

# ELECTRICAL AND COMPUTER ENGR (ECEN)

## ECEN 1521 Digital Circuits 3 s.h.

Digital concepts and design techniques; number systems, switching algebra, logic gates, truth tables. Combinational logic circuits with an introduction to sequential circuits. Practical applications.

## ECEN 1521L Digital Circuits Laboratory 1 s.h.

Laboratory exercises to accompany ECEN 1521. Design and testing of combinational and sequential logic circuits. Experiments with digital hardware.

**Prereq. or Coreq.:** ECEN 1521.

## ECEN 1555 Computer Engineering 3 s.h.

Introduction to the personal computer, applications software, technologies, microprocessors, microcomputer programming and applications. Basic operations of digital circuits, interfacing using integrated chips, and analog computers. Experiments accompany lectures, providing practical experience for students.

## ECEN 1555H Honors Computer Engineering 3 s.h.

The personal computer, its components, and the role it plays in control applications, instrumentation, and engineering design. Basic experiments using digital circuits, microcomputers, integrated circuits, and design software integrated into a project with the personal computer and instrumentation.

**Prereq. or Coreq.:** ENGL 1550H and admission to the Honors Program, or permission of instructor and Director of Honors Program.

## ECEN 1560 Electrical Engineering Computing 2 s.h.

Problem solving techniques for the fields of electrical and computer engineering; procedural program development using the C/C++ programming language. Fundamentals of engineering drawing using AutoCAD commercial software packages. One hour lecture, three hours lab. ENGR 1555 may be taken concurrently.

**Prereq.:** MATH 1571 or concurrent high school technical drawing proficiency or ENGR 1555.

## ECEN 2610 Computer Tools for Electrical and Computer Engineering 1 s.h.

Introduction to software packages and resources such as MATLAB, PSpice, and Quartus II for analysis and design of circuits and systems. Prereq. or Coreq.: ECEN 2632 and ECEN 2611.

## ECEN 2611 Instrumentation and Computation Lab 1 1 s.h.

Laboratory experiments and computer exercises to accompany ECEN 2632. Laboratory experimentation and basic instrumentation. Computer-aided analysis and simulation.

**Prereq. or Coreq.:** ECEN 2632.

## ECEN 2612 Instrumentation and Computation Lab 2 1 s.h.

Laboratory experiments and computer exercises to accompany ECEN 2633. Laboratory experimentation and basic instrumentation. Computer-aided analysis and simulation.

**Prereq.:** ECEN 2611.

**Prereq. or Coreq.:** ECEN 2633.

## ECEN 2614 Basics of Electrical Engineering 3 s.h.

Introduction to electrical circuit elements and laws; DC and AC analysis. Introduction to digital devices and circuits with applications. Applications of electromagnetics. Intended for non-electrical engineering majors.

**Prereq.:** MATH 1571.

## ECEN 2632 Basic Circuit Theory 1 3 s.h.

Basic principles of linear circuits. Circuits concepts and laws, methods of analysis, network theorems. Source-resistor circuits. Inductors and capacitors. Analysis of AC circuits using phasors; impedance and admittance. Power calculations in DC and AC circuits.

**Prereq. or Coreq.:** MATH 1572.

## ECEN 2633 Basic Circuit Theory 2 3 s.h.

Continuation of ECEN 2632. First- and second-order transients in RLC circuits. Mutual inductance and transformers. Three-phase circuits. Transform methods in circuit analysis, transfer functions, resonance.

**Prereq.:** ECEN 2632.

**Prereq. or Coreq.:** MATH 2673.

## ECEN 3710 Signals and Systems 3 s.h.

Operation and analysis of communication, control, and computer systems at the signal level. Computer aided design tools and methods to analyze signals and systems. Continuous and discrete-time transforms. Noise analysis, signal detections, line codes, and multiplexing.

**Prereq.:** ECEN 2633, ECEN 1521 and MATH 3705.

## ECEN 3711 Intermediate Laboratory 1 1 s.h.

Laboratory experiments and computer exercises in the areas of digital and analog electronics and logic and computer circuits. Designed to accompany the co-requisite courses.

