

Clemson Electrical and Computer Engineering Courses

EE Core Courses:

E C E 201, H201 Logic and Computing Devices 3 (2,2)

Study of logic with an introduction to Boolean algebra; number systems and representation of information; use of integrated circuits to implement combinational and sequential logic functions and computing elements; and organization and structure of computing systems. *Preq:* MTHSC 108, PHYS 122.

E C E 202, H202 Electric Circuits I 3 (3,0)

Study of DC resistive circuits, Kirchhoff's Laws, Nodal and Mesh emphasis, sources, Thevenin's and Norton's theorems, RC, RL, RCL circuit solutions with initial condition using homogenous or nonhomogenous ordinary differential equations having constant coefficients. Develop sinusoidal steady state solution. *Preq:* MTHSC 108, PHYS 122. *Coreq:* E C E 211, PHYS 221.

E C E 211 Electrical Engineering Laboratory I 1 (0,2)

Principles of measurement and instruments used to measure parameters and dynamic variables in electric circuits, steady state and transient measurements in DC and AC circuits, and data analysis methods are included. *Coreq:* E C E 202.

E C E 212 Electrical Engineering Laboratory II 1 (0,2)

Emphasizes measurement techniques in AC steady-state circuits and comparison to theoretical predictions. Two-port network methodology and transfer functions are studied experimentally and related to analysis using transform techniques. *Preq:* E C E 202, 211. *Coreq:* E C E 262.

E C E 262, H262 Electric Circuits II 3 (3,0)

Continuation of the study of electric circuits, including three-phase circuits, complex frequency and network functions, frequency response, two-port parameters, magnetically-coupled circuits, Laplace transforms, and introduction to Fourier series and transforms. *Preq:* E C E 202, MTHSC 206, PHYS 221. *Coreq:* E C E 212, MTHSC 208.

E C E 272 Computer Organization 4 (3,2)

Introductory course in computer organization and architecture. Topics include basic hardware and software structure, addressing methods, programs control, processing units, I-O organization, arithmetic, main-memory organization, peripherals, microprocessor families, RISC architectures, and multiprocessors. *Preq:* E C E 201 and CP SC 101 or 111 or 157 or 210.

E C E 311 Electrical Engineering Laboratory III 1 (0,2)

Measurements and characteristics of electronic devices and circuits; use of manual and automated instruments to acquire data; oral and written engineering reports. *Preq:* E C E 262, MTHSC 208, PHYS 221. *Coreq:* E C E 320.

E C E 312 Electrical Engineering Laboratory IV 1 (0,2)

Design and characterization of functional circuits using solid-state devices; use of manual and automated instruments for measurements; statistical analysis of data; preparation of engineering reports. *Preq:* E C E 311, 320. *Coreq:* E C E 321.

E C E 317 Random Signal Analysis 3 (3,0)

Introduction to engineering problems of a probabilistic nature. Systems transformations, statistical averages, simulation, and estimation of system parameters. *Preq:* E C E 262, MTHSC 208. *Coreq:* E C E 330.

E C E 320 Electronics I 3 (3,0)

Introduction to electronic materials and devices; principles of design; design of DC and AC circuits using diodes, bipolar junction transistors, field-effect transistors and use of transistors in digital circuits. *Preq:* E C E 262, MTHSC 208, PHYS 221. *Coreq:* E C E 311.

E C E 321 Electronics II 3 (3,0)

Analysis and design of discrete amplifier circuits at low and high frequencies; operational amplifiers, distortion in amplifiers, oscillator design, and circuit analysis of active digital devices. *Preq:* E C E 320. *Coreq:* E C E 312.

E C E 330, H330 Signals, Systems, and Transforms 3 (3,0)

Study of systems models, analysis of signals, Fourier series and transforms, sampling and Z transforms, discrete Fourier transforms. *Preq:* E C E 262, MTHSC 208.

E C E 360 Electric Power Engineering 3 (3,0)

Presents the basic principles of electromagnetic induction and electromagnetic forces developed. Topics include synchronous machines, power transformers, electric power transmission, and distribution systems, DC motors, and induction motors. *Preq:* E C E 262, PHYS 221.

E C E 371 Microcomputer Interfacing 4 (1-3,1-3)

Interfacing of microcomputers to peripherals or other computers for purposes of data acquisition, device monitoring and control, and other communications. The interfacing problem is considered at all levels including computer architecture, logic, timing, loading, protocols, and software laboratory for building and simulating designs. *Preq:* E C E 262, 272. *Coreq:* E C E 320.

