 - OPERATING SYSTEMS
Semester Hours: 3

Study of the fundamentals of operating systems. Emphasis on processes, file management, interprocess communication, input-output, virtual memory, networking and security. Course must be taken concurrently with CPE 435. Prerequisites: CPE 221 and CPE 353.

CPE 435 - OPERATING SYSTEMS LABORATORY
Semester Hour: 1

Laboratory component of Operating Systems course. Experiments include implementation of device drivers, process and thread management, virtual memory management, dynamic memory management, file-systems. Students must take this course concurrently with CPE 434.

CPE 436 - INTERNALS OF MODERN OPER SYS
Semester Hours: 3

In-depth study of the design of modern operating systems such as Unix, NT and Linux. Emphasis on the internals and implementation details of interrupt processing, real-time clocks, device independent I/O, process management, memory management, file management. (Same as CPE 536) Prerequisite: CPE 434.
CPE 448 - INTRO TO COMPUTER NETWORKS  
Semester Hours: 3  
Introduction to the concepts and architecture of computer networks. Review of communication protocols using the Internet and the TCP/IP model as major examples. High-speed networking, congestion control, data compression, security and distributed processing. (Same as EE 468, CPE 548, EE 548) Prerequisites: CPE 112 and CPE 221.

CPE 449 - INTRO INFORM ASSURANCE ENGR  
Semester Hours: 3  
Introduction to cryptography and computer security through hardware and physical security to a knowledge of audit methods, security management, and public law. Includes skills such as business process analysis, software security, IAE evaluation, and IAE testing. (Same as CPE 549) Prerequisite: CPE 448.

CPE 449L - INTRO INFORM ASSURANCE ENG LAB  
Semester Hours: 0  
Students enrolling in CPE 449 must enroll concurrently in CPE 449L.

CPE 453 - SENIOR SOFTWARE STUDIO  
Semester Hours: 3  
Basic concepts of software engineering. Software project management including specifications, design, implementation, testing and documentation. Software design and management tools. Includes a multi-student software project. Prerequisites: CPE 353 and CS 317.

CPE 490 - SPECIAL TOPICS IN COMP ENGR  
Semester Hours: 1-3  
Topics will vary. The course may be repeated when topics vary. Consent of advisor.

CPE 490L - SPECIAL TOPICS LABORATORY  
Semester Hours: 0

CPE 495 - COMPUTER ENGINEERING DESIGN I  
Semester Hours: 3  
First course in the senior capstone design sequence. Application of techniques to the design of electronic systems that have digital hardware and software components. Application of engineering courses to solve real-world design problems. Must be taken in the same academic year as CPE 496. Prerequisites: CPE 323, CPE 353 and EE 315.

CPE 496 - COMPUTER ENGINEERING DESIGN II  
Semester Hours: 3  
Second course in the senior capstone design sequence. Must be taken in the same academic year as CPE 495. Prerequisite: CPE 495.

CPE 497 - COMPUTER ENGR INTERNSHIP  
Semester Hours: 1-3  
Active involvement in an engineering project in an engineering enterprise, professional organization, or government agency that has particular interest and relevance to the student. Junior/senior standing and approval from Engineering Faculty advisor.

CPE 499 - PROJECT IN COMPUTER ENGRG  
Semester Hours: 3  
Individual design project under the direction of an ECE faculty memeber. Senior standing and permission of instructor required.

EE 100 - FUND COMP ELEC & OPTICAL ENG  
Semester Hours: 3  
Introduction to computer, electrical, and optical engineering. Includes use of modern computational and design tools, ethics and fundamentals of voltage, current, power, Boolean algebra, binary arithmetic, logic gates, computer architecture and networks, and optics. Laboratory required. Prerequisites with concurrency: 100 level MA course or Placement 2 on Math Placement test.

EE 100L - LABORATORY  
Semester Hours: 0  
Students enrolling in EE 100L must enroll concurrently in EE 100.
EE 202 - INTRO DIGITAL LOGIC DSGN
Semester Hours: 3

Engineering approaches to design and analysis of digital logic circuits. Boolean algebra, Karnaugh maps, design using Hardware Description Languages, digital computer building blocks, standard logic (SSI MSI) vs. programmable logic (PLD, PGA), finite state machine design. Prerequisites: CPE 112 and EE 100.

EE 203 - DIGITAL LOGIC DESIGN LAB
Semester Hour: 1

Experiments in applying Boolean logic concepts to digital design. The course introduces students to small-scale prototyping and simulation techniques that are used to implement and evaluate digital combinational and sequential logic designs. Prerequisite: EE 202.

EE 212 - FUNDAMENTALS OF SOFTWARE ENGRG
Semester Hours: 4

Introduction to structured programming using C++. Search and sort algorithms. Introduction to data structures. Applications to engineering related problems.