**Prereq.:** ECEN 2612.

**Prereq. or Coreq.:** ECEN 3733 and ECEN 3771.

## ECEN 3712 Intermediate Laboratory 2 1 s.h.

Laboratory experiments and computer exercises in the areas of digital and analog electronics, logic and computer circuits, and electromagnetics. Designed to accompany the co-requisite courses.

**Prereq.:** ECEN 3711.

**Prereq. or Coreq.:** ECEN 3742 and either ECEN 3772 or ECEN 3734.

## ECEN 3717 Sensor Fundamentals 3 s.h.

Basic principles of sensors such as electro-chemical, -mechanical, -optical, and -thermal transducers. Signal conditioning and smart sensors. Applications to process control and environmental systems.

**Prereq.:** MATH 3705, and either PHYS 2611 or ECEN 2632.

## ECEN 3730 Microprocessors and Microcontrollers 3 s.h.

Organization and structured assembly language programming. Digital controller devices and their relationships to processors and physical environments. Two hours lecture and three hours laboratory per week.

**Prereq.:** ECEN 3733.

## ECEN 3733 Digital Circuit Design 3 s.h.

Modern digital circuit analysis and design. Latches, flip-flops, registers, counters, memories, programmable logic arrays, and arithmetic logic units. Logic gate-level synthesis and computer simulation using CAD tools. Synchronous and asynchronous finite-state machines.

**Prereq.:** ECEN 1521, ECEN 2633.

## ECEN 3734 Computer Design 3 s.h.

Systematic methodologies for digital computer hardware and software designs. VLSI circuits. SOPC, CPLD, and FPGA designs. Hardware description languages.

**Prereq.:** ECEN 3733.

## ECEN 3741 Electromagnetic Fields 1 3 s.h.

Maxwell's equations. Static electric and magnetic fields. Magnetic materials and forces, dielectrics, conductance, capacitance, and inductance. Poisson's and Laplace's equations.

**Prereq.:** ECEN 2633, prerequisite or concurrent MATH 3705.

## ECEN 3742 Electromagnetic Fields 2 3 s.h.

Maxwell's equations. Time varying electric and magnetic fields. Electro-mechanical devices, transmission lines, microwaves. Antennas and radiation.

**Prereq.:** ECEN 3741.

## ECEN 3771 Digital and Analog Circuits 1 3 s.h.

Terminal characteristics of electronic devices such as diodes, BJTs (bipolar junction transistors), FETs (field effect transistors), and operational amplifiers. The design of digital circuits with these devices. Basic bias and small-signal models for analog amplifiers. Computer-aided design and analysis.

**Prereq.:** ECEN 2633.

**ECEN 3772 Digital and Analog Circuits 2 3 s.h.**

Continuation of ECEN 3771. Bias and signal modeling for amplifier design. Large-signal, small-signal and DC amplifiers. Single-stage, multistage and power amplifiers. Frequency response. Applications with op amps such as amplifiers, comparators, filters, and oscillators. Computer-aided design and analysis.

**Prereq.:** ECEN 3771.

**ECEN 4803 Linear Control Systems 3 s.h.**

System modeling, responses and performance measures. Stability analysis by root locus, Bode, and Nyquist plots. Computer-aided control system design. Compensator design. Three hours lecture per week.

**Prereq.:** ECEN 2633, ECEN 3712, MATH 3705, MECH 2620.

**ECEN 4803L Linear Control Systems Laboratory 1 s.h.**

Laboratory exercises to accompany ECEN 4803. Three hours laboratory per week. 1 s.h.

**Prereq.:** ECEN 2633, ECEN 3712, MATH 3705, MECH 2620.

**Prereq. or Coreq.:** ECEN 4803.

**ECEN 4811 Senior Laboratory 1 s.h.**

Laboratory experiments and computer exercises in the areas of applied electromagnetics, energy conversion. Designed to accompany the co-requisite course.

