

ELECTRICAL ENGINEERING (EENG)

EENG 160. DIGITAL CIRCUITS. 4 Credits.

Pre-requisites: MTHD 104 or equivalent. Corequisite: EENG 160L.

Fundamentals of digital computer design including appropriate number systems, boolean algebra, and basic digital circuits. Methods introduced include the use of Karnaugh Maps and the Quine-Mckluskey procedure. Computer laboratory work involves the use of current software for the design, analysis, and simulation of digital circuits. Companion course to EENG 160L.

EENG 160L. DIGITAL CIRCUITS LAB. 1 Credit.

Pre-requisites: MTHD 104 or equivalent. Corequisite: EENG 160.

Companion lab to EENG 160.

EENG 163. INTRODUCTION TO EMBEDDED SYSTEMS AND ELECTRICAL ENGINEERING. 4 Credits.

Pre-requisites: EENG 160. Corequisite: EENG 163L.

Provides an introduction to Electrical Engineering while exploring the fundamentals of Embedded System using Python. Topics include programming, basic input/output, control flow, and debugging. Laboratory exercises include a diverse set of exercises, drawing from different areas in electrical engineering. Companion course to EENG 163L.

EENG 163L. INTRO TO EMBEDDED SYSTEMS AND ELECTRICAL ENGINEERING LAB. 1 Credit.

Pre-requisites: EENG 160. Corequisite: EENG 163.

Companion lab to EENG 163.

EENG 199. DIRECTED STUDY. 1-5 Credits.

Pre-requisites: permission of the instructor, department chair and college dean.

Directed study.

EENG 209. CIRCUIT THEORY I. 4 Credits.

Pre-requisites: PHYS 153 or permission of the instructor. Corequisite: EENG 209L.

Provides electrical engineering students with an understanding of electricity and its applications. Topics include AC/DC circuit-analysis methods such as nodal and mesh analysis, superposition, Norton Theorem, Thevenin Theorem, and transient analysis. Companion course to EENG 209L.

EENG 209L. CIRCUIT THEORY I LAB. 1 Credit.

Pre-requisites: PHYS 153 or permission of the instructor. Corequisite: EENG 209.

Companion lab to EENG 209.

EENG 210. CIRCUIT THEORY II. 4 Credits.

Pre-requisites: EENG 209. Corequisite: EENG 210L.

Covers circuit analysis using Laplace transform, phasors and AC analysis, AC Power, three-phase circuits, magnetically coupled circuits, and the ideal transformer. Companion course to EENG 210L.

EENG 210L. CIRCUIT THEORY II LAB. 1 Credit.

Pre-requisites: EENG 209. Corequisite: EENG 210.

Companion lab to EENG 210.

EENG 220. INTRODUCTION TO LINEAR SYSTEMS. 4 Credits.

Pre-requisites: MATH 163, EENG 163. Corequisite: EENG 220L.

Provides an applied introduction to multi-input multi-output (MIMO), linear, time-invariant Electrical and Computer Engineering systems. Topics include linear systems representation methods; Eigen-Decomposition with Eigenvalue and Eigenvectors; State-Space methods for computer simulation of MIMO systems. Companion course to EENG 220L.

EENG 220L. INTRODUCTION TO LINEAR SYSTEMS LAB. 1 Credit.

Pre-requisites: MATH 163, EENG 163. Corequisite: EENG 220.

Companion lab to EENG 220.

EENG 255. INTRODUCTION TO C FOR EMBEDDED SYSTEMS. 4 Credits.

Pre-requisites: EENG 163; MATH 161 or permission of the instructor. Corequisite: EENG 255L.

An introduction to the C programming language, with a focus on skills required for embedded systems. Students write, run, debug, analyze, and evaluate C programs. Topics include data types, number systems, file I/O, control structures, function design and usage, arrays, pointers, and digital I/O. The lab component focuses on programming projects that interact with hardware. Companion course to EENG 255L.

EENG 255L. INTRODUCTION TO C FOR EMBEDDED SYSTEMS LAB. 1 Credit.

Pre-requisites: EENG 163; MATH 161 or permission of the instructor. Corequisite: EENG 255.

