ELECTRICAL AND COMPUTER ENGINEERING (E&C-ENGR)

RESTRICTIONS

Courses under this subject code may have program (major, minor, certificate) specific enrollment restrictions. The Courses (http://catalog.umkc.edu/course-offerings/undergraduate/) section of the Catalog shows all courses offered by UMKC. Specific course restrictions are detailed in Pathway. If you have questions about your course options, please contact Roo Advising (or your academic advisor).

Please select the 'COURSES' tab above to view all courses within this subject code.

Courses

E&C-ENGR 130 Engineering Graphics Credits: 3
Introduction to Engineering Graphics with the use of the Computer Aided Design tools AutoCAD and SolidWorks. Introduction to 2D design with AutoCAD and introduction to 3D design with SolidWorks. Also an introduction to electrical circuit diagrams. No previous 2D or 3D CAD experience is necessary to take this class.

E&C-ENGR 216 Engineering Computation Credits: 4
Development, analysis and synthesis of structured computer programs for solving engineering problems in the Python and C languages. Introduction to algorithms and data structures.
Prerequisites: MATH 110 or MATH 120 (or higher) or ALEKS score of 51 (or higher); or MyMathTest College Algebra Score of 70 or higher, or ACT Math sub-score of 28 or higher; or SAT Math sub-score of 660 or higher.

E&C-ENGR 217 Engineering Computation Credits: 2
Students learn to develop, analyze and synthesize structured computer programs for solving engineering problems in the Python and C languages, This course also provides an introduction to algorithms and data structures. This course is available by approval of the degree program committee if transfer credit has been approved for one of the listed programming languages.
Prerequisites: MATH 110 or MATH 120 (or higher) or ALEKS score of 51 (or higher); or MyMathTest College Algebra Score of 70 or higher, or ACT Math sub-score of 28 or higher; or SAT Math sub-score of 660 or higher.

E&C-ENGR 226 Logic Design Credits: 3
Design of combinational logic circuits, logic minimization techniques, design of sequential logic circuits, state machine design techniques, digital system design.
Co-requisites: E&C-ENGR 227.

E&C-ENGR 227 Logic Design Laboratory Credit: 1
Laboratory for E&C-ENGR 226. Experimental topics related to the design of combinational and sequential logic systems and small digital systems.
Co-requisites: E&C-ENGR 226.

E&C-ENGR 228 Introduction to Computer Design Credits: 3
This course covers computer organizations and fundamental computer design techniques. It also discusses design of computer data unit, control unit, input-output, microprogramming. Memory systems (RAM memory, Cache memory, interrupts, secondary memory) and direct memory access design is also discussed. Verilog HDL design is introduced and applied to small digital systems.
Prerequisites: E&C-ENGR 226 and E&C-ENGR 227.

Co-requisites: E&C-ENGR 229.

E&C-ENGR 229 Introduction to Computer Design Laboratory Credit: 1
This laboratory course covers experimental topics related to the design of digital computer systems and arithmetic circuits which students study in the E&C-ENGR 228.
Prerequisites: E&C-ENGR 226 and E&C-ENGR 227.

Co-requisites: E&C-ENGR 228.

E&C-ENGR 241 Applied Engineering Analysis I Credits: 3
Partial differentiation, multiple integrals, first and second order ordinary differential equations, partial fractions, and Laplace transform solution of Ordinary Differential Equations.
Prerequisites: MATH 220 or MATH 268 (with a grade of C or better).

E&C-ENGR 250 Engineering Mechanics and Thermodynamics Credits: 3
This course concentrates on practical concepts in mechanics and thermodynamics for EC-ENGR majors, such as the practical use of forces, moments, couples, centroids, and moment of inertia, friction, manipulating systems of rigid bodies in motion and applying conservation of energy to gases, liquids, and solids. Materials will also be addressed.
Prerequisites: MATH 220 or MATH 266; and PHYSICS 240 (both with a grade of C or better).