**Prereq.:** ECEN 3712.

**Prereq. or Coreq.:** ECEN 4844.

**ECEN 4820 5G Wireless Networks 3 s.h.**

This course will cover the fundamental aspects of wireless networks, with emphasis on current and next-generation wireless networks. Various aspects of wireless networking will be covered including: Introduction to Wireless networks and technical challenges, Coding and Modulation Techniques, Multiplexing Techniques (SDMA, TDMA, FDMA, CDMA), Cellular Systems (1G, 2G, 3G, 4G, 5G), Wireless LAN/PAN/MAN, Internet of Things.

**Prereq. or Coreq.:** ECEN 3710.

**ECEN 4844 Electromagnetic Energy Conversion 3 s.h.**

An examination of lumped electromagnetic parameters with development of theoretical, experimental, and design parameters for electrical energy conversion devices such as transformers, motors, and generators. Typical and special applications.

**Prereq.:** ECEN 3741 or concurrent: MECH 2620.

**ECEN 4851 VLSI System Design 3 s.h.**

Basic MOSFET models. Layout of inverters, NAND, NOR, PLA, PAL and ROMs. CMOS process and design rules. VLSI system design methodology and computer EDA tools such as PSpice and layout editors.

**Prereq.:** ECEN 3771, ECEN 3733.

**ECEN 4852 Neural Networks and Robotics 3 s.h.**

Principles for control applications and robotics, direct inverse control, neural networks, and fuzzy set theory. Applications including adaptive control, neural networks for motion control and path planning in robotics.

**Prereq.:** ECEN 3733.

**ECEN 4854 Principles of Electromagnetic Compatibility 3 s.h.**

Review of electromagnetic theories. Techniques of electromagnetic compatibility in electronic systems and computer hardware. Modeling and simulation of transmission lines and circuits. Electromagnetic discharge and grounding problems for high-frequency applications. Radio-frequency emissions from electronic devices. Shielding techniques to prevent ESD and EMI.

**Prereq.:** ECEN 3742 and MATH 3705.

**ECEN 4855 Advanced Digital Control 3 s.h.**

Fundamentals of sampled linear control systems, digital controllers and observers. Analysis techniques including difference and state-variable equations, transfer functions, transforms. Sampling, stability, and discrete approximation.

**Prereq.:** ECEN 3733.

**ECEN 4856 Embedded System Design 4 s.h.**

Fundamentals of small-scale and medium-scale embedded systems. Design techniques for processors, timers, input device interfacing, interrupt controllers, and drive circuits. Real-time operating system programming tools. Hardware-software co-designs. Three hours lecture, three hours laboratory.

**Prereq.:** ECEN 3733.

**ECEN 4881 Modern Control System Design 3 s.h.**

Advanced control system analysis and design. LQR, pole placement, state observer design. Introduction to system identification and adaptive controllers. MATLAB simulation and real-time implementation of controllers. Three hours lecture, three hours laboratory per week.

**Prereq.:** ECEN 4803.

**ECEN 4899 Senior Design Project 3 s.h.**

An electrical/computer engineering design problem is chosen or assigned; students work in teams. Proposals are presented which describe the design problem and approaches to it. The final design is presented in written and oral forms. This capstone course is intended to mimic a typical industrial or research project and includes ethical and economical considerations with the engineering work. Three-hour lecture/discussion per week.

**Prereq.:** ECEN 4811 and 27 semester hours of ECEN courses.

**Gen Ed:** Capstone.

**ECEN 4899L Senior Design Project Lab 1 s.h.**

Laboratory exercises to accompany ECEN 4899. Three hours laboratory per week.

**Prereq.:** ECEN 4811 and 27 semester hours of ECEN courses.

**Prereq. or Coreq.:** ECEN 4899.

**ECEN 5800 Special Topics 1-3 s.h.**

Special topics, new developments in Electrical Engineering. Subject matter, special prerequisites, and credit hours to be announced in advance of each offering. May be repeated with different subject matter to a maximum of 6 s.h.