E C E 380 Electromagnetics 3 (3,0)

Introduction to electric fields and potentials, dielectrics, capacitance, resistance, magnetic field, forces, work and energy, inductance, time-varying fields, and Maxwell's equations. *Preq:* E C E 262, MTHSC 206, PHYS 221.

E C E 381 Fields, Waves, and Circuits 3 (3,0)

Covers foundation of circuit theory, transmission lines and circuits, plane-wave propagation, fiber optics, radiation and antennas, and coupled circuits. *Preq:* E C E 380, MTHSC 208.

E C E 409 Continuous and Discrete Systems Design 3 (3,0)

Introduction to classical linear control systems. Topics include continuous and discrete descriptions of systems, time and frequency response, stability, system specification, system design of continuous and discrete systems. *Preq:* E C E 330. *Coreq:* E C E 495.

E C E 427 Communications Systems 3 (3,0)

Study of communication systems design and analysis. Topics include signals and spectra, baseband signaling and detection in noise, digital and analog modulation and demodulation techniques, communications link budget analysis. *Preq:* E C E 317, 330.

E C E 495 Integrated System Design I 2 (1,3)

Engineering design of systems is considered in a continuous process of project definition, planning, execution, and evaluation. This process includes consideration of both technical and non-technical factors in design. Strong emphasis is placed on the development of effective technical communications skills, particularly oral communications competency. *Preq:* E C E 321, 330, 360, 371, 381 (three of which must have been completed prior to enrollment, with the remaining taken as corequisite courses). *Coreq:* E C E 409 (in addition to any deficit courses in the prerequisites).

E C E 496 Integrated System Design II 2 (0,6)

Project-oriented course which brings together electrical engineering students of dissimilar training into teams or project groups. Group assignments are made which are designed to develop an appreciation for individual and creative thinking as well as team effort. *Preq:* E C E 321, 330, 360, 371, 381, 409, 495.

EE Elective courses:

E C E 204 Circuit Analysis Problems I 1 (0,3)

Analysis and solution of electrical network problems using mesh and nodal analysis, Thevenin's and Norton's theorems and equivalent circuits and other circuit analysis from E C E 202. *Coreq:* E C E 202.

E C E 222 Systems Programming Concepts for Computer Engineering 3 (3,0)

Development of computer systems programming and code reading techniques. Tools, programming languages, libraries, operating systems, and hardware. Code reading is emphasized. Programming projects reinforce course topics. *Preq:* CP SC 111.

E C E 223 Computer Systems Engineering 3 (3,0)

Analysis of implementation techniques for systems software. Applying engineering principles including code reading to the design of data structures and algorithms for low level computer systems, embedded systems, and hardware/software systems. Includes coverage of address translation, memory management, file systems, and process management. *Preq:* E C E 222.

E C E 263 Circuit Analysis Problems II 1 (0,3)

Analysis of basic AC circuit analysis techniques to analyze the transient and steady-state behavior of both simple and complex circuits. *Coreq:* E C E 262, MTHSC 208.

E C E H300 Junior Honors Seminar 1 (2,0)

Acquaints students enrolled in the Departmental Honors Program with current research activities in the Department. Faculty provide seminars where research interests are summarized. Seminars are planned to prepare students in choosing research topics for their senior theses.

E C E 307 Basic Electrical Engineering 2(2,0)

A first course in electrical engineering to provide non-Electrical Engineering majors with a knowledge of DC and AC circuit theory, AC power distribution, and numerous electrical devices, apparatus, and digital systems. *Preq:* MTHSC 206, PHYS 221. *Coreq:* E C E 309.

E C E 308 Electronics and Electromechanics 2 (2,0)

Continuation of E C E 307. Energy conversion systems are considered, as well as basic electronics. *Preq:* E C E 307.

E C E 309 Electrical Engineering Laboratory I 1 (0,2)

Laboratory to accompany E C E 307. Basic electrical circuits and instrumentation. *Coreq:* E C E 307.

E C E 327 Digital Computer Design 3 (3,0)

Design of high-speed ALUs, control and timing circuitry, memory systems and I/O circuitry; microprogrammed computer design using bit-slice microprocessors; current hardware topics related to computer design; hands-on design experience; and use of logic analyzer for system debugging. *Preq:* E C E 371.

E C E 329 Computer Systems Structures 3 (3,0)

Fundamental structures and issues that arise in the analysis and implementation of computer systems. Topics include operating systems structures and data structures and their relationship to computer organization. Engineering science background for computer systems design. *Preq:* CP SC 102 or 210; CP SC 340 or 212; E C E 272.