Companion lab to EENG 255.

EENG 260. MICROCONTROLLER SYSTEMS. 3 Credits.

Pre-requisites: EENG 160, EENG 255. Corequisite: EENG 260L.

An introductory course on microprocessor and microcontroller systems organization. Provides low-level programming principles for microcomputer based systems. Emphasizes assembly and C language programming techniques and laboratory experiments in input/output programming, memory organization, interrupts and interfacing methods. Companion course to EENG 260L.

EENG 260L. MICROCONTROLLER SYSTEMS LAB. 1 Credit.

Pre-requisites: EENG 160, EENG 255. Corequisite: EENG 260.

Companion lab to EENG 260.

EENG 299. DIRECTED STUDY. 1-5 Credits.

Directed study.

EENG 320. SIGNALS AND SYSTEMS I. 4 Credits.

Pre-requisites: EENG 163, EENG 210 or concurrent enrollment, or permission of the instructor; MATH 163. Corequisite: EENG 320L.

An introduction to continuous-time signal analysis. Topics include: generalized functions and the relationship to basic signals including impulses, pulses and unit step; system properties such as linearity, time-invariance and causality; and Fourier analysis. Companion course to EENG 320L.

EENG 320L. SIGNALS AND SYSTEMS I LAB. 1 Credit.

Pre-requisites: EENG 163, EENG 210 or concurrent enrollment, or permission of the instructor; MATH 163. Corequisite: EENG 320.

Companion lab to EENG 320.

EENG 321. SIGNALS AND SYSTEMS II. 4 Credits.

Pre-requisites: EENG 320, MATH 163. Corequisite: EENG 321L.

Introduction to Laplace Transform, Z-transform, the Fourier Series, the Fourier Transform, the Discrete Fourier Transform (DFT), the Discrete-Time Fourier Transform (DTFT) and Sampling Theorem. Introduction to analysis of Linear Time Invariant (LTI) system using above techniques for continuous and discrete time. Companion course to EENG 321L.

EENG 321L. SIGNALS AND SYSTEMS II LAB. 1 Credit.

Pre-requisites: EENG 320, MATH 163. Corequisite: EENG 321.

Companion lab to EENG 321.

EENG 330. MICROELECTRONICS I. 4 Credits.

Pre-requisites: CHEM 171, or HONS 171, and CHEM 171L; EENG 209; MATH 163. Corequisite: EENG 330L.

Introduces the characterization, modeling, and application of semiconductor devices in the context of analog integrated circuits. Emphasis is placed on the development of models for circuit-level behavior of diodes, bipolar transistors, and apply the models to the analysis and design of linear amplifiers. Companion course to EENG 330L.

EENG 330L. MICROELECTRONICS I LAB. 1 Credit.

Pre-requisites: CHEM 171, or HONS 171, and CHEM 171L; EENG 209; MATH 163. Corequisite: EENG 330.

Companion lab to EENG 330.

EENG 331. MICROELECTRONICS II. 4 Credits.

Pre-requisites: EENG 210, EENG 330, MATH 163. Corequisite: EENG 331L.

Second in the characterization, modeling and application of semiconductor devices in the context of analog integrated circuits. Emphasis is on the metal-oxide-semiconductor (MOS) transistor. Topics include differential amplifiers, frequency response and feedback effects. Companion course to EENG 331L.

EENG 331L. MICROELECTRONICS II LAB. 1 Credit.

Pre-requisites: EENG 210, EENG 330, MATH 163. Corequisite: EENG 331.

Companion lab to EENG 331.

EENG 350. ENERGY SYSTEMS. 4 Credits.

Pre-requisites: EENG 210, MATH 163. Corequisite: EENG 350L.

Provides an introduction to the different energy sources, methods of electric energy conversion, the electric power system, transformers, and electrical machines. Companion course to EENG 350L.

EENG 350L. ENERGY SYSTEMS LAB. 1 Credit.

Pre-requisites: EENG 210, MATH 163. Corequisite: EENG 350.

Companion lab to EENG 350.

EENG 360. HARDWARE DESCRIPTION LANGUAGES. 4 Credits.