E&C-ENGR 276 Circuit Theory I Credits: 3
Kirchoff's circuit laws, Ohm's Law, nodal and mesh analyses, source transformations, superposition, Thevenin and Norton equivalents, transient analysis of 1st and 2nd order systems. AC circuit analysis, phasors, impedance, sinusoidal steady-state responses, operational amplifiers and PSpice.
Prerequisites: PHYSICS 250 and E&C-ENGR 241 (or MATH 345 as a pre or co-req) with a grade of C or better.

E&C-ENGR 277 Circuit Theory I Lab Credit: 1
Introduction to the use and limitations of basic instruments used in electrical testing and measurement. Experimental techniques and laboratory safety. Data gathering, interpretation and presentation. Preparation of laboratory reports. Experimental work supporting theoretical concepts developed in E&C-ENGR 276.
Co-requisites: E&C-ENGR 276.

E&C-ENGR 302 Electromagnetic Waves and Fields Credits: 3
Elements of vector calculus: curl, gradient and divergence differential operations; vector identities; integration of vectors Stokes and Gauss's theorems, laplacian; review of electrostatic and magnetostatic fields; boundary value problems; boundary conditions; time-harmonic fields and phasors; Maxwell's equations,Poynting vector; vector and scalar wave equations; electromagnetic wave propagation in free-space, lossy and lossless dielectrics and conductors; polarization; reflections at normal and oblique incidences; transmission line parameters; telegraphers equations; input impedance and VSWR; Smith Chart and impedance matching; transients on transmission lines.
Prerequisites: E&C-ENGR 341R, E&C-ENGR 376.

Co-requisites: E&C-ENGR 303.

E&C-ENGR 303 Electromagnetic Waves and Fields Lab Credit: 1
The goal of the lab is to complement and demonstrate the main concepts of transmission line and microwave theory using hands on experiments. The experiments will introduce students to microwave sources, components, and transmission lines. Moreover, the experiments will demonstrate the concepts of wave propagation, attenuation, power splitting, reflection, and standing waves. Moreover, students will design and conduct experiments to characterize unknown loads and antennas. Recommended preparation: MATLAB knowledge/proficiency.
Co-requisites: E&C-ENGR 302.

E&C-ENGR 330 Electronic Circuits Credits: 3
Application of operational amplifiers, semiconductors device physics, elementary analysis and design of analog electronic circuits that utilize diodes, BJT's, and MOSFET's in single and multistage amplifiers with passive loads and power amplifiers; DC biasing, small signal analysis and calculation of frequency responses. The use of CAD (Spice) in the analysis and design of electronic circuits.
Prerequisites: E&C-ENGR 334.

Co-requisites: E&C-ENGR 331.

E&C-ENGR 331 Electronic Circuits Laboratory Credit: 1
Laboratory experiments in the application of operational amplifiers, the analysis, design, and testing of single and multistage amplifiers with passive loads, and the measurement of frequency response. Recommended preparation: E&C-ENGR 276, E&C-ENGR 277.
Co-requisites: E&C-ENGR 330.

E&C-ENGR 334 Semiconductors and Devices Credits: 3
Junction theory, semiconductor diodes and models, bipolar transistors and models, field-effect transistors and models, selected electron devices and models.
Prerequisites: E&C-ENGR 241, E&C-ENGR 276.

E&C-ENGR 341R Applied Engineering Analysis II Credits: 3
Complex numbers; Euler's formulas, analytic functions, Taylor and Laurent series; Cauchy residue theorem and application to evaluation of integrals; linear algebra, eigenvalue and eigenvectors; Fourier series and transforms.
Prerequisites: E&C-ENGR 241 (with a grade of C or better).

E&C-ENGR 358 Introduction to Control Systems Credits: 3
Study of feedback techniques, with applications to control systems. Includes modeling, applications of Bode plot, root locus, state-variable, and Nyquist methods.
Prerequisites: E&C-ENGR 376.

E&C-ENGR 376 Circuit Theory II Credits: 3
Power, transformers, three-phase circuits, two-port networks, the theory and application of Laplace Transforms.
Prerequisites: E&C-ENGR 276.

Co-requisites: E&C-ENGR 377.