EE 213 - ELECTRICAL CIRCUIT ANALYSIS I
Semester Hours: 3

Circuit elements, voltage-current characteristics for circuit elements; independent and dependent sources; Kirchhoff's laws and circuit equations. Source transformations; Thevenin's and Norton's theorems and superposition. Transient and forced response of first and second order circuits. Prerequisites: PH 112, MA 238 and either MA 244 or CE 244.

EE 223 - DES & MOD ELEC CIR & SYS
Semester Hours: 3

Electrical circuit and systems design and modeling. Includes using modern tools (i.e. Matlab and simulink) to design and model circuits. Introduces and reinforces engineering design principles.

EE 305A - SEMICONDUCTOR ENGINEERING/A&M
Semester Hours: 3

EE 307 - ELECTRICITY & MAGNETISM
Semester Hours: 3

Basic concepts of electrostatics, electric potential theory, electric fields and currents, fields of moving charge, magnetic fields, time varying electromagnetic fields, Maxwell's equations. Prerequisites: EE 213, MA 238 and MA 244.

EE 308 - ELECTROMAGNETIC ENGR
Semester Hours: 3

Review of Maxwell's equations, uniform plane waves in different types of media, reflection, and transmission of uniform plan waves, transmission lines, waveguides, and antennas. Prerequisites: EE 307.

EE 310 - SOLID STATE FUNDAMENTALS
Semester Hours: 3

Introduction to semiconductors including crystalline structure, energy bands and charge carriers, excess carriers, and thermal properties. Introduction to semiconductor junctions, the bipolar junction transistor, the MOSFET. Prerequisites: PH 113 and MA 238.

EE 313 - ELECTRICAL CIRCUIT ANALYSIS II
Semester Hours: 3

Use of phasors and impedance to analyze linear circuits at steady state. AC steady-state power for single and polyphase circuits. Properties and practical uses of resonant circuits, magnetically couple circuits, and transformers. Prerequisite: EE 213.

EE 315 - INTRO ELECTRONIC ANAL & DESIGN
Semester Hours: 3

Properties of diode, bipolar transistors, FET and operational amplifiers, analysis of DC and AC small-signal operation and circuit models for the design and analysis of electronic circuits. Prerequisite: EE 213.

EE 316 - ELE CIRCUITS & ELTRNC DSGN LAB
Semester Hour: 1

Electric circuit experiments including first and second order DC circuits, maximum power transfer, impedance measurements, transformers, measurement of electronic device characteristics and design and testing of operational amplifier circuits and single-stage amplifiers using MOSFETs and BJTs. Prerequisite: EE 315.
EE 382 - ANALY METH CONTINUOUS TIME SYS  
Semester Hours: 3  
Fourier Series, Fourier and Laplace transforms with emphasis on their physical interpretation. System representation by transfer functions and impulse response functions. Convolution integral. Transient response. Modeling and simulation. Prerequisites: EE 213, MA 238 and MA 244.

EE 383 - ANALY METH MULTIVARIABLE  
Semester Hours: 3  
Discrete time signals and systems, sampling techniques, Z and discrete Fourier transforms, multivariable systems. Introduction to digital signal processing. Prerequisite: EE 382.

EE 384 - DIG SIGNAL PROCESS LAB  
Semester Hour: 1  
Design and programming of digital processing algorithms such as DFT, FFT, IIR, and FIR filtering. Prerequisites: EE 383 or CPE 381.

EE 385 - RANDOM SIGNALS & NOISE  
Semester Hours: 3  
Random variables and probabilities description of signals. Introduction to random processes; autocorrelations, cross correlation, power spectral density. Noise analysis, thermal, shot, white, and colored. Response of electrical systems to random inputs. Prerequisites: EE 382 or CPE 381.

EE 386 - INTRO CONTROL/ROBOTIC SYS  
Semester Hours: 3  
Theory and analytical techniques for modeling, analysis and control of dynamical systems. Transfer functions, block-diagrams, frequency response, stability criteria, series and feedback controller design, and digital control. Introduction to the dynamic analysis and control of robotic systems. Prerequisites: EE 382 or CPE 381.

EE 401 - REAL-TIME DIGITAL SIGNAL PROCE  
Semester Hours: 3  
Introduction to digital signal processor architectures, applications, assembly language programming, and development tools for designing and implementing DSP systems. Prerequisites: EE 383 or CPE 381.

EE 410 - SELECTED TOPICS/ECE  
Semester Hours: 1-6  
Special topics in Electrical Engineering.

EE 410L - SELECTED TOPIC LABORATORY  
Semester Hours: 0

EE 411 - ELECTRIC POWER SYSTEM  
Semester Hours: 3  
Power generation, transmission and distribution. Three-phase circuits and per unit analysis, loadflow studies, symmetrical components, and power systems stability. Prerequisite: EE 313.

EE 412 - SR DSGN PROJ ELECT ENGR  
Semester Hours: 1-6  
Individual design project under the direction of an ECE faculty member. Senior standing and permission of instructor.

