ELECTRICAL AND COMPUTER ENGINEERING

Department Information

(251) 460-6117

Department of Electrical and Computer Engineering website
https://www.southalabama.edu/colleges/engineering/ece/index.html
(https://www.southalabama.edu/colleges/engineering/ece/)

Department of Electrical and Computer Engineering Administrative Staff

Title	Name
Chair	Hulya Kirkici
Professors	Gong, Kirkici, Woods
Associate Professors	El-Sharkh, Khan, Latif, Russ, Spencer, Wang
Assistant Professors	Shaban, Touma
Emeritus Professors	Bosarge, Gungor, Sakla
Part-time Instructors	Gholson, Sakla, Steadman, Thomas

The Department of Electrical and Computer Engineering offers the degrees of Bachelor of Science in Electrical Engineering (BSEE) and Bachelor of Science in Computer Engineering (BSCpE), both granted by the College of Engineering. The BSCpE program is administered by the ECE Department in collaboration with the School of Computing. The ECE Department also offers the degree of Master of Science in Electrical Engineering.

BSEE Program Educational Objectives

The program educational objectives (PEOs) of the Electrical Engineering B.S. degree program are to produce graduates who, during their first few years after graduation, will:

1. Achieve professional advancement with increasing responsibility, leadership, and mentorship.
2. Function effectively on multidisciplinary teams, and individually, to develop and apply electrical engineering solutions within a global, societal, and environmental context.
3. Communicate effectively and manage resources skillfully as members and leaders of their profession.
4. Advance professional competence through continuous learning such as studying for advanced degrees, professional registration, and leadership through ethical standards and professionalism.

BSEE Student Outcomes

By the time of graduation from the Electrical Engineering B.S. program, students should 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 BSEE curriculum is designed to ensure the attainment of the student outcomes.

The Bachelor of Science degree program in Electrical Engineering at the University of South Alabama is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org, (http://www.abet.org) under the General Criteria and the Program Criteria for Electrical, Computer, Communications, Telecommunication(s) and similarly named Engineering programs.

Electrical Engineering is among the fastest evolving disciplines in our technological society. Engineering developments in electrical technology have provided, in a substantial way, improvement in the standard of living of humanity. The domain of the electrical engineer reaches from massive electrical energy systems to microscopic integrated circuits; from life studies in bioengineering to satellite communications systems; and from the control of electromagnetic radiation to the control of information flow in this field.

The highly diverse and rapidly evolving characteristics of these fields require a thorough understanding of fundamentals as well as flexibility in the design of individualized programs of study.

Therefore, emphasis is placed on mathematics, physics, humanities, social sciences, basic sciences and engineering sciences during the first two years. Sufficient flexibility is provided at the senior level to allow a student, in consultation with an advisor, to prepare a specialized course of study in six main concentration areas from the broad field of electrical engineering: 1 – Control Systems, 2 – Communications and Networks, 3 – Digital Systems, 4 – Electromagnetics and Optics, 5 – Electronics, and 6 – Power Systems. In addition, means are provided, through the Electrical and Computer Engineering Design Laboratory, for a student to pursue a design topic outside of, but related to, the formal course work.

Students are required to take general education (GenEd) elective courses in four broad areas: (i) Literature, (ii) Humanities and Fine Arts, (iii) Natural Science and Mathematics and (iv) History, Social, and Behavioral Sciences. These courses provide breadth to the educational experience of Electrical Engineering and Computer Engineering students. They must be planned, in consultation with an academic advisor, to reflect a rationale appropriate to the educational objectives of the Departmental Programs, while conforming strictly to the requirements of the Articulation and General Studies Committee of the State of Alabama.

All students are required to successfully complete EH 101 and EH 102, English Composition I and II from area (i) (or acceptable alternatives), plus a minimum of 18 semester hours of general education courses from areas (ii) and (iv). In area (ii), Public Speaking (CA110) is required by all Electrical and Computer Engineering students. Of the two remaining courses, one course must be in literature and one course must be in

the fine arts. In area (iv), at least one course must be in history and at least one course must be from disciplines in the social and behavioral sciences.

Students in Electrical Engineering are required to become Student Members of the Institute of Electrical and Electronics Engineers (IEEE) by the time they enroll in EE 401 and EE 404. Through participation in the activities of such technical organizations students become aware of the activities of electrical and computer engineers in society. An excellent opportunity is provided to students for contact with practicing professionals as well as fellow students.

Any Electrical Engineering student interested in pursuing a career in medicine or bioengineering should consult with an advisor for an appropriate sequence of courses which will meet the minimum requirements for entry into a medical school or the necessary life sciences background to enter a graduate program in bioengineering.

The award of the BSEE degree will allow the graduate to enter the professions of electrical engineering directly, or to continue his/her education at graduate level.

BSCpE Program Educational Objectives

The program educational objectives (PEOs) of the Computer Engineering B.S. degree program are to produce graduates who, during their first few years after graduation, will:

1. Achieve professional advancement with increasing responsibility, leadership and mentorship.
2. Function effectively on multidisciplinary teams, and individually, to develop and apply computer engineering solutions within a global, societal, and environmental context.
3. Communicate effectively and manage resources skillfully as members and leaders of their profession.
4. Advance professional competence through continuous learning such studying for advanced degrees, professional registration, and leadership through ethical standards and professionalism.

BSCpE Student Outcomes

By the time of graduation from the Computer Engineering B.S. program, students will have demonstrated attainment of 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 BSCpE curriculum is designed to ensure the attainment of the student outcomes.

The Bachelor of Science degree program in Computer Engineering at the University of South Alabama is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org, (http://www.abet.org) under the General Criteria and the Program Criteria for Electrical, Computer, Communications, Telecommunication(s) and similarly named Engineering programs.

The Computer Engineering program is geared to students who are interested in the design of digital computing systems, integrating both hardware and software design components.

In the Computer Engineering degree program, sequences of courses are chosen from Electrical and Computer Engineering and from Computer Science that produce an in-depth treatment of digital logic and systems theory. In addition, means are provided, through the Electrical and Computer Engineering Design Laboratory, for a student to pursue a design topic outside of, but related to, the formal course work.

Students are required to take general education (GenEd) elective courses in four broad areas:

1. Literature,
2. Humanities and Fine Arts,
3. Natural Sciences and Mathematics and
4. History, Social, and Behavioral Sciences.

These courses provide breadth to the educational experience of Electrical Engineering and Computer Engineering students. They must be planned, in consultation with an academic advisor, to reflect a rationale appropriate to the educational objectives of the Departmental Programs, while conforming strictly to the requirements of the Articulation and General Studies Committee of the State of Alabama.