Pre-requisites: EENG 255 or EENG 163; EENG 160. Corequisite: EENG 360L.

Introduces methodologies and computer-aided design (CAD) tools for the design of complex electronic systems. Emphasis is on high-level description languages and their use for specifying, designing, simulating and synthesizing digital very large-scale integration (VLSI) circuits in MOS (metal-oxide-semiconductor) technologies. Theoretical knowledge will be complemented by hands-on use of commercial CAD tools. Companion course to EENG 360L.

EENG 360L. HARDWARE DESCRIPTION LANGUAGES LAB. 1 Credit.

Pre-requisites: EENG 255 or EENG 163; EENG 160. Corequisite: EENG 360.
Companion lab to EENG 360.

EENG 383. APPLIED STOCHASTIC PROCESSES. 4 Credits.

Pre-requisites: MATH 163; EENG 163 or EENG 255 or CSCD 240; or permission of the instructor. Must be taken concurrently with EENG 388.
Provides an introduction to the basic concepts of stochastic processes and their application to engineering problems. Topics include analysis of continuous and discrete random signals and systems, as well as modern estimation techniques.

EENG 388. STOCHASTIC PROCESSES LAB. 1 Credit.

Pre-requisites: concurrent enrollment in EENG 383.
This laboratory course introduces basic concepts of stochastic processes and their application to engineering problems.

EENG 399. DIRECTED STUDY. 1-5 Credits.

Pre-requisites: senior standing.
Directed study.

EENG 401. ENGINEERING APPLIED ELECTROMAGNETICS. 4 Credits.

Pre-requisites: EENG 210, EENG 320, MATH 241, and MATH 347. Corequisite: EENG 401L.
Provides the technical basis to analyze electromagnetic applications systems. Topics include waves and phasors, vector analysis, electrostatics, magnetostatics, Maxwell's equations for time-varying fields, and plane wave propagation. Companion course to EENG 401L.

EENG 401L. ENGINEERING APPLIED ELECTROMAGNETICS LAB. 1 Credit.

Pre-requisites: EENG 210, EENG 320, MATH 241, and MATH 347. Corequisite: EENG 401.
Companion lab to EENG 401.

EENG 420. DIGITAL SIGNAL PROCESSING. 4 Credits.

Pre-requisites: EENG 321. Corequisite: EENG 420L.
Provides an introduction to digital signal processing. Convolution, time invariance, and stability of discrete-time systems are presented. In addition, various signal processing techniques such as Z-transform, discrete Fourier transform (DFT) and fast Fourier transform (FFT) are studied. Time and frequency domain techniques for designing and applying infinite impulse response (IIR) and finite impulse response (FIR) digital filters are introduced. Companion course to EENG 420L.

EENG 420L. DIGITAL SIGNAL PROCESSING LAB. 1 Credit.

Pre-requisites: EENG 321. Corequisite: EENG 420.
Companion lab to EENG 420.

EENG 427. INTRODUCTION TO DEEP NEURAL NETWORKS. 4 Credits.

Pre-requisites: EENG 383 and EENG 388 (or MATH 380); and EENG 255 (or CSCD 240, or any high-level programming language such as C/C++, Java, Python etc.). Corequisite: EENG 427L.
Provides an introduction to deep neural networks (DNNs) such as CNNs, RNNs, ResNets, GANs, etc. Those DNNs are built up from a basic multi-layer perceptron. The learning algorithm using backpropagation is introduced and built up to advanced learning algorithms such as SGD, Adam etc. In addition, several design issues in DNNs such as overfitting/underfitting, vanishing and exploding gradient problems etc. are explained in the context of optimization for DNNs. Companion course to EENG 427L.

EENG 427L. INTRODUCTION TO DEEP NEURAL NETWORKS LAB. 1 Credit.

Pre-requisites: EENG 383 and EENG 388 (or MATH 380); and EENG 255 (or CSCD 240, or any high-level programming language such as C/C++, Java, Python etc.). Corequisite: EENG 427.
Companion lab to EENG 427.

EENG 428. REINFORCEMENT LEARNING. 4 Credits.