E C E 352 Programming Systems 3 (3,0)

Second course in programming languages and systems. Topics include assemblers, compilers, and syntactical methods; string manipulation and list processing; concepts of executive programs and operating systems; introduction to time-sharing systems. *Preq:* CP SC 340 or 212 and MTHSC 419.

E C E 404, 604 Semiconductor Devices 3 (3,0)

Consideration of the principles of operation, external characteristics, and applications of some of the more important semiconductor devices presently available. *Preq:* E C E 320. *Coreq:* MTHSC 311 or 434.

E C E 405 Design Projects in Electrical and Computer Engineering 1-3 (0,2-6)

Individually defined projects oriented toward providing experience in establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation. Develops student creativity through the solution of open-ended problems. Includes individual instruction in design methodology. May be repeated for a maximum of three credits. *Preq:* E C E 330 or 409, consent of project supervisor.

E C E 406, 606 Introduction to Microelectronics Processing 3 (3,0)

Microelectronic processing, MOS and bipolar monolithic circuit fabrication, thick and thin film hybrid fabrication, applications to linear and digital circuits, fundamentals of device design. *Preq:* E C E 320. *Coreq:* MTHSC 311 or 434.

E C E 410, 610 Modern Control Theory 3 (3,0)

Introduction to modern control theory. Topics include fundamentals of matrix algebra, state space analysis and design, nonlinear systems and optimal control. *Preq:* E C E 409.

E C E 412 Electrical Machines Laboratory 1 (0,2)

Selected experiments to familiarize students with characteristics of transformers, DC and AC motors and generators. Measurement techniques and component modeling are included. *Coreq:* MTHSC 434 or consent of instructor. *Preq or Coreq:* E C E 360 or 419.

E C E 417, 617 Elements of Software Engineering 3 (3,0)

Foundations of software design, reasoning about software, the calculus of programs, survey of formal specification techniques and design languages. *Preq:* E C E 329, 352, MTHSC 419.

E C E 418, 618 Power System Analysis 3 (3,0)

Study of power system planning and operational problems. Subjects covered are load flow, economic dispatch, fault studies, transient stability, and control of problems. System modeling and computer solutions are emphasized through class projects. *Preq:* E C E 360, 380.

E C E 419, 619 Electric Machines and Drives 3 (3,0)

Performance, characteristics, and modeling of AC and DC machines during steady-state and transient conditions. Introduction to power electronics devices and their use in adjustable speed motor drives. *Preq:* E C E 321, 360, 380. *Coreq:* MTHSC 434 or consent of instructor.

E C E 422, 622 Electronic System Design I 3 (2,2)

Emphasizes the application of theory and skills to the design, building, and testing of an electronic system with both analog and digital components. Application varies each semester. Extensive use is made of computer software tools in the design process. *Preq:* E C E 321, 330, 360, 371, 381.

E C E 429, 629 Organization of Computers 3 (3,0)

Computer organization and architecture. Topics include a review of logic circuits, bus structures, memory organization, interrupt structures, arithmetic units, input-output structures, state generation, central processor organization, control function implementation, and data communication. Registered Transfer Language (RTL) for description and design of digital systems. *Preq:* E C E 272 or consent of instructor.

E C E 430, 630 Digital Communications 3 (3,0)

Study of digital communication systems. Topics include error-control coding, synchronization, multiple-access techniques, spread spectrum signaling, and fading channels. *Preq:* E C E 427.

E C E 431, 631 Digital Electronics 3 (2,2)

Considers electronic devices and circuits of importance to digital computer operation and to other areas of electrical engineering. Topics include active and passive waveshaping, waveform generation, memory elements, switching, and logic circuits. Experimentation with various types of circuits is provided by laboratory projects. *Preq:* E C E 321. *Coreq:* MTHSC 311 or 434.

E C E 432, 632 Instrumentation 3 (3,0)

Theory and analysis of transducers and related circuits and instrumentation. Generalized configurations and performance characteristics of instruments are considered. Transducer devices for measuring physical parameters such as motion, force, torque, pressure, flow, and temperature are discussed. *Preq:* E C E 321. *Coreq:* MTHSC 311 or 434.

E C E 436, 636 Microwave Circuits 3 (3,0)

Analysis of microwave networks comprising transmission lines, waveguides, passive elements, interconnects, and active solid state microwave circuits. Use of modern CAD tools to design RF/ Microwave passive/active networks. Fabrication of typical circuits. *Preq:* E C E 381 or equivalent. *Coreq:* MTHSC 311 or 434.