All students are required to successfully complete EH 101 and EH 102, English Composition I and II from area (1) (or acceptable alternatives), plus a minimum of 18 semester hours of general education courses from areas (2) and (4). In area (2), Public Speaking (CA 110) is required by all Electrical and Computer Engineering students. Of the two remaining courses, one course must be in literature and one course must be in the fine arts. In area (4), at least one course must be in history and at least one course must be from disciplines in the social and behavioral sciences.

Students in Computer Engineering are required to become members of either the Institute of Electrical and Electronics Engineers (IEEE) or the Association for Computing Machinery (ACM) by the time they enroll in EE 401 and EE 404. Through participation in the activities of such technical organizations students become aware of the activities of electrical and computer engineers in society. An excellent opportunity is provided to students for contact with practicing professionals as well as fellow students.

Any Computer Engineering student interested in pursuing a career in medicine or bioengineering should consult with an advisor for an appropriate sequence of courses which will meet the minimum requirements for entry into a medical school or the necessary life sciences background to enter a graduate program in bioengineering.

The award of the BSCpE degree will allow the graduate to enter the professions of electrical engineering or computer engineering directly, or to continue his/her education at the graduate level.

BSEE and BSCpE Accelerated Bachelor's to Master's (ABM) Degree Option

The USA Accelerated Bachelor's to Master's (ABM) programs in Electrical and Computer Engineering provide exceptional undergraduate students the opportunity to earn a bachelor's and a master's degree at an accelerated pace. ABM students may count up to 12 credit hours of graduate coursework towards either the undergraduate degrees in Electrical or Computer Engineering or the graduate degree in Electrical Engineering. ABM students typically complete the master's degree within one academic year after completing the undergraduate degree. See a departmental advisor for specific details.

Degrees, Programs, or Concentrations

- Computer Engineering (BS) (http://bulletin.southalabama.edu/programs-az/engineering/electrical-computer-engineering/computer-engineering-bs/)
- Electrical Engineering (BS) - General Track (http://bulletin.southalabama.edu/programs-az/engineering/electrical-computer-engineering/electrical-engineering-bs-general-track/)
- Electrical Engineering (BS) - Premed Track (http://bulletin.southalabama.edu/programs-az/engineering/electrical-computer-engineering/electrical-engineering-bs-premed-track/)
- Electrical Engineering (MS) (http://bulletin.southalabama.edu/programs-az/engineering/electrical-computer-engineering/electrical-engineering-ms/)

Courses

EE 220 Circuit Analysis I 3 cr
Resistive networks with independent and dependent sources: Ohm's law; Kirchhoff's law; nodal and loop analysis; network theorems; energy storage elements (capacitors and inductors); operational amplifiers; steady state AC analysis; and introduction to PSpice.
Prerequisite: MA 125 Minimum Grade of C and PH 201 Minimum Grade of C

EE 223 Network Analysis 3 cr
Transient analysis of RLC circuits; Three-phase systems; power-factor correction in three-phase power systems; magnetically coupled networks; Operational amplifiers; network frequency response functions and resonance; Fourier series.
Prerequisite: EE 220 Minimum Grade of C and PH 202 Minimum Grade of C and MA 227 (may be taken concurrently) Minimum Grade of C and MA 238 (may be taken concurrently) Minimum Grade of C

EE 227 Circuits and Devices Lab 1 cr
Introduction to electrical laboratory equipment and instrumentation; analog and digital meters, oscilloscopes, bridges, power supplies, function generators. Measurement of voltage, current and power in DC networks and in single-phase and three-phase AC networks. Verification of Kirchhoff's laws. Measurement of resistance, capacitance, and inductance. Corequisite: EE 223 and credit for or concurrent registration in EH102.
Prerequisite: EE 223 (may be taken concurrently) Minimum Grade of D and (EH 102 (may be taken concurrently) Minimum Grade of D or EH 105 Minimum Grade of D)

EE 263 Digital Logic Design 3 cr
Number systems, introduction to basic logic circuits, analysis and design of combinational and sequential logic circuits, k-map methods, finite state machines, multiplexers, decoders, encoders, adders, latches, flip-flops, registers, and counters.
Prerequisite: CPE 260 Minimum Grade of C

EE 264 Microprocessor Sys-Interfacing 3 cr
Small computer organization, assembly and machine level programming, microprocessor architectures and instruction sets, microprocessor and microcontroller system design, and microprocessor based peripheral interfacing.
Prerequisite: EE 263 Minimum Grade of C or CSC 228 Minimum Grade of C

EE 268 Digital Logic Design Lab 1 cr
A series of digital logic circuit experiments and simulations using TTL/CMOS integrated circuits designed to reinforce the material presented in EE 263. Design projects include standard SSI and MSI digital circuit based simulation and experiments.
Prerequisite: EE 263 Minimum Grade of C or CSC 228 Minimum Grade of C

EE 302 Computer Methods in EE - CpE 1 cr
Introduction to the use of computer softwares such as MATHCAD/MATLAB and PSPICE/ ELECTRONIC WORKBENCH for the analysis of engineering related problems and the solution of electric/ electronic circuits.
Prerequisite: EE 223 Minimum Grade of C and EE 263 Minimum Grade of C

EE 321 Signals, Systems & Transforms 3 cr
Modeling of analog and discrete-time signals and systems, time domain analysis, Fourier series, continuous and discrete time Fourier transforms and applications, sampling, z-transform, state variables, analysis of signals and systems and basic filter design, filter implementation using MatLab.
Prerequisite: EE 223 Minimum Grade of D and MA 238 Minimum Grade of C

EE 322 Prob, Rand Sigs & Stat Anlys 3 cr
Discrete and continuous probability distributions; random variables; Bernoulli trials; hypothesis testing; confidence intervals; Anova multiple comparisons; Bayes' theorem; estimation; sampling; random processes and random signals in linear systems. Probability applications in computer and electrical engineering.
Prerequisite: MA 238 Minimum Grade of C and EE 321 (may be taken concurrently) Minimum Grade of D

EE 328 Feedback Control Systems 3 cr
Review of the Laplace Transform. Transfer functions; block diagrams; signal-flow graphs and Mason's Gain Formula. Stability of feedback control systems; Routh-Hurwitz criterion; root-locus technique and the Nyquist criterion. Bode plots; gain and phase margins. PI, PD and PID controller design. Introduction to the use of Matlab for analysis and design.
Prerequisite: EE 321 Minimum Grade of D

EE 331 Physical Electronics 3 cr
Introduction to quantum concepts; particles in one dimensional potential well; tunneling. Silicon band structure, electrons and holes. Drift and diffusion current density; band bending; Einstein diffusion coefficient; recombination/generation. The pn junction; step and linear junctions; depletion layer. I-V characteristics of a pn junction and steady-state carrier concentrations at junctions. Bipolar junction transistor fundamentals; pnp and npn types; common emitter configuration, biasing and gain.
Prerequisite: MA 238 Minimum Grade of C and PH 202 Minimum Grade of C and CH 131 Minimum Grade of C