**Prereq.:** Senior standing in Electrical and Computer Engineering.

**ECEN 5807 Advanced Digital and Analog Circuits 3 s.h.**

Chip circuitry for devices such as BJT, CMOS, and ECL-based digital logic chips. Switching devices such as SCRs, triacs, and timers. Switching power supplies. Power amplifiers. Applications and specifications of off-the-shelf IC devices. Computer-aided design and analysis.

**Prereq.:** ECEN 3772.

**ECEN 5808 Advanced Signals and Systems 3 s.h.**

Communication and control system modeling and simulations; signal analysis in continuous-time, discrete-time and frequency domains. Advanced communication system applications.

**Prereq.:** ECEN 3710 and MATH 3705.

**ECEN 5816 Theory and Fabrication of Solid-State Devices 3 s.h.**

An introductory study of physical theory, design, and fabrication of discrete devices and integrated circuits. Electronic properties of semiconductors such as carrier concentration, energy gap, mobility, lifetime. Techniques of fabrication such as oxidation, diffusion, alloying ion implantation, metallization, masking.

**Prereq.:** ECEN 3741 and ECEN 3771.

**ECEN 5817 Sensor Design and Application 3 s.h.**

Designs and applications for measurement and control; includes electro-chemical, -mechanical, -optical, and -thermal transducers. Signal conditioning and smart sensors.

**Prereq.:** ECEN 3771 or ECEN 3717.

**ECEN 5820 Function, Design, and Application of Medical Imaging Systems 3 s.h.**

Introduction to the Physics, Instrumentation, Image Processing Methods used in common medical imaging modalities. Systems covered include X-Ray, CT, Ultrasound, MRI, nuclear medicine, and fluorescence. Primary foci will be system construction as well as image reconstruction and processing. Students will engage in limited hands-on image acquisition and code-based processing.

**Prereq.:** PHYS 2611 or ECEN 3741.

**Prereq. or Coreq.:** ECEN 3710.

**ECEN 5830 Digital Signal Processing 3 s.h.**

Discrete time signals and systems; discrete, fast, and inverse Fourier transforms. Digital filter analysis and design, digital signal processing applications. Two hours lecture, three hours laboratory.

**Prereq.:** ECEN 3710.

**ECEN 5835 Computer Architecture with VHDL 4 s.h.**

Use of hardware description languages to design computer components and systems. Arithmetic and logic units, control units, VHDL models for memories and busses, interfacing, transfer design. Survey of modern computer systems.

**Prereq.:** ECEN 3734.

**ECEN 5840 Electric Power Systems 4 s.h.**

Modeling of power system components. Power flow, faults, protection systems, and stability problems. Special projects and laboratory experiments including CAD applications for analysis, design, and simulation of power system networks. Three hours lecture, three hours laboratory per week.

**Prereq. or Coreq.:** ECEN 4844.

**ECEN 5850 Communications Applications 3 s.h.**

Applicable technologies and "real-world" communication components and systems. Design and analysis tools. Emerging technologies, "killer apps", networking, data acquisition, and convergence.

**Prereq.:** ECEN 3710 or ECEN 5808.

**ECEN 5860 Fundamental of Antenna Design and Application 3 s.h.**

Examination of dipole, loop aperture, and microstrip antennas; array theory; radiation resistance, directivity, equivalent circuits, input impedance, and basic transceiver architecture. Investigation of practical applications of antennas and arrays in communications systems, radar systems and airborne navigation systems.

**Prereq.:** ECEN 3742 grade of "C" or better and 21 s.h. of ECEN courses.

**ECEN 5879 Computer-Aided Design 3 s.h.**

The design, analysis, and modeling of linear and nonlinear networks and systems using a simulation and modeling computer program. Development and use of library models of devices, subcircuits, and subsystems.

**Prereq.:** ECEN 2611 and 21 s.h. of ECEN courses.

**ECEN 5890 Power Electronics 4 s.h.**

SCRs, rectifier circuits, commutation techniques, AC controllers, converters, and inverters. Special projects and laboratory experiments including computer applications for analysis, design, and simulation of power electronics network. Three hours lecture, three hours laboratory per week.

