ELECTRICAL ENGINEERING (EE)

EE-210 Engineering Circuit Analysis I 4 Credits
Corequisites: PHYS-224, PHYS-225
Prerequisites: MATH-102 or MATH-102X
This course introduces the fundamental principles of electric circuit analysis emphasizing DC and transient behavior. Students will learn methods to analyze and design electrical circuits using mathematical models, fundamental circuit laws, and simulation tools. Topics include a thorough study of DC resistive circuit analysis techniques, capacitors, inductors, and first-order transient analysis, along with an introduction to sinusoidal signals and ac steady-state phasor analysis. The course introduces circuit simulation techniques to complement theoretical learning and provides a laboratory component emphasizing handson experience, practical electrical measurement skills, application of electrical safety standards, and the connection between theoretical concepts and real-world circuit implementation.
Lecture: 3, Lab 2, Other 0

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 Engineering Circuit Analysis II 4 Credits
Prerequisites: (EE-210 or MECH-211) and MATH-204
This second course in Engineering Circuit Analysis provides a deeper exploration of linear electrical circuits with emphasis on alternating-current (AC) analysis, frequencydomain methods, and introductory system-level modeling tools. Students extend their understanding of phasor techniques, power computation, magnetic coupling, and transformer behavior while developing proficiency in transfer functions, frequency response, and passive filter design. The course also introduces Laplace-transform methods for analyzing transient and steady-state circuit behavior and integrates computational tools to support analytical and design tasks. By the end of the course, students will be able to analyze, model, and interpret the behavior of AC and dynamic circuits commonly encountered in electrical engineering.
Lecture: 4, Lab 0, Other 0

EE-312 PCB Design & Testing 4 Credits
Prerequisites: (ENGR-101 or ECE-101) and EE-320
Minimum Class Standing: Junior
This is a hands-on ECE class with focus on the design process for building printed circuit boards (PCBs). Students will select a design project from among a list of options, based on interest. The Altium Designer software will be studied and used to develop circuit schematics, a PCB layout, a Bill-of-Materials, and other fabrication files. The PCBs will be designed to interface with an Arduino Uno microcontroller board, serving as an "Arduino shield". Upon receiving materials, students will build, test & verify their hardware. Students will then develop software for the Atmel ATmega328 microcontroller to operate their circuit and interact with it using a USB-Serial interface. The course will conclude with project demonstrations and a poster presentation open to all ECE students.
Lecture: 2, Lab 2, Other 0

EE-320 Introduction to Microelectronic Devices and Circuits 4 Credits
Prerequisites: EE-210 or MECH-211
The basic building blocks used in electronic engineering are studied. The course introduces the fundamental principles and applications of electronic circuits and devices including operational amplifiers; semiconductor properties, pn junction diodes; MOS and bipolar devices; and basic transistor amplifier configurations. The laboratory component emphasizes hands-on learning, allowing students to apply theoretical knowledge to practical circuit design and analysis. By the end of the course students will have the ability to analyze and design basic discrete and integrated electronic circuits and be prepared for more advanced study in microelectronics.
Lecture: 3, Lab 2, Other 0

EE-325 Principles of Microelectronics Processing 4 Credits
Prerequisites: CHEM-135 and CHEM-136 and PHYS-224 and PHYS-225
This course covers the principles of semiconductor processing for modern integrated circuits for students studying within the engineering and material science disciplines. It begins with an overview of semiconductor devices, circuit families, and CMOS technology, which form the foundation of today's integrated circuits. Students will explore key topics such as process flow, crystal growth, semiconductor processing, thin film deposition, oxidation, etching, lithography, and clean room practices. Additionally, the course will introduce principles of manufacturing process control and modeling for manufacturability. Computer simulations will be extensively utilized where applicable. The course focuses on the processes involved in producing modern silicon-based, very large-scale integrated (VLSI) circuits. Time permitting, the course will also provide a brief introduction to processes used in the production of optical devices, nanotechnology, and microelectromechanical systems (MEMS), all of which are becoming increasingly important.
Lecture: 4, Lab 0, Other 0

EE-336 Continuous-Time Signals and Systems 4 Credits
Prerequisites: MATH-204 and (EE-210 or MECH-211)
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 and (EE-210 or MECH-211)
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 or MECH-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-346 High Voltage Generation and Measurement Techniques 4 Credits
Prerequisites: (EE-210 or MECH-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 or MECH-211) 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 omissions; 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-399 EE Independent Study 4 Credits
Prerequisites: None
Lecture: 0, Lab 0, Other 0

EE-410 eMobility System Analysis & Control 4 Credits
Prerequisites: (ENGR-101 or ECE-101) and (EE-210 or MECH-211)
Minimum Class Standing: Junior
This course will provide system analysis and design methods for electrified road vehicles. Firstly, the components and subsystems of electrified powertrain will be reviewed with real application design, including battery, electric motor and inverter etc. Modeling and simulation methods with MATLAB/Simulink will be covered for students to adopt multi-physical level model skills. With the knowledge of the systems, powertrain design basics will be reviewed, including hybrid/electric powertrain configurations, E/E architecture and energy management strategies. Finally, functional safety topics will be covered, including subjects and work products of road vehicle functional safety standard ISO-26262. System and function analysis methods, such as fault tree analysis (FTA), will be covered as well.
Lecture: 4, Lab 0, Other 0

EE-420 Electronics II 4 Credits
Prerequisites: EE-310 and EE-320
In this course, students will explore advanced principles of microelectronic circuit design, focusing on the core building blocks of modern integrated-circuit (IC) amplifiers and their application in analog VLSI systems. The course emphasizes the unique design philosophies behind ICs compared to traditional discrete circuits, with a primary focus on MOS and CMOS technologies, though BJT components will also be addressed. Key topics include integrated circuit biasing methods, differential and multistage amplifiers, high-frequency modeling, frequency response, and amplifier output stages. Through hands-on laboratory practice and experience with circuit simulation software, students will gain the skills necessary to validate and optimize microelectronic amplifier designs.
Lecture: 3, Lab 2, Other 0

EE-421 Energy Storage Systems with EV Applications 4 Credits
Prerequisites: EE-210 or MECH-211
This course introduces the basics of energy storage systems. Several competing energy storage concepts and management systems will be considered with emphasis 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, modeling and state estimation, as well as battery management systems.
Lecture: 4, Lab 0, Other 0

EE-424 Power Electronics and Applications 4 Credits
Prerequisites: EE-310 and EE-320
Electrical energy conversion principles, along with several powerelectronic devices and converter topologies are studied. Topics include: characteristics of diodes, thyristors, BJTs, IGBTs, and MOSFETs; transistor gatedrive circuits; operating principles of AC/DC, DC/DC and DC/AC converter circuits; isolation and isolated DC/DC converter circuits; power loss and efficiency calculations; high-frequency magnetic component design, and computer-aided analysis of the dynamic response of the converter circuits. Applications involving the dynamic representation and speed control of electric motors, together with power electronics, are also studied.
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-158 or 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: (ENGR-101 or 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-443 Fundamentals of Power Systems 4 Credits
Prerequisites: EE-210 or MECH-211
Basic structure of electrical power systems and characteristics of power transmission lines, transformers and generators are studied. Topics include: conventional and renewable energy resources for power generation, representation of power systems; symmetrical three-phase fault analysis; symmetrical components; unsymmetrical fault computations; and simulation tools and network analyzers.
Lecture: 3, Lab 2, Other 0

EE-444 Computational Methods in Power Systems 4 Credits
Prerequisites: EE-443
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
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-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