EE 334 Digital Electronics 3 cr
Review of semiconductor diodes and diode circuits; Introduction to digital electronics; Review of BJTs, operating characteristics and DC analysis, TTL logic gates; Field effect devices, operating characteristics and DC analysis; NMOS, PMOS, CMOS devices and logic circuits, transmission gates; Design considerations.
Prerequisite: EE 331 Minimum Grade of D

EE 354 Electromagnetics I 3 cr
Basic concepts of electrostatics, electric potential theory, electric fields and currents, fields of moving charge, Poisson's and Laplace's equations, magnetostatics, metallic conductors and dielectric materials, electric-scalar and magnetic-vector potentials and boundary conditions, general time varying fields and Maxwell's equations.
Prerequisite: (MA 237 Minimum Grade of C and MA 238 Minimum Grade of C and PH 202 Minimum Grade of C)

EE 355 Electromagnetics II 3 cr
Lumped versus distributed circuit components, capacitance, inductance and mutual inductance, uniform plane waves, power flow and skin effect, reflection, transmission and propagation of uniform plane waves through different media, wave polarization, transmission lines, waveguides, optical fiber, electromagnetic radiation and antennas, the Radar equation.
Prerequisite: EE 354 Minimum Grade of D

EE 356 Electromagnetics Laboratory 1 cr
Computer-aided and experimental field mapping; shielding techniques; field measurement of elementary radiating structures and waveguide circuits; terminal characteristics of klystrons and space wave propagation losses.
Prerequisite: EE 355 (may be taken concurrently) Minimum Grade of C

EE 368 Microprocessor Sys Interf Lab 1 cr
This Laboratory is designed to reinforce the material covered in EE 264 and to provide practical hands-on experience with microprocessor software, hardware and interfacing. Topics include integration of microprocessor software, hardware and peripheral devices; assembly level programming and hardware interfaces for control and instrumentation.
Prerequisite: EE 268 Minimum Grade of D and EE 264 (may be taken concurrently) Minimum Grade of D

EE 372 Introduction to Communications 3 cr
Introduction to communication systems; analog, digital, deterministic and stochastic messages; modulation; redundancy coding. Signal energy and power; correlation; orthogonal signal set and Fourier series. Fourier transforms; signal transmission through linear systems; ideal and practical filters; signal distortion; Parseval's theorem; essential bandwidth and energy and power spectral density. Amplitude modulation: DSB, SSB, AM, QAM and VSB; phase and frequency modulation and the basic design of a FM transmitter. Sampling theorem; pulse code modulation and differential pulse code modulation.
Prerequisite: EE 322 (may be taken concurrently) Minimum Grade of D and EE 321 Minimum Grade of D

EE 381 Electromech Energy Conversion 3 cr
Introduction to the principles of electromechanical energy conversion. Energy balance, force, and torque of electromagnetic systems; magnetic circuits and ferromagnetic losses; transformers and their connections; three-phase induction motors; synchronous generators and motors; non-salient machines. Parallel operation of synchronous generators. Dynamics of electric machines.
Prerequisite: EE 223 Minimum Grade of D

EE 385 Energy Conversion Lab 1 cr
Laboratory experiments based on: Faraday's Law and magnetic coupling; magnetic circuits; transformers (single and three phase) and their connections and tests. Three phase induction motors - tests and performance characteristics; synchronous generators and motors. Machine data acquisition methods and processing using a computer.
Prerequisite: (EE 381 Minimum Grade of D and EE 227 Minimum Grade of D)

EE 401 Intro Elec and CpE Design - W 1 cr
Specification of design criteria. Written and oral presentations of design proposals. Coverage of professional and contemporary issues and students are required to become members of the IEEE or ACM and attend two technical meetings of IEEE/ACM.
Prerequisite: CA 110 Minimum Grade of D and EE 321 Minimum Grade of D and EE 334 (may be taken concurrently) Minimum Grade of D and EE 368 (may be taken concurrently) Minimum Grade of D

EE 404 Electrical and Computer Engineering Design 3 cr
Implementation of design project from the field of Electrical or Computer Engineering in the broadest sense and under the guidance of a project director from the electrical and computer engineering faculty. Written and oral presentations of project proposals, interim and final reports. Students are required to be current members of the IEEE/ACM and attend two technical meetings.
Prerequisite: EE 328 Minimum Grade of D and EE 334 Minimum Grade of D and EE 368 Minimum Grade of D and EE 401 Minimum Grade of D

EE 422 Adv Feedback Control Systems 3 cr
Sensors, encoders and DC motors in control systems. The performance and design of feedback control systems. System bandwidth; Nichol's Chart and the stability of control systems with time delays. State variable analysis and design. This course is dually listed with an equivalent graduate level course (EE522) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 328 Minimum Grade of D

EE 423 Modern Control Theory 3 cr
Simulation and modeling; introduction to linear systems theory; concepts of controllability and observability; specifications; structures and limitations; review of classical design methods; state feedback design methods; multivariable control; robust stability and sampled data implementation. Introduction to the use of MATLAB for design. This course is dually listed with an equivalent graduate-level course (EE 523) and requires a minimum G.P.A of 2.75 or the instructor's permission for admission.
Prerequisite: EE 328 Minimum Grade of D

EE 424 Nonlinear Control Systems 3 cr
State space description; methods of linearization; isoclines; stability of nonlinear systems; Lyapunov's direct method; harmonic linearization; describing functions; dual input describing functions; Popov's method; circle criterion and computer aided analysis. This graduate-level course is dually listed with an equivalent course (EE524) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 328 Minimum Grade of D

EE 427 Digital Control Systems 3 cr
State space and transfer function description of discrete-time systems; solution of discrete state equation; discrete-time model of analog plants; frequency domain analysis; design of discrete state-feedback regulators; observers and tracking systems. This course is dually listed with an equivalent graduate-level course (EE 527) and requires a minimum G.P.A. of 2.75 or the instructors permission for admission.
Prerequisite: EE 328 Minimum Grade of D

EE 430 Power Semiconductor Dev 3 cr
Characteristics of power devices; physics of transport phenomena; breakdown voltage; power rectifiers; bipolar transistors; power MOSFET; insulated-gate bipolar transistor and MOS-gated thyristors.
Prerequisite: EE 331 Minimum Grade of D

EE 431 Analog Electronics 3 cr
Small signal model of diodes, applications, advanced op-amp applications, principle of operation of FETs, small signal model of FET and basic FET amplifiers, small signal model of BJT and basic BJT amplifiers, differential and multistage amplifiers, Miller?s Theorem, Nyquist stability criterion and frequency response, internal circuit of typical op-amp.
Prerequisite: EE 334 Minimum Grade of D