E&C-ENGR 377 Circuit Theory II Lab Credit: 1
Continuation of E&C-ENGR 277 introducing the use of additional instruments used in electrical testing and measurements. Statistical data evaluation methods. Experimental work supporting concepts developed in E&C-ENGR 376.
Prerequisites: E&C-ENGR 277.

Co-requisites: E&C-ENGR 376.

E&C-ENGR 380 Signals and Systems Credits: 3
Continuous and discrete-time signals and systems, frequency response, Fourier analysis of discrete and continuous signals and systems and use of z, Fourier, Discrete Fourier, and Fast Fourier Transforms.
Prerequisites: E&C-ENGR 341R or MATH 345.

Co-requisites: E&C-ENGR 381.

E&C-ENGR 381 Signals and Systems Lab Credit: 1
Computer Laboratory for E&C-ENGR 380. Various signal processing software programs (MATLAB and DSP) are used to investigate properties and applications of continuous and discrete time signals and systems.
Co-requisites: E&C-ENGR 380.

E&C-ENGR 400 Problems in Electrical and Computer Engineering Credits: 1-4
Analytic or experimental problems pertaining to electrical or computer engineering.
Prerequisites: Departmental consent.

E&C-ENGR 401 Topics In Electrical And Computer Engineering Credits: 1-4
Topics covering current and new technical developments in electrical or computer engineering.
Prerequisites: Senior standing.

E&C-ENGR 401PQ Topics in Electrical Engineering Credits: 1-4
Topics covering current and new technical developments in electrical or computer engineering.
Prerequisites: Senior standing.

E&C-ENGR 402 Senior Design I Credits: 3
This is the first capstone design course in electrical and computer engineering providing and accounting for laboratory, library, research and other work needed for the development of the project and stresses oral presentations.
Prerequisites: E&C-ENGR 330 and (E&C-ENGR 428R or E&C-ENGR 466).

E&C-ENGR 403 Senior Design II Credits: 2
This is the second capstone design course in electrical and computer engineering providing laboratory experience in prototyping, fabrication, and troubleshooting of the design project with stresses in written and oral presentation. Course topics include: project management, professional practice, ethical and engineering economic considerations and development of written and oral presentation skills.
Prerequisites: E&C-ENGR 402.

E&C-ENGR 412 Principles of RF/Microwave Engineering Credits: 3
General aspects of TE, TM and TEM mode propagation in waveguides; circular waveguides; optical waveguides; wave propagation on dielectric backed conductors; wire antennas; equivalence principle and aperture antennas; antenna impedance and mutual coupling in arrays; array beamforming; scattering matrix representations; impedance matching; resonators; filters, couplers and power-dividers; microstriplines and striplines; r.f. propagation in wireless and radar systems; conformal mapping techniques and applications (optional). Recommended preparation: MATLAB proficiency.
Prerequisites: E&C-ENGR 302, E&C-ENGR 380, E&C-ENGR 381.

E&C-ENGR 414 Microwave Engineering for Wireless Systems Credits: 3
Microwave networks; s-, z-, y- and abcd matrices; signal flow graphs; circular waveguides; stripline microstrip characteristics; impedance transformers; power dividers and directional couplers; microwave filters; microwave resonators; active microwave circuits.
Prerequisites: E&C-ENGR 302, E&C-ENGR 380, MATLAB proficiency.

E&C-ENGR 415 Microwave Engineering for Wireless Systems Lab Credit: 1
Design performance simulation of microwave filters and active microwave circuits; comparative analysis of impedance transformers; use of CAD tools in microwave circuit design.
Prerequisites: E&C-ENGR 414.

E&C-ENGR 416 Neural and Adaptive Systems Credits: 3
A hands-on introduction to the theory and applications of neurocomputing. Includes classification, function approximation, supervised and unsupervised learning, time series analysis, and adaptive filtering using different feed-forward and recurrent artificial neural networks.
Prerequisites: COMP-SCI 394R, E&C-ENGR 341R.