Pre-requisites: EENG 383 or permission of instructor. Corequisite: EENG 428L.
Introduces various reinforcement learning (RL) algorithms such as Dynamic Programming (DP), Monte Carlo (MC) learning, Temporal-Difference (TD) learning, Dyna-Q learning etc. These RL learning algorithms are built up in iterative ways from Bellman equations based on the interactions between agent(s) and environment. Furthermore, exploration, exploitation, and effective search algorithms are introduced in the context of the RL learning process. Companion course to EENG 428L.

EENG 428L. REINFORCEMENT LEARNING LAB. 1 Credit.

Pre-requisites: EENG 383 or permission of instructor. Corequisite: EENG 428.
Companion lab to EENG 428.

EENG 440. DIGITAL COMMUNICATION SYSTEMS. 4 Credits.

Pre-requisites: EENG 321, EENG 383. Corequisite: EENG 440L.
Provides a solid background in modern digital communication systems. Random processing is applied in the realm of communication theory. Common digital modulation and demodulation techniques are presented. Other topics include bandpass transmission of binary data, coherent/noncoherent communications, intersymbol interference and equalization. Companion course to EENG 440L.

EENG 440L. DIGITAL COMMUNICATION SYSTEMS LAB. 1 Credit.

Pre-requisites: EENG 321, EENG 383. Corequisite: EENG 440.
Companion lab to EENG 440.

EENG 450. POWER SYSTEMS ANALYSIS. 4 Credits.

Pre-requisites: EENG 350. Corequisite: EENG 450L.

Provides the ability to analyze power systems from technical and economic perspectives. It includes symmetrical components, calculation of line parameters, power flow control, representation of transmission lines, and power components. Companion course EENG 450L.

EENG 450L. POWER SYSTEMS ANALYSIS LAB. 1 Credit.

Pre-requisites: EENG 350. Corequisite: EENG 450.

Companion lab to EENG 450.

EENG 452. PROTECTIVE RELAYS. 4 Credits.

Pre-requisites: EENG 450. Corequisite: EENG 452L.

Provides the technical basis to analyze and design protection for power systems. Topics include per unit and phasors, symmetrical components, relay input sources, protection fundamentals, system grounding principles, and protection of power system components. Companion course to EENG 452L.

EENG 452L. PROTECTIVE RELAYS LAB. 1 Credit.

Pre-requisites: EENG 450. Corequisite: EENG 452.

Companion lab to EENG 452.

EENG 460. COMPUTING SYSTEMS: ORGANIZATION AND DESIGN. 4 Credits.

Pre-requisites: EENG 255, EENG 360. Corequisite: EENG 460L.

Provides the theoretical and practical knowledge required for analyzing and designing complex computing systems. Topics include computer performance, MIPS assembly language, integer and floating point arithmetic, designing a processor, pipelining and memory hierarchies. Assembly programming and design using VHDL are offered in weekly labs. Companion course to EENG 460L.

EENG 460L. COMPUTING SYSTEMS: ORGANIZATION AND DESIGN LAB. 1 Credit.

Pre-requisites: EENG 255, EENG 360. Corequisite: EENG 460.

Companion lab to EENG 460.

EENG 461. EMBEDDED SYSTEMS DESIGN. 4 Credits.

Pre-requisites: EENG 260, EENG 360 or permission of the instructor. Corequisite: EENG 461L.

Provides theoretical and practical knowledge required for analyzing and designing embedded computing systems. The key challenge of embedded systems is to optimize various design metrics and assess the impact the organization and interfacing of hardware/software components have on system performance. Hands-on experience using hardware interfaced with select microcontroller development boards is offered in weekly labs.

Companion course to EENG 461L.

EENG 461L. EMBEDDED SYSTEMS DESIGN LAB. 1 Credit.

Pre-requisites: EENG 260, EENG 360 or permission of the instructor. Corequisite: EENG 461.

Companion lab to EENG 461.

EENG 462. REAL TIME EMBEDDED SYSTEMS. 4 Credits.

Pre-requisites: EENG 461 or permission of the instructor. Corequisite: EENG 462L.

Involves the design and development of real-time software and hardware for embedded systems with an emphasis on Real-Time Operating Systems (RTOS), Networking and Security. Communication and Timeliness can be compromised under these design environments and therefore constitute some of the design challenges. Hands-on experience using microcontroller development boards sensors and actuators, are offered in weekly labs.

Companion course to EENG 462L.

EENG 462L. REAL TIME EMBEDDED SYSTEMS LAB. 1 Credit.

Pre-requisites: EENG 461 or permission of the instructor. Corequisite: EENG 462.

Companion lab to EENG 462.

EENG 470. CONTROL SYSTEMS. 4 Credits.

Pre-requisites: EENG 321. Corequisite: EENG 470L.

Reviews basic topics such as transfer function, step response and stability conditions. Includes feedback systems, analysis techniques such as root-locus analysis, transient and steady-state response analyses, and frequency response analysis are studied. In addition, state-space analysis techniques are explained within the context of state-space system models. Analysis and design of proportional, integral, and derivative (PID), PI and PD controllers are presented. Companion course to EENG 470L.

EENG 470L. CONTROL SYSTEMS LAB. 1 Credit.

Pre-requisites: EENG 321. Corequisite: EENG 470.

Companion lab to EENG 470.

EENG 471. DIGITAL CONTROL SYSTEMS. 4 Credits.

Pre-requisites: EENG 470. Corequisite: EENG 471L.

Provides the technical basis to understand and analyze digital control systems. Topics include frequency response, modeling digital control systems, steady-state error, stability, Z-domain design, and state-space models. An introduction to Lyapunov techniques is presented. Companion course to EENG 471L.

EENG 471L. DIGITAL CONTROL SYSTEMS LAB. 1 Credit.

Pre-requisites: EENG 470. Corequisite: EENG 471.

Companion lab to EENG 471.

EENG 490A. SENIOR CAPSTONE DESIGN I. 1 Credit.

Pre-requisites: EENG 210, EENG 260, EENG 320, EENG 330, and EENG 350. Corequisite: EENG 490AL.

Satisfies: a university graduation requirement—senior capstone.

Simulates the industrial environment, where students work in a team to solve a real world problem, from design to implementation. Team dynamics are strictly monitored and each student's unique skills are utilized in different stages of the design process. Dealing with problems typical of a team environment results in an invaluable learning experience both in the professional and civic lives of the students. First of a two-course sequence. Companion course to EENG 490AL.

EENG 490AL. SENIOR CAPSTONE DESIGN I LAB. 1 Credit.

Pre-requisites: EENG 210, EENG 260, EENG 320, EENG 330, and EENG 350. Corequisite: EENG 490A.

Companion lab to EENG 490A.

EENG 490B. SENIOR CAPSTONE DESIGN II. 1 Credit.

Pre-requisites: EENG 490A. Corequisite: EENG 490BL.

Satisfies: a university graduation requirement—senior capstone.

Simulates the industrial environment, where students work in a team to solve a real world problem, from design to implementation. Team dynamics are strictly monitored and each student's unique skills are utilized in different stages of the design process. Dealing with problems typical of a team environment results in an invaluable learning experience both in the professional and civic lives of the students. Second of a two-course sequence. Companion course to EENG 490BL.

EENG 490BL. SENIOR CAPSTONE DESIGN II LAB. 2 Credits.

Pre-requisites: EENG 490A. Corequisite: EENG 490B.

Companion lab to EENG 490B.

EENG 495. INTERNSHIP. 1-6 Credits.

Notes: graded Pass/Fail.

Pre-requisites: junior or senior status and permission of the instructor, department chair and dean.
Internship.

EENG 496. EXPERIMENTAL. 1-5 Credits.

Pre-requisites: varies by course.

Experimental.

EENG 498. SEMINAR. 1-6 Credits.

Seminar.

EENG 499. DIRECTED STUDY. 1-10 Credits.

Pre-requisites: permission of the instructor, department chair and college dean.

Designed for students wanting to pursue a subject beyond the scope of regular courses.

EENG 599. INDEPENDENT STUDY. 1-5 Credits.

Independent Study.