EE 432 Microelectronic Devices 3 cr
Introduction to semiconductor material properties; semiconductor diodes; structure and operation; diode circuit applications; bipolar transistor; structure and operation; junction field effect transistors (JFETs); metal oxide field effect transistors (MOSFETs) fabrication technology and construction of semiconductor devices; biasing and stability of amplifiers. This course is dually listed with an equivalent graduate-level course (EE 532) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 334 Minimum Grade of D

EE 437 Electronics Lab 1 cr
Computer analysis and measurement of the characteristics and parameters of power supplies; operational amplifiers; voltage and power amplifiers; oscillators and active filters.
Prerequisite: (EE 334 Minimum Grade of D and EE 431 (may be taken concurrently) Minimum Grade of D)

EE 438 Virtual Instrumentation 3 cr
Transducers; measurement techniques; measurement errors; digital signal processing; noise sources and reduction; introduction to LabVIEW software, data acquisition and processing using computer-controlled data acquisition hardware.
Prerequisite: EE 334 Minimum Grade of D

EE 439 VSLI Technology-Fabrication 3 cr
Introduction to semiconductor devices; crystal growth and wafer preparation; chemical and physical vapor deposition; oxidation; diffusion; ion implantation; lithography; etching metallization, process integration of CMOS and bipolar technologies; diagnostic techniques and measurements; packaging; yield and reliability. This course is dually listed with an equivalent graduate-level course (EE 539) and requires a minimum G.P.A. of 2.75 or the instructor's permission for admission.
Prerequisite: EE 331 Minimum Grade of D

EE 440 HDL Logic Synthesis 3 cr
Introduction to the syntax and elements of the basic VHDL language such as entities and architectures; creating combinational, synchronous logic and state machines using both structural and behavioral VHDL; using hierarchy in large designs; synthesizing and implementing designs. This course is dually listed with an equivalent graduate-level course (EE 540) and requires a minimum GPA of 2.75 or the instructor's permission for admission. Credit for both EE 440 and EE 443 not allowed toward a degree.
Prerequisite: EE 264 Minimum Grade of D and EE 268 Minimum Grade of D

EE 441 Computer Networks 3 cr
Introduction to design and analysis of computer networks. Polling networks and ring networks. This course is dually listed with an equivalent graduate-level course (EE 541) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 264 Minimum Grade of D and EE 268 Minimum Grade of D

EE 443 HDL Logic Simulation 3 cr
Introduction to the syntax and elements of the basic Verilog language such as modules and ports; hierarchical modeling; gate-level modeling; dataflow modeling; switch-level modeling; tasks and functions; timing and delays; user-defined primitives; synthesizing and implementing designs. Emphasis is on the simulation and test-bench aspects. This course is dually listed with an equivalent graduate-level course (EE 543) and requires a minimum GPA of 2.75 or the instructor's permission for admission. Credit for both EE 440 and EE 443 not allowed toward a degree.
Prerequisite: EE 264 Minimum Grade of D and EE 268 Minimum Grade of D

EE 444 Wireless Networks 3 cr
Introduction to modern wireless networks/systems, the cellular concept, frequency reuse, interference and system capacity improvement, trunking and grade of service, multiple access techniques, wireless/wireline interworking, and advanced networks (i.e. ad hoc networks). This course is dually listed with an equivalent graduate-level course (EE 544) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 441 Minimum Grade of D

EE 445 Smart Grid 3 cr
Introduction to smart grid concepts, phasor measurement units, applications of PMUs in protection and fault recovery, communication over power lines, smart metering, smart grid standards, and cyber security.
Prerequisite: EE 264 Minimum Grade of D and EE 381 Minimum Grade of D
Corequisite: EE 483

EE 446 Embedded System Design Lab 1 cr
Design projects utilizing 16-bit and 32-bit microprocessor hardware and software; interfaces to memory and peripheral devices.
Prerequisite: EE 457 (may be taken concurrently) Minimum Grade of D

EE 447 Programmable Logic Devices Lab 1 cr
Digital design projects utilizing simulation and synthesis CAD tools and targeting programmable logic devices.
Prerequisite: EE 264 Minimum Grade of D and EE 268 Minimum Grade of D

EE 449 Control and Communications Lab 1 cr
Computer-aided modeling, design and performance analysis in time and frequency domain of analog and digital communication end-to-end systems, and automatic control systems.
Prerequisite: EE 328 Minimum Grade of D and EE 372 (may be taken concurrently) Minimum Grade of D

EE 450 Fundamentals of Fourier Optics 3 cr
Two-dimensional Fourier analysis; linear systems; sampling theory; scalar diffraction theory. Fourier transform imaging properties of lenses; frequency analyses of diffraction-limited coherent and incoherent imaging systems; aberrations and resolution analysis; Vander Lugt filters and frequency domain analysis and synthesis; SAR and pattern recognition applications.
Prerequisite: EE 331 Minimum Grade of D and EE 355 Minimum Grade of D

EE 452 Microwave Engineering 3 cr
Generation and transmission of high frequency electromagnetic energy; magnetrons, klystrons, masers, parametric amplifiers, traveling wave tubes and solid-state devices; waveguides and resonators. This course is dually listed with an equivalent graduate level course (EE 552) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 355 Minimum Grade of D

EE 453 Antenna Theory and Design 3 cr
Radiation fundamentals; linear antennas; loop antennas; aperture antennas; reflector antennas; antenna impedance and measurements; computer-aided design of antenna systems. This course is dually listed with an equivalent graduate-level course (EE 553).
Prerequisite: EE 355 Minimum Grade of D

EE 454 Digital Computer Architecture 3 cr
Computer organization; instruction set design; ALU design; control unit design; I/O and interrupt designs; memory organization; DMA; microprogramming; introduction to multi-processors; performance analysis. This course is dually listed with an equivalent graduate level course (EE 554) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 264 Minimum Grade of D and EE 268 Minimum Grade of D

EE 455 Optoelectronics 3 cr
Wave propagation in free-space and in wave guides; optical resonators; interaction of radiation and atomic systems; laser oscillation; solid-state lasers. He-Ne and Argon lasers, integrated optics including integration of emitters and detectors; optical interconnects; spatial light modulators; optoelectronic materials and devices; and applications of optoelectronics. This course is dually listed with an equivalent graduate-level course (EE 555) and requires a minimum GPA of 2.75 or the instructor's permission of admission.
Prerequisite: EE 355 Minimum Grade of D

EE 456 Fiber Optic Communication Sys 3 cr
Review of optical principles, dielectric waveguides, signal propagation, degradations and attenuation of fibers. Fiber interconnection devices, active and passive components, optical transmitters and receivers, power budget, fiber optic communication systems. This course is dually listed with an equivalent graduate-level course (EE 556).
Prerequisite: EE 355 Minimum Grade of D