**Prereq.:** ECEN 3771 and 21 s.h. of ECEN courses.

**ECEN 6900 Seminar 1-3 s.h.**

Designed to examine topics in the field. May be repeated once.

**ECEN 6901 Control Systems 1 3 s.h.**

Fundamental concepts in linear system theory. matrix algebra, linear vector spaces, linear operators. Input-output and state-space models for continuous-time systems; canonical forms. Solutions of state space equations. Characteristics of linear systems: stability; controllability and observability. State variable feedback; introduction to state estimation.

**ECEN 6902 Control Systems 2 3 s.h.**

State-variable feedback techniques; design of state estimators. Design using polynomial equations. Design of digital controllers: discrete equivalents and direct methods. Introduction to implementation of digital control systems.

**Prereq.:** ECEN 6901.

**ECEN 6903 Advanced Control Systems 3 s.h.**

Introduction to nonlinear control systems: basic nonlinear phenomena, describing functions, Lyapunov stability, linearization techniques. Introduction to linear optimal quadratic control; stochastic modeling and Kalman filtering.

**Prereq.:** ECEN 6902.

**ECEN 6911 Electromagnetic Fields 1 3 s.h.**

Solution of boundary value problems in general form. Laplace, Poisson, and diffusion and wave equations in orthogonal coordinate systems.

**ECEN 6912 Electromagnetic Fields 2 3 s.h.**

Solution of boundary value problems in general form. Laplace, Poisson, and diffusion and wave equations in orthogonal coordinate systems.

**ECEN 6933 Digital Systems: VHDL Design 3 s.h.**

Local minimization, design of combinational networks; design of synchronous and asynchronous sequential machines; design of digital systems using VHD, modeling combinational and sequential networks, compilation, simulation, and synthesis of VHDL codes.

**ECEN 6934 Digital Systems: Computer Arithmetic 3 s.h.**

Number system representations: standard and unconventional formats. Design of two-operand and multi-operand fast adders. High-speed multiplication and division algorithms. Floating-point numbers, algorithms, and error control. Hardware algorithms for function evaluation.

**Prereq.:** ECEN 6933.

**ECEN 6981 Electric Power System Engineering 3 s.h.**

The formulation of equations to study electric power network problems, including feeders, power flow, short circuits, protection systems, and stability. The study of power system over voltages and transients caused by short circuits, switching, and lightning. The application of numerical techniques to study and design special projects using digital computations.

**ECEN 6983 Modern Power Sources 3 s.h.**

Analytical and descriptive study of modern power plants. Combustion and environmental problems with fossil-fueled power plants. Electromagnetic circuits and devices with emphasis on the principles of electromechanical energy conversions.

**Cross-Listed:** CHEN 6983 and MECH 6983.

**ECEN 6985 Electromechanical Motion Devices 3 s.h.**

Thermodynamics of batteries, and of electric and fuel cells. Power from nuclear isotopes. Features common to rotating electromagnetic fields. Analysis and design of electromechanical power components. Logic circuit design with I/O structure and interface.

**Cross-Listed:** CHEN 6985 and MECH 6985.

**ECEN 6986 Power Electronics Circuits and Devices 3 s.h.**

The design and analysis of power electronic circuits using solid-state switching devices. Topics include power semiconductor diodes and transistors, diode circuits and controlled rectifiers, thyristors, communication techniques, AC voltage controllers, and switching regulators, with applications.

**ECEN 6987 Power Electronics and Industrial Drives 3 s.h.**

The design and analysis of power electronic circuits and systems, static switches, power supplies, AC and DC drives, and protection of power electronic devices and circuits.

**ECEN 6988 Nano- and Micro-Electro Mechanical Systems 3 s.h.**

NEMS and MEMS fabrications, elastic system structure, membranes and plates, magnetically actuated systems, continuum theory and scaling laws. Microfluidics and nanofluidics devices.

**Prereq.:** Graduate standing.

**ECEN 6990 Thesis 1-6 s.h.**

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