E C E 438, 638 Computer Communications 3 (3,0)

Digital data transmission techniques, modems and communications channels, communications software and protocols, multiprocessors and distributed processing; concurrency and cooperation of dispersed processors. *Preq:* Senior standing in Electrical or Computer Engineering or Computer Science or consent of instructor.

E C E 439, 639 Fiber Optics 3 (3,0)

The underlying principles of design for optical fibers in practical systems are covered. Optical fiber as a wave-guide is examined using wave optics and ray optics. Design criteria for using mono- and multimode fibers are discussed. Other topics include fabrication, measurement. *Preq:* E C E 381. *Coreq:* MTHSC 434 or consent of instructor.

E C E 440, 640 Performance Analysis of Local Computer Networks 3 (3,0)

Introduction to the design and performance analysis of local computer networks. Emphasis is on performance analysis of representative multi-access procedures. Three common types of networks are considered in detail. *Preq:* E C E 272, 317.

E C E 442, 642 Knowledge Engineering 3 (3,0)

Introduction to the theoretical and practical aspects of knowledge engineering or applied artificial intelligence. Topics include symbolic representation structures and manipulation, unification, production systems and structures, rule-based and expert systems, planning and AI system architectures; system design in PROLOG and LISP. Project is required. *Preq:* E C E 329, 352.

E C E 446, 646 Antennas and Propagation 3 (3,0)

Study of the theoretical and practical aspects of antenna design and utilization, input impedances, structural considerations, and wave propagation. *Preq:* E C E 330, 381 or 436, MTHSC 311 or 434.

E C E 449 Computer Network Security 3 (1,4)

Hands-on practicum in the administration and security of modern network service with emphasis on intrusion prevention techniques, detection, and recovery. *Preq:* Senior standing in Computer Engineering.

E C E 453 Software Practicum 3 (1,6)

Students design and implement a software system that satisfies both a requirements and specifications document. The resulting system is tested for compliance. *Preq:* E C E 329, 352.

E C E 455, 655 Robot Manipulators 3 (3,0)

Analysis of robot manipulator systems with special focus on interaction of these technologies with society. Emphasis is on rigid-link robot manipulator systems. Topics include history of robot technology, kinematics, dynamics, control, and operator interfaces. Case studies reinforce impact of robot technology on society and vice versa. *Preq:* MTHSC 206, 311, or consent of instructor.

E C E (M E) 456, 656 Fundamentals of Robotics 3 (3,0)

See M E 456.

E C E 459, 659 Integrated Circuit Design 3 (2,2)

Design concepts and factors influencing the choice of technology; fundamental MOS device design; silicon foundaries, custom and semicustom integrated circuits; computer-aided design software/ hardware trends and future developments; hands-on use of CAD tools to design standard library cells; systems design considerations, testing, and packaging. *Preq:* E C E 321. *Coreq:* MTHSC 311 or 434.

E C E 460 Computer-Aided Analysis and Design 3 (3,0)

Principles and methods suited to the solution of engineering problems on the digital computer. Topics include widely used methods for the solution of the systems of algebraic and/or differential equations which arise in modeling of engineering systems, data approximation and curve fitting, continuous system simulation languages, and design-oriented programming systems. *Preq:* E C E 262, MTHSC 311, 434, or consent of instructor.

E C E 467, 667 Introduction to Digital Signal Processing 3 (3,0)

Introduction to characteristics, design, and applications of discrete time systems; design of digital filters; introduction to the Fast Fourier Transform (FFT); LSI hardware for signal processing applications. *Preq:* E C E 330.

E C E 468, 668 Embedded Computing 3(2,2)

Principles of using computing in the larger context of a system. Topics include bus and processor design types (e.g. microprocessor, microcontroller, DSP), codecs, digital circuit power management, real time scheduling, and embedded operating systems. Lab work consists of projects on embedded hardware (e.g. PC-104+). *Preq:* CP SC 212 and E C E 371 or consent of instructor.

E C E H491 Undergraduate Honors Research 1-6

Individual research projects conducted under the direct supervision and guidance of a faculty member. May be repeated for a maximum of six credits.



E C E 492, 692 Special Problems 1-3

Special assignment in electrical or computer engineering. Some typical assignments include computer programs, term papers, technical literature searches, hardware projects, and design project leadership. May be taken only once for credit.

E C E 493, 693 Selected Topics 1-3 (1-3,0)

Classroom study of current and new technical developments in electrical and computer engineering. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.