EE 457 Embedded System Design 3 cr
Architecture and software of 16-bit and 32-bit microprocessor hardware and software; interface design to memory and peripheral devices; multiprocessing. This course is dually listed with an equivalent graduate level course (EE 557) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 264 Minimum Grade of D and EE 368 Minimum Grade of D

EE 458 Radar Systems 3 cr
Introduction to radar signal processing. Continuous wave and pulsed radars. Clutter and radio wave propagation. Moving target indicator, target surveillance and tracking radar systems. Side-looking, synthetic aperture, interferometric and other airborne radars. This course is dually listed with an equivalent graduate level course (EE 558) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 355 Minimum Grade of D

EE 465 Digital Signal Processing 3 cr
Review of discrete Fourier and Z-transforms; review of analog filter design; design of IIR and FIR digital filters. Fast Fourier transform (FFT) and applications; Hardware implementation and quantization effects. Advanced digital filter structures and design. DSP algorithm design and implementation. Analysis of finite word length effects of DSP applications. Extensive use of MatLab for analysis and design.
Prerequisite: (EE 321 Minimum Grade of C and EE 322 (may be taken concurrently) Minimum Grade of D)

EE 468 Programmable Logic Controllers 3 cr
Hardware and software principles of PLC devices, ladder logic, hardware components of PLC systems and controller configuration, basic PLC operation, program construction and manipulation, advanced operation and networking.
Prerequisite: EE 264 Minimum Grade of D and EE 268 Minimum Grade of D

EE 469 Signal Integrity 3 cr
Design techniques for high-speed digital interfaces and circuit boards; signal integrity including crosstalk and ground bounce; electromagnetic aspects of high-speed digital design; frequency-domain analysis of power-system integrity; state-of-the-art buses and standards. This course is dually listed with an equivalent graduate-level course (EE 569) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 264 Minimum Grade of D and EE 268 Minimum Grade of D and EE 334 Minimum Grade of D

EE 470 Synth Active-Passive Networks 3 cr
Reliability of network functions (high-pass, band-pass, low-pass, band reject and equalizing filters); approximation techniques; sensitivity analysis; passive and active synthesis; positive and negative feedback and biquads. Computer techniques for the realization of standard filter forms (Butterworth, Chebyshev, Bessel, Sallen and Key, and other forms).
Prerequisite: EE 321 Minimum Grade of D

EE 471 Wireless Communication 3 cr
Introduction to wireless communications propagation in mobile radio channels, large, small scale fading and multipath; diversity and diversity combining techniques and modulation techniques. This course is dually listed with an equivalent graduate level course (EE 571) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 372 Minimum Grade of D

EE 473 Advanced Communication Systems 3 cr
Digital line coding; pulse shaping; partial response signaling; scrambling; M-ary communication; digital carrier systems and digital multiplexing. Probability; random variables; quantization error in PCM; random processes; white noise and the behavior of analog systems in the presence of noise. Information theory; compact codes and error correcting codes. This course is dually listed with an equivalent graduate level course (EE 573) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 372 Minimum Grade of D

EE 481 Electrical Machines 3 cr
DC machines-motors and generators. Single-phase motors; unbalanced two-phase motors; servo-motors; commutator motors; stepper motors; synchros; shaded pole motors; reluctance and hysteresis motors and brushless DC motors. Dynamic circuit analysis of rotating machines.
Prerequisite: EE 381 Minimum Grade of D

EE 482 Switch Mode Power Conversion 3 cr
Design and analysis of switch mode power converters; design of magnetic components; stability considerations; input filter interactions; performance measurements and evaluations. This course is dually listed with an equivalent graduate-level course (EE 582) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 334 Minimum Grade of D and EE 381 Minimum Grade of D

EE 483 Power Systems I 3 cr
Principles of power system analysis. Synchronous machines, transformers and loads; transmission line parameters and analysis. Impedance/admittance matrix representation of power systems. Power flow analysis. Symmetrical fault studies and protective devices.
Prerequisite: EE 381 Minimum Grade of D and EE 385 (may be taken concurrently) Minimum Grade of D

EE 484 Power Systems II 3 cr
Symmetrical components and sequence networks; computer studies of transmission lines; fault studies using a computer; state estimation of power system and power system stability, Economic analysis.
Prerequisite: EE 483 Minimum Grade of D

EE 485 Power Distrib and Utilization 3 cr
Principles and characteristics of generating stations; transformers; conversion equipment; primary and secondary distribution systems; short-circuit calculations; selection of protective devices; system grounding and over current protection; voltage control; power factor control and correction; load and cost estimating.
Prerequisite: EE 483 Minimum Grade of D

EE 486 Power Electronics 3 cr
Power semiconductor diodes and thyristors; commutation techniques; rectification circuits - uncontrolled and controlled; AC voltage controllers; DC chopper; pulse-width modulated inverters and resonant pulse inverters. This course is dually listed with an equivalent graduate level course (EE 586) and requires a minimum GPA of 2.75 or the instructor's permission for admission.
Prerequisite: EE 334 Minimum Grade of D and EE 381 Minimum Grade of D

EE 487 Switch Mode Power Conversion 3 cr
Design and analysis of switch mode power converters; design of magnetic components; stability considerations; input filter interactions; performance measurements and evaluation. This course is dually listed with an equivalent graduate level course and requires a minimum GPA of 2.75 for admission.
Prerequisite: EE 334 Minimum Grade of D and EE 381 Minimum Grade of D

EE 488 Illumination Engineering 3 cr
Photometric units and definitions; light sources and luminaires; interior lighting and artificial illumination design techniques; daylight lighting design; exterior lighting design and the theory of color. Optics and control of lighting. Prerequisite: Instructor's permission.

EE 489 Renewable Energy 3 cr
Introduction to renewable energy sources. Fuel cells: classification , configuration and operation. Hydrogen: production, purification and storage. Photovoltaic cells: solar cells and operational characteristics. Wind turbines: operational characteristics. Energy from water sources: hydroelectric, wave and tidal energy. This course is dually listed with an equivalent graduate course and requires a minimum GPA 2.75 or the instructor's permission for admission.
Prerequisite: EE 381 Minimum Grade of D

EE 490 Special Topics 1-3 cr
Topics of current electrical and computer engineering interest. This course requires permission of the department chair and a minimum GPA of 2.75 for admission. (Prerequisites: PCS and Instructor's permission.)

EE 494 Directed Studies 1-3 cr
Directed study under the guidance of a faculty advisor, of a topic from the field of electrical and/or computer engineering, not offered in a regularly scheduled course. This course requires permission of the Department Chair and a minimum GPA of 2.75 for admission. Pre-requisite: PCS.