E&C-ENGR 418 Introduction to Radar Systems Credits: 3
Radar equation; MT, Pulsed Doppler and Tracking Radars; detection of and information from radar signals; radar antennas; transmitters and receivers; radar propagation and clutter.
Prerequisites: E&C-ENGR 302, E&C-ENGR 380, E&C-ENGR 381.

E&C-ENGR 426 Microcomputer Architecture and Interfacing Credits: 3
Students learn to develop microcontroller programs in assembly and C languages. They will also be introduced to interrupts, ports, timers, serial communication, pulse width modulation, and additional concepts.
Prerequisites: E&C-ENGR 216.

E&C-ENGR 427 Microcomputer Laboratory Credit: 1
Laboratory for E&C-ENGR 426. Microprocessor hardware and software involving interfacing of peripherals to 8-bit and 16-bit microprocessor. Simple D/A conversion, music composition, and various programmable controllers.
Prerequisites: E&C-ENGR 227.

Co-requisites: E&C-ENGR 426.

E&C-ENGR 428R Embedded Systems Credits: 3
This course examines the hardware/software aspects associated with developing microcontroller-based computer systems. The students learn about the architecture and assembly language for popular microcontrollers and how to take advantage of a variety of input/output options that include binary ports, A/D and D/A converters, communication ports, and interfacing techniques for various applications.
Prerequisites: E&C-ENGR 426, E&C-ENGR 427.

Co-requisites: E&C-ENGR 429.

E&C-ENGR 429 Embedded Systems Laboratory Credit: 1
The laboratory introduces the students to a variety of challenging design projects using microcontroller interfacing techniques to develop real world applications, such as digital thermometer and digital pressure monitoring systems. Students must produce an individual design project.
Prerequisites: E&C-ENGR 426, E&C-ENGR 427.

Co-requisites: E&C-ENGR 428R.

E&C-ENGR 436 Power Electronics I Credits: 3
Power electronic device characteristics, important circuit and component concepts, phase controlled rectifiers, line communicated inverters and AC phase control. Includes laboratory projects.
Prerequisites: E&C-ENGR 330.

E&C-ENGR 439 Principles of Nanoscale Devices & Circuits Credits: 3
This course will cover advances in nanoscale device design and circuit integration. Students will be introduced to fundamentals of device physics as they apply to both traditional and emerging nanodevices. A range of nanodevices will be studied along with their integration in both conventional and unconventional computing techniques. This course will have modules from ongoing research in nanodevice and circuits directions. Students will learn fundamental governing principles of nanodevices and circuits and be able to apply them towards computing applications.
Prerequisites: E&C-ENGR 442.

E&C-ENGR 440 Principles of Nanomanufacturing Credits: 3
Students will evaluate semiconductor processing theory and applications as well as limitations of existing process techniques. Advances in both physical implementation and circuit/integration techniques will be introduced along with an overview of topics such as optical lithography, EUV lithography, nanoimprint, implantation and manufacturing aware circuit design. Students will also participate in modeling and simulation laboratory work with state-of-the-art semiconductor processing and device simulation tools such as SRIM, Sentaurus TCAB Process and Sentaurus TCAD Device.
Prerequisites: E&C-ENGR 442.

E&C-ENGR 442 Introduction to VLSI Design Credits: 3
The goal of this course is to familiarize students with the design fundamentals and layout of Very Large Scale Integrated (VLSI) Circuits. The primary focus of this course is complementary MOSFET (CMOS) based digital integrated circuits design and analysis. However, the topics regarding transistor, interconnect, and circuit implementation are relevant to digital, analog and mixed-signal integrated circuits. This course is designed to be a comprehensive foundation for advanced micro- and nano-electronics courses. To familiarize the students with the realities of design complexities they will get exposure to commercial CAD tools in a separate lab co-requisite class. Recommended preparation: Basic Electronics.
Prerequisites: E&C-ENGR 330.

E&C-ENGR 443 Introduction to VLSI Design Laboratory Credits: 3
The goal of this course is to teach basic design concepts and implementation issues of digital integrated circuits. Various methods of designing and optimizing very large scale integrated (VLSI) circuits will be introduced in the lab projects. To familiarize students with the realities of integrated circuit design and layout, they will get exposure to industry-standