

# ELECTRICAL ENGINEERING (EE)

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## EE-210 Circuits I 3 Credits

Corequisites: EE-211

Prerequisites: PHYS-224 and PHYS-225 and (MATH-102 or MATH-102H or MATH-102X)

Fundamental DC and AC circuit analysis techniques are covered in this introductory course. Topics include circuit variables and elements; resistors, inductors, and capacitors; and sinusoidal steady-state analysis with power calculations.

Lecture: 3, Lab 0, Other 0

## EE-211 Circuits I Lab 1 Credits

Corequisites: EE-210

Prerequisites: None

An introductory laboratory course designed to reinforce the fundamental analysis techniques discussed in EE-210, Circuits I. Topics include: safe use of laboratory equipment and experimental verification of analysis techniques.

Lecture: 0, Lab 2, Other 0

## EE-212 Applied Electrical Circuits 3 Credits

Corequisites: MATH-204, MECH-231L

Prerequisites: PHYS-224 and PHYS-225

Application of electrical circuit components are covered in this course. Topics include: Ohm's law and Kirchhoff's laws; series and parallel circuits; voltage and current division rules; node-voltage and mesh-current methods; superposition; Thevenin's, and Norton's theorems; first- and second-order R-L-C circuits; steady-state analysis and power calculations for sinusoidally-varying (ac) sources; operational amplifiers; and diodes. This course will not satisfy the requirements of an Electrical or Computer Engineering degree.

Lecture: 3, Lab 0, Other 1

## EE-240 Electromagnetic Fields and Applications 4 Credits

Prerequisites: PHYS-224 and PHYS-225

Basics of electromagnetic fields and applications are studied. Topics include: vector analysis; gradient, divergence, and curl; electrostatic fields; electrostatic boundary-value problems; magnetostatic fields; magnetic circuits; and Maxwell's equations for time-varying fields.

Lecture: 4, Lab 0, Other 0

## EE-310 Circuits II 4 Credits

Prerequisites: EE-210 and (MATH-204 or MATH-204H)

A second course in circuit analysis. Topics include: first-order and second-order transient circuit analysis, the Fourier series, three-phase circuits, resonance, filters, Bode plots and magnetically coupled circuits.

Lecture: 4, Lab 0, Other 0

## EE-320 Electronics I 3 Credits

Corequisites: EE-321

Prerequisites: EE-210 and EE-211

The basic building blocks used in electronic engineering are studied. Topics include: operational amplifiers; diodes; MOS and bipolar devices; basic transistor amplifier configurations; and MOSFET digital logic circuits.

Lecture: 3, Lab 0, Other 0

## EE-321 Electronics I Laboratory 1 Credits

Corequisites: EE-320

Prerequisites: EE-210 and EE-211

An introductory laboratory course designed to reinforce the topics in EE-320, Electronics I. Experiments include: PSPICE simulation, operational amplifiers; diodes; MOS and bipolar transistor configurations; MOSFET digital circuits.

Lecture: 0, Lab 2, Other 0

## EE-325 Principles of Microelectronics Processing 4 Credits

Prerequisites: EE-320 and EE-321

The principles of semiconductor processing for modern integrated circuits are covered in this introductory course. Topics include a brief review of semiconductor devices and semiconductor circuit families, modern CMOS technology and process flow, crystal growth, semiconductor processing, thin film deposition oxidation, etching, lithography and an introduction to clean room principles. Principles of manufacturing process control and modeling for manufacturability will be presented. Computed simulation will be extensively used where appropriate.

Lecture: 4, Lab 0, Other 0

## EE-336 Continuous-Time Signals and Systems 4 Credits

Prerequisites: (MATH-204 or MATH-204H) and EE-210

Minimum Class Standing: Sophomore

Introductory continuous-time signals and systems are studied. Topics include: definitions and properties of signals and systems, convolution, differential equations, Laplace transform with applications, Fourier series, and Fourier transform of continuous-time signals with applications.

Lecture: 4, Lab 0, Other 0

## EE-338 Discrete-Time Signals and Systems 4 Credits

Prerequisites: (MATH-204 or MATH-204H) and EE-210

Minimum Class Standing: Sophomore

Introductory discrete-time signals and systems are studied. Topics include: definitions and properties of signals and systems, sampling, convolution, difference equations, Z transform with applications, and the Fourier transform of discrete-time signals with applications.

Lecture: 4, Lab 0, Other 0

## EE-340 Electromagnetic Wave Propagation 4 Credits

Prerequisites: EE-240

Advanced concepts of electromagnetic fields are studied. Topics include: propagation of uniform plane waves in various material media; transmission line analysis; electromagnetic wave propagation in waveguides; and antennas.

Lecture: 4, Lab 0, Other 0

## EE-342 Electrical Machines 4 Credits

Corequisites: EE-310

Prerequisites: EE-210 and EE-211 and EE-240

Operating principles and design concepts of various types of electrical machines are studied. Topics include: magnetic circuits, single-phase and three-phase transformers; dc motors and generators; three-phase alternators; synchronous motors, induction motors and single-phase motors.

Lecture: 3, Lab 2, Other 0

**EE-344 Fundamentals of Power Systems 4 Credits**

Prerequisites: EE-210 and EE-211

Basic structure of electrical power systems and characteristics of power transmission lines, transformers and generators are studied. Topics include: representation of power systems; symmetrical three-phase fault analysis; symmetrical components; unsymmetrical fault computations; and network analyzers.

Lecture: 3, Lab 2, Other 0

**EE-346 High Voltage Generation and Measurement Techniques 4 Credits**

Prerequisites: EE-210 and EE-211 and EE-240

Insulation overvoltage-tests are studied. Topics include: generation of high, direct, alternating, and impulse voltages; voltage multiplier circuits; resonant test circuits; resistive, capacitive and mixed high-voltage dividers; sphere gaps; electrostatic voltmeters, Kerr Cell; and electrostatic coupling, interference, and grounding and safety.

Lecture: 3, Lab 2, Other 0

**EE-348 Electromagnetic Compatibility 4 Credits**

Prerequisites: EE-210 and EE-240

Issues involved in designing electrical and electronic systems to achieve electromagnetic compatibility are studied. Topics include: interference sources; government regulations limiting conducted and radiated emissions; electric and magnetic field noise coupling; grounding; filtering; shielding; electrostatic discharge; spectral analysis of electromagnetic interference; design methods for minimizing radiated emissions from digital circuits; and measurements of system emissions and susceptibility.

Lecture: 4, Lab 0, Other 0

**EE-391 EE Special Topics 4 Credits**

Prerequisites: None

Lecture: 4, Lab 0, Other 0

**EE-399 EE Independent Study 4 Credits**

Prerequisites: None

Lecture: 0, Lab 0, Other 0

**EE-420 Electronics II 4 Credits**

Prerequisites: EE-310 and EE-320 and EE-321

Advanced concepts of electronic engineering are studied. Topics include: nonlinear circuits; active filters; differential and multistage amplifiers; pulse and switching circuits; integrated circuits; and electronic system design.

Lecture: 3, Lab 2, Other 0

**EE-421 Energy Storage Sys w/ EV App 4 Credits**

Prerequisites: EE-210 or EE-212

The purpose of this course is to introduce the basics of energy storage systems. We will look at several competing energy storage concepts and management systems. The emphasis is on rechargeable Li-ion batteries for EV applications. The course will focus on the fundamentals of Li-ion batteries with respect to the physical principles of operation, design, manufacturing, modeling and state estimation. Students are required to complete research projects and independent review of research topics with approval of the instructor.

Lecture: 4, Lab 0, Other 0

**EE-424 Power Electronics and Applications 4 Credits**

Prerequisites: EE-310 and EE-320 and EE-321

Speed control and dynamic representation of electric motors are studied. Topics include: characteristics of diodes; diacs; thyristors; and MOSFET's; thyristor gate firing circuits; operating principles of AC/DC, DC/DC and DC/AC converter circuits; and computer-aided state-space analysis of the dynamic response of the converter circuits.

Lecture: 3, Lab 2, Other 0

**EE-427 Semiconductor Device Fundamentals 4 Credits**

Prerequisites: EE-320

Basic semiconductor theory for solid-state devices, diode theory, and applications of theory for transistors are studied. Topics include: energy bands, carrier statistics, equilibrium carrier concentrations, carrier transport, electrostatic devices, diode I-V characteristics, optical device applications, microwave device effects, and BJT, JFET, MESFET and MOSFET transistor models.

Lecture: 4, Lab 0, Other 0

**EE-430 Communication Systems 4 Credits**

Prerequisites: EE-310 and EE-320 and MATH-258 and (EE-336 or EE-338)

The study of methods used in electronic communication systems. Topics include: Fourier Transforms; analysis of distortion over a communication channel; autocorrelation of deterministic and random signals; energy and power spectral density; amplitude modulation; frequency modulation; phase modulation; digital line coding and modulation; communication circuitry.

Lecture: 4, Lab 0, Other 0

**EE-432 Feedback Control Systems 4 Credits**

Prerequisites: EE-310 or EE-336

Time and frequency domain representations of control systems are studied. Topics include: stability criteria; root locus methods; frequency response techniques, s-plane design methods. Design and evaluation of control systems are supplemented with computer aided control system design software.

Lecture: 3, Lab 2, Other 0

**EE-433 Digital Control Systems 4 Credits**

Prerequisites: EE-338 and EE-432

Minimum Class Standing: Senior 1

Control of continuous-time processes using computer-based controllers is studied. Topics include design of control algorithms for implementation, modeling of discrete time systems, application of z-transforms, stability analysis, root locus analysis, controller design via conventional techniques, state-space analysis and modeling, and design and implementation of digital controller. Implementation of real-time digital controllers is performed in the laboratory.

Lecture: 3, Lab 2, Other 0

**EE-434 Digital Signal Processing 4 Credits**

Prerequisites: ECE-101 and EE-338

Basic principles, design and applications of digital signal processing systems are presented. Topics include: review of discrete-time signals and systems, the z-transform, discrete-time Fourier analysis, the Discrete Fourier Transform, the Fast Fourier Transform, digital filter structures, FIR filters, and IIR filters. This course includes extensive use of MATLAB and experimental design projects using real-time signal processors.

Lecture: 3, Lab 2, Other 0

**EE-444 Computational Methods in Power Systems 4 Credits**

Prerequisites: EE-344

Matrix analysis of power system networks is studied. Topics include: power flow study of large scale interconnected power systems using Gauss-Seidel and Newton-Raphson methods; computer-aided short circuit analysis of large systems; economic operation of power networks; transient stability analysis; overvoltage calculations; and fundamentals of power system protection.

Lecture: 4, Lab 0, Other 0

**EE-446 Vector Control of AC Electric Machines 4 Credits**

Prerequisites: EE-240 and EE-310 and EE-320 and EE-321

Methods of controlling electric machines and their applications in electric vehicles are discussed. Topics include the theory of permanent-magnet and induction machines; coordinate-frame transformations; analysis and tuning of torque and speed control systems; modeling and dynamics of electric drives and vehicles, power-electronic devices, power-electronic circuits and switching schemes; rotor-flux oriented vector control; regenerative braking; and rotor-flux position-sensing methods. Machine and vehicle models will be developed using MATLAB Simulink. A low-voltage permanent-magnet machine and power-electronic inverter will be analyzed and tested.

Lecture: 3, Lab 2, Other 0

**EE-482 Robot Dynamics and Control 4 Credits**

Corequisites: EE-432

Prerequisites: None

Review of mathematical principle for robotics including matrix operations and their concepts. Principles of robot analysis, design, and operation are presented. Topics include review of historical robotics evolutions and applications, robot coordinate system placement rules, kinematic model development, kinematic solutions and analysis, trajectory planning and movement optimization, collision avoidance and path planning, feedback control system for robotics, feedforward, study of sensors for robotics applications, vision system types and application for robotics and mobile robots.

Lecture: 4, Lab 0, Other 0

**EE-490 Senior Electrical Engineering Design Project 4 Credits**

Prerequisites: CE-320 and EE-240 and EE-310 and EE-320 and EE-321 and (EE-336 or EE-338)

Minimum Class Standing: Senior

Students are prepared for engineering practice through a major design experience based on knowledge and skills acquired in earlier course work. They work in teams to creatively solve an open-ended engineering design problem and develop a prototype system to meet a given specification. The design will emphasize electrical engineering, but will be multidisciplinary. The specification requires the design solution to incorporate appropriate engineering standards with consideration of multiple constraints such as: public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Designs are documented in a professional manner and presented publicly for a range of audiences.

Lecture: 2, Lab 4, Other 0