EE 499 Honors Senior Project - H 1-6 cr
Under the advice and guidance of a faculty mentor, honors student will identify and carry out a research project, relevant to the field of Electrical and Computer Engineering which will lead to a formal presentation at the annual Honors Student Colloquium. The senior project will be judged and graded by three faculty chaired by the honors mentor. Students are required to become members of IEEE/ACM and attend two technical meetings. This course is required for Honors recognition. A minimum of 4 credit hours is required, but students may enroll for a maximum of 6 credit hours over two semesters. Prerequisites: an approved project prospectus.
Prerequisite: (EE 401 Minimum Grade of C or HON 301 Minimum Grade of C)

EE 522 Adv Feedback Control Systems 3 cr
Sensors; encoders and D.C. motors in control systems. The performance and design of feedback control systems. System bandwidth; Nichol's Chart and the stability of control systems with time delays. State variable analysis and design. Use of MatLab for analysis and design. This course is dually listed with an equivalent 400-level Electrical/Computer Engineering course.

EE 523 Modern Control Theory 3 cr
Simulation and modeling; introduction to linear system theory; concepts of controllability and observability; specifications, structures and limitations; review of classical design methods; state feedback design methods; multivariable control; robust stability and sampled data implementation. Introduction to the use of MATLAB for design. This course is dually listed with an equivalent 400-level course (EE 423).

EE 524 Nonlinear Control Systems 3 cr
State space description; methods of linearization; isoclines; stability of nonlinear systems; Lyapunov's direct method; harmonic linearization; describing functions; dual input describing functions; Popov's method; circle criterion, computer aided analysis. This course is dually listed with an equivalent 400-level course(EE 424).
Prerequisite: EE 523

EE 525 Optimal Control Systems 3 cr
Static optimization; method of Lagrange multipliers; adaptive controllers; dynamic optimization; calculus of variations; the principle of optimality and dynamic programming; Pontryagin's maximum principle; quadratic optimal control.
Prerequisite: EE 523

EE 526 Introduction to Robotics 3 cr
Basic mathematics of robotic systems; coordinate transformations: forward and inverse kinematics; velocity kinematics; path planning and trajectory generation; numerical methods; mobile robots. Fee

EE 527 Digital Control Systems 3 cr
State space and transfer function description of discrete time systems; solution of the discrete state equation; discrete-time model of analog plants; frequency domain analysis; designing of discrete state-feedback regulators; observers and tracking systems. This course is dually listed with an equivalent 400-level course (EE 427).

EE 528 Advanced System Theory 3 cr
Review of linear spaces and operators; state variable description of time varying and time invariant linear systems. Controllability and observability of linear dynamical systems; state feedback and state estimators; stability of linear systems; arbitrary pole assignment for multivariable case. Prerequisite: Instructor's permission.

EE 530 Nanotechnology 3 cr
Nanotechnology fundamentals and principles; quantum wires and dots; single electron effects and coulomb blockade; nanomagnets and spintronics; spin based electronics (magnetic memories, magnetic field sensors); nanofabrication; nanoelectronics (QCQ); organic electronics (carbon fullerenes and nanotubes, polymers); advanced characterization techniques; applications especially those related to nanotechnology; MEMS and microsystems (sensors); QWIP technology and its associative nanoscience; photonic crystal; advances in nanostructured materials. Requires instructor's permission.

EE 531 Advanced Electronic Devices 3 cr
Semiconductor electronics; semiconductor diode circuit analysis; bipolar and field effect transistors; analog-to-digital and digital-to-analog circuits and active filters. This course is dually listed with an equivalent 400-level course (EE 431). Prerequisite: Instructor's permission

EE 532 Microelectronic Devices 3 cr
Introduction to semiconductor material properties; semiconductor diodes: structure and operation; diode circuit applications; semiconductor heterojunctions; metal-semiconductor junctions; bipolar transistor: structure and operation; junction field effect transistors (JFETs); metal oxide field effect transistors (MOSFETs); metal semiconductor field effect transistors (MESFETs); fabrication technology and construction of semiconductor devices; photodetectors; light-emitting diodes; laser diodes; solar cells; image sensors; spice based microelectronic circuit design. This course is dually listed with equivalent 400-level course (EE 432).

EE 534 VLSI Design Systems 3 cr
Review of fabrication of microelectronic devices; introduction to MOS technology; basic physical and electrical properties of field effect transistors; CMOS fabrication; layout of CMOS integrated circuits; MOSFETS; concepts of VLSI chip design; physical design of CMOS integrated circuit.

EE 535 Electronic Materials Prop-Appl 3 cr
Schrodinger's equation, potential wells and barriers; crystallographic geometry; Kronig-Penney model; energy bands in crystalline solids; density of states - Fermi statistics; intrinsic and extrinsic semiconductors; conductivity and Hall effects; interfaces; magnetic materials; superconducting materials; optical materials. Prerequisite: Instructor's permission.

EE 536 Intro to Superconductivity 3 cr
Microscopic theory of superconductivity; BCS theory; superconduction tunneling phenomena; superconducting device; superconducting materials; High-Tc superconductors. Prerequisite: Instructor's permission.

EE 537 Adv Plasma Process Elect Mat 3 cr
Analysis, design and application of DC, RF and microwave plasma in microelectronic material processing; sputtering; etching; deposition; surface modification; diagnostic and characterization techniques. Prerequisite: Instructor's permission.

EE 538 Magnetic Recording Media 3 cr
Magnetostatic fields; magnetization processes; demagnetizing factors; magnetic circuits; hard disk / tape media; inductive and MR heads; magnetic data storage systems. Prerequisite: Instructor's permission.

EE 539 VLSI Technology - Fabrication 3 cr
Introduction to semiconductor devices; crystal growth and wafer preparation; chemical and physical vapor deposition; oxidation; diffusion; ion implantation; lithography; etching; metallization; process integration of CMOS and bipolar technologies; diagnostic techniques and measurements; packaging; yield and reliability. This course is dually listed with an equivalent 400-level course (EE 439).

EE 540 HDL Logic Synthesis 3 cr
Introduction to the syntax and elements of the basic VHDL language such as entities and architectures; creating combinational, synchronous logic and state machines using both structural and behavioral VHDL; using hierarchy in large designs; synthesizing and implementing designs. This course is dually listed with an equivalent undergraduate-level course (EE 440) and requires a minimum GPA of 2.75 or the instructor's permission for admission. Credit for both EE 540 and EE 543 not allowed toward a degree.

EE 541 Computer Networks 3 cr
Introduction to design and analysis of computer networks. Polling networks and ring networks. Networking applications. This course is dually listed with an equivalent 400-level EE course.

EE 542 Adv Top Digital Design - HDLs 3 cr
Current topics of interest in digital design. State-of-the-art software tools used in digital design. Advanced topics in HDLs.

EE 543 HDL Logic Simulation 3 cr
Introduction to the syntax and elements of the basic Verilog language such as modules and ports; hierarchical modeling; gate-level modeling; dataflow modeling; behavioral modeling; switch-level modeling; tasks and functions; timing and delays; user-defined primitives; synthesizing and implementing designs. Emphasis is on the simulation and test-bench aspects. This course is dually listed with an equivalent undergraduate-level course (EE 443) and requires a minimum GPA of 2.75 or the instructor's permission. Credit for both EE 540 and EE 543 not allowed toward a degree.

EE 544 Wireless Networks 3 cr
Introduction to modern wireless networks/systems, the cellular concept, frequency reuse, interference and system capacity improvement, trunking and grade of service, multiple access techniques, wireless/wireline interworking, and ad hoc networks). This course is dually listed with an equivalent 400-level course (EE 444) and requires a minimum GPA of 2.75.
Prerequisite: EE 541

EE 545 Optical Network 3 cr
Digital transmission using fiber optics as point-to-point link. Wavelength-division-multiplexing concepts and components, LAN, WAN, and MAN, SONET/SDH, FDDI Networks, Broadcast-and-select WDM Networks, Wavelength-routed Networks, and Performance of WDM and EDFA systems. Prerequisite: Instructor's permission.
Prerequisite: EE 456 Minimum Grade of D

EE 546 Neural Networks 3 cr
Introduction to neural networks and their application to electrical engineering. Concept learning and the general-to-specific ordering, decision tree learning, linear perceptrons, back propagation networks, recursive networks, radial basis networks, neural network-based control systems, unsupervised learned networks.

EE 548 Computer-Network Security 3 cr
Cyptography; Symmetric and asymmetric encryption; authentication and identification schemes; MACs and Digital Signatures; applications of security.

EE 552 Microwave Engineering 3 cr
Generation and transmission of high frequency electromagnetic energy-magnetrons, klystrons, maser, parametric amplifiers, traveling wave tubes and solid-state devices. This course is dually listed with an equivalent 400-level course (EE 452). Prerequisite: Instructor's permission.

EE 553 Antenna Theory and Design 3 cr
Radiation fundamentals; linear antennas; loop antennas; aperture antennas; reflector antennas; antenna impedance and measurements; computer-aided design of antenna systems. This course is dually listed with an undergraduate level course (EE 453).

EE 554 Digital Computer Architecture 3 cr
Computer organization; instruction set design; ALU design; control unit design; I/O and interrupt designs; memory organization; DMA; microprogramming; introduction to multi-processors; performance analysis. This course is dually listed with an undergraduate level course (EE 454).

EE 555 Optoelectronics 3 cr
Wave propagation in free-space and in wave guides; optical resonators, interaction of radiation and atomic systems; laser oscillation; solid-state lasers. He-Ne and Argon ion lasers, integrated optics including integration of emitters and detectors; optical interconnects; spatial light modulators; optoelectronic materials and devices; and applications of optoelectronics. This course is dually listed with a 400-level course (EE 455).

EE 556 Fiber Optic Communication Sys 3 cr
Review of optical principles, dielectric waveguides, signal propagation, degradations and attenuation of fibers. Fiber interconnection devices, active and passive components, optical transmitters and receivers, power budget, fiber optic communication systems. This course is dually listed with an equivalent undergraduate-level course (EE 456).

EE 557 Adv. Embedded System Design 3 cr
Architecture and software of 16-bit and 32-bit microprocessor hardware and software; interface design to memory and peripheral devices; multiprocessing. This course is dually listed with an undergraduate level course (EE 457).

EE 558 Radar Analysis 3 cr
Introduction to radar signal processing. Continuous wave and pulsed radars. Clutter and radio wave propagation. Moving target indicator, target surveillance and tracking radar systems. Side-looking, synthetic aperture, interferometric and other airborne radars. This course is dually listed with an equivalent 400-level (EE458).

EE 559 Optical Info Process-Holograph 3 cr
Parallel optical information processing in Fourier transform systems; nonlinear optical image processing in a linear optical processing; optical image equidensity and pseudo-color using techniques; wave-front reconstruction; on-axis and off-axis holography, effects of film MTF and nonlinearities; holographic memory, display and non-destructive testing; and optical computing. Prerequisite: Instructor's permission.

EE 560 Adv Computer Architecture 3 cr
Overview of software/hardware architectures of selected RISC/CISC microprocessors, advanced pipelining and instruction level parallelism, superscalar techniques, memory hierarchy design, cache coherency, introduction to multiprocessor systems and interconnection networks.
Prerequisite: EE 554 Minimum Grade of C

EE 565 Adv Digital Signal Processing 3 cr
Review of discrete Fourier and z-transforms; review of analog filter design; canonical digital filter forms; design of IIR and FIR digital filters. Fast Fourier Transforms (FET) and their applications; hardware implementation and quantization effects. Advanced digital filter structures and design. DSP algorithm design and implementation. Analysis of finite word length effects of DSP applications. Extensive use of MatLab for analysis and design. This course is dually listed with an equivalent 400-level EE course (EE465).

EE 566 Digital Image Processing 3 cr
Review of digital image fundamentals; different image transforms; image enhancement techniques; image restoration methods; detection of discontinuities and thresholding.

EE 567 Biomedical Imaging 3 cr
Introduction to biomedical imaging, projection radiography, computer aided tomography, single photon emission computed tomography (SPECT), positron emission tomography (PET), magnetic resonance imaging (MRI and fMRI), ultrasound imaging, optical imaging techniques including confocal microscopy and optical coherence tomography (OCT).
Prerequisite: EE 566 Minimum Grade of D

EE 568 Pattern Recognition 3 cr
Introduction to pattern recognition, statistical, syntactic and neural pattern recognition; Decision procedures; Parameter estimation and supervised learning; Non-parametric techniques; Feature extraction and nonlinear mapping; Fuzzy systems in pattern recognition; Methods of testing

EE 569 Signal Integrity 3 cr
Design techniques for high-speed digital interfaces and circuit boards; signal integrity including crosstalk and ground bounce; electromagnetic aspects of high-speed digital design; frequency-domain analysis of power-system integrity; state-of-the-art buses and standards. This course is dually listed with an equivalent undergraduate-level course (EE 469).

EE 571 Wireless Communications 3 cr
The cellular concept and system design fundamentals, propagation in mobile radio channels, large scale fading; small-scale fading and multi-path statistical distributions, distributions, diversity and diversity combining techniques. This course is dually listed with an equivalent undergraduate level course (EE 471) and requires instructor's permission for admission.
Prerequisite: EE 322 Minimum Grade of D and EE 372 Minimum Grade of D

EE 573 Advanced Communication Systems 3 cr
Digital line coding; pulse shaping; partial response signaling; scrambling; M-ary communication; digital carrier systems and digital multiplexing. Probability; random processes; white noise and the behavior of analog systems in the presence of noise. Information theory; compact codes and error correcting codes. This course is dually listed with an equivalent 400-level course (EE 473).