EE 414 - ANALOG & DIGITAL FILTER DESIGN  
Semester Hours: 3  
Analog filter design via Butterworth, Chebyshev, and elliptical approximation. Active filter design using operational amplifiers. Digital filter design methods. Prerequisites: EE 315 and EE 383.

EE 416 - ELECTRONICS II  
Semester Hours: 3  
Integrated circuits and micro-devices related to multistage amplifiers, oscillators, design specifications, operational amplifiers, and microunits. Computer simulation. Prerequisites: EE 313 and EE 315.

EE 422L - LABORATORY  
Semester Hours: 0  
Students enrolling in EE 422L must enroll concurrently in EE 422.
EE 423 - COMM SYS & SIMULATION W/ LAB
Semester Hours: 3

Modern test equipment and computer-based simulation methods are used to conduct experiments in the area of communication systems. Includes experiments to investigate signal modulation and demodulation, and filters. (Same as EE 523) Prerequisite: EE 426.

EE 424 - INTRO DATA COMMUN NETWORKS
Semester Hours: 3

Overview of historic development of modern telephone and data communication system, system architecture, standards, broadband switching systems, modems, protocols, personal and mobile communications, digital modulation techniques. (Same as EE 504) Prerequisites: EE 383 and EE 385.

EE 426 - COMMUNICATION THEORY
Semester Hours: 3

Signals and systems including the Hilbert transform, cross and auto correlation, power density spectrum, and the Wiener-Khintchine theorem. Filter design. Linear and nonlinear modulation and demodulation methods and circuits. Phase lock and frequency feedback techniques. (Same as EE 506). Prerequisites: EE 382 or CPE 381.

EE 427 - VLSI DESIGN I
Semester Hours: 3

Introduction to VLSI design using CAD tools, CMOS logic, switch level modeling, circuit characterization, logic design in CMOS, systems design methods, test subsystem design, design, examples, student design project. Laboratory required. (Same as EE 427 and CPE 527) Prerequisites: EE 202 and EE 315.

EE 427L - LABORATORY
Semester Hours: 0

Students enrolling in EE 427L must enroll concurrently in EE 427.

EE 428L - LABORATORY
Semester Hours: 0

Students enrolling in EE 428L must enroll concurrently in EE 428.

EE 436 - DIGITAL ELECTRONICS
Semester Hours: 3

Introduction to digital electronics. The Metal-Oxide-Semiconductor (MOS) transistor. MOS inverters and gate circuits. Bipolar junction transistors, ECL inverters, and bipolar digital gates. Semiconductor Memories. (Same as EE 516) Prerequisites: EE 202 and EE 315.

EE 437 - ELECTRONICS MANUF PROCESSES
Semester Hours: 3

Concepts, facilities, and technology utilized in the manufacture of electronic components and products. Includes printed wiring board fabrication and component mounting methods, automation, quality and reliability, product testing, and economic issues. Senior standing. (Same as ISE 437 and EE 537).

EE 451 - OPTOELECTRONICS
Semester Hours: 3

Basic concepts for understanding electro-optic devices and systems. Blackbody radiation; light sources; quantum and thermal detectors, noise in detectors; optical heterodyning; acousto-optic, magneto-optic, and electro-optic modulation. (Same as OPE 451) Prerequisites: EE 307 and EE 315.

EE 453 - LASER SYSTEMS
Semester Hours: 3

Spontaneous and stimulated emission, population inversion, optical resonators, three- and four-level systems, Q-switching and mode-locking, semiconductor lasers, integrated optic waveguides and couplers, scanning systems, high-power industrial application. Prerequisite: EE 307.

EE 454 - OPTICAL FIBER COMMUNICA
Semester Hours: 3

Introduction to optical fibers and their transmission characteristics, optical fiber measurements, sources and detectors, noise considerations for digital and analog communication, optical fiber systems. (Same as OPE 454) Prerequisites: (EE 307 or PH 432) and (EE 382 or CPE 381).
EE 486 - INTRO MODERN CONTROL SYSTEMS
Semester Hours: 3
Modern control theory including techniques for modeling, analysis and control of MIMO dynamic systems, state-variable feedback control design and state observers. Kalman-filtering. Fundamentals of nonlinear systems analysis and discrete-time system modeling, analysis and control. Prerequisites: EE 386.

EE 494 - EE DESIGN PROJECTS
Semester Hours: 3
Senior Capstone Course. Design, simulation, and construction of technical projects. Review of legal, economic, and ethical issues. Students work as individuals or teams to design, implement, test, and evaluate their projects. Oral presentation and written reports are required. Senior Standing. Prerequisites: ISE 321, EE 308, EE 310, EE 313, EE 315, CPE 323, EE 383, and EE 386.

EE 497 - ELEC ENGR INTERNSHIP
Semester Hours: 1-3
Active involvement in an engineering project in an engineering enterprise, professional organization, or government agency that has particular interest and relevance in the student. Junior/senior standing and Approval of Engineering Faculty Advisor.