EE 574 Digital Communications 3 cr
Analysis and design of digital communication systems based on probability theory; signal space representation and optimum detection principles; Digital modulation techniques and their performance in additive white Gaussian noise.
Prerequisite: EE 573

EE 575 Stochastic Processes 3 cr
Introduction to estimation theory. Markov chains - finite, countable, continuous time, optimal stopping; Martingales; renewal processes, reversible Markov chains, Brownian motion and stochastic integration.

EE 576 Optical Communications 3 cr
Light sources, detectors, fiber components and optical systems for fiber communication; free-space inter-satellite optical networks for high-speed global communication; coding problems in optical fiber data transmission; three-dimensional optical data storage for database processing; propagation losses and fiber amplifiers; and optical free-space interconnections in future computers. Prerequisite: Instructor's permission.

EE 577 Information Theory 3 cr
Self-information; entropy; mutual information and channel capacity; encoding; error detecting and correcting codes. Sampling theorem. Discrete and continuous channels. Band-limited channels.

EE 578 Error Correction Codes 3 cr
This course is designed to introduce the students to error correcting codes, their construction and properties, encoding and decoding.

EE 579 Wireless Sensor Networks 3 cr
Introduction to Wireless Sensor Networks; Network deployment; Network Topologies; Localization; Tracking; Time synchronization techniques; Wireless characteristics; Energy considerations; MAC layer protocol and sleep scheduling; Routing; Sleep-based topology control; Latest development in the field.
Prerequisite: EE 544 Minimum Grade of D

EE 582 Switch-Mode Power Conversion 3 cr
Design and analysis of switch mode power converters-design of magnetic components; stability considerations; input filter interactions; performance, measurements and evaluation. This course is dually listed with an equivalent 400-level course (EE 482). Prerequisite: Instructor's permission.

EE 585 Advanced Power Systems 3 cr
Special topics that are not covered in traditional power systems courses, such as: Optimization techniques, computer methods, unified fault (short circuit) analysis, protection and control of power systems. Prerequisite: Instructor's permission.

EE 586 Power Electronics 3 cr
Power semiconductor diodes and thyristors; commutation techniques; rectification circuits - uncontrolled and controlled; AC voltage controllers; DC chopper; pulse-width modulated inverters and resonant pulse inverters. This course is dually listed with an equivalent undergraduate level course (EE 486).
Cross-Listed: EE 486

EE 588 Power Semiconductor Drives 3 cr
Rectifier control of DC motors; chopper control of DC drives; closed-loop control of DC drives; induction motor speed control and multiquadrant control; control of induction motors by AC controllers and frequency-controlled drives; slip power control of induction motors; synchronous motor drives - brushless DC and AC motor drives. Prerequisites: Instructor's permission.

EE 589 Renewable Energy 3 cr
Introduction to renewable energy sources. Fuel cells: classification , configuration and operation. Hydrogen: production, purification and storage. Photovoltaic cells: solar cells and operational characteristics. Wind turbines: operational characteristics. Energy from water sources: hydroelectric, wave and tidal energy.

EE 590 Special Topics - 1-3 cr
Topics of current electrical engineering interest. Prerequisite: Instructor's permission.

EE 592 Directed Independent Study 1-3 cr
Directed study, under the guidance of a faculty advisor, of a topic from the field of Electrical and Computer Engineering not offered in a regularly scheduled course. Prerequisite: Instructor's permission.

EE 594 Project in Electrical Engr 1-3 cr
An investigation of an original problem in electrical engineering under the guidance of the student's major professor. Prerequisites: Approval of the project prospectus by the student's advisory committee, and consent of the Director of Engineering Graduate Studies.

EE 599 Thesis 1-6 cr
An investigation of an original problem in electrical and/or computer engineering under the guidance of the student's major professor. Prerequisite: Approval of the thesis prospectus by the student's Advisory Committee and the Graduate School and consent of the Director of Engineering Graduate Studies.

Faculty

Faculty Name	Faculty Department	Faculty Position	Degrees Held
EL-SHARKH, MOHAMED YOUSEF MOHAMED (yelshark@southalabama.edu)	Electrical-Computer Eng	Associate Professor	BS, Ain Shams Univ MS, Ain Shams Univ PHD, University of Alabama
GONG, NA (nagong@southalabama.edu)	Electrical-Computer Eng	Professor	PHD, SUNY at Buffalo
KHAN, AURANGZEB (akhan@southalabama.edu)	Electrical-Computer Eng	Associate Professor	BS, University of Karachi MS, University of Karachi MPHIL, Quaid-i-Azam University PHD, Tottori University
KIRKICI, HULYA (hkirkici@southalabama.edu)	Electrical-Computer Eng	Professor	PHD, Polytechnic University
LATIF, SAEED IFTAKHAR (slatif@southalabama.edu)	Electrical-Computer Eng	Associate Professor	BS, Bangladesh Univ of Engineer MS, Univ of Manitoba PHD, Univ of Manitoba
RUSS, SAMUEL H. (sruss@southalabama.edu)	Electrical-Computer Eng	Associate Professor	BSEE, Georgia Inst of Tech - Main PHD, Georgia Inst of Tech - Main
SHABAN, MOHAMED E (mshaban@southalabama.edu)	Electrical-Computer Eng	Assistant Professor	BS, Mansoura University MS, Mansoura University MS, University of LA at Lafayette PHD, University of LA at Lafayette
SPENCER, EDMUND A. (espencer@southalabama.edu)	Electrical-Computer Eng	Associate Professor	BE, University of Leicester MS, University of Texas- Austin PHD, University of Texas- Austin
THOMAS, THOMAS GEIGER (tthomas@southalabama.edu)	Electrical-Computer Eng	Part-Time Instructor	BS, University of South Alabama BSEE, University of South Alabama MSEE, Univ of Alabama-Birmingham PHD, University of Alabama-Huntsv
WANG, JINHUI (jwang@southalabama.edu)	Electrical-Computer Eng	Associate Professor	BS, Hebei University MS, Beijing University of Tech PHD, Beijing University of Tech
WOLTER FERREIRA TOUMA, DANIELA (dtouma@southalabama.edu)	Electrical-Computer Eng	Assistant Professor	BS, Uni de Sao Paulo MS, Uni de Sao Paulo DSC, Uni de Sao Paulo
WOODS, ROGER CLIVE (clivewoods@southalabama.edu)	Electrical-Computer Eng	Professor	DPHIL, University of Oxford England MA, University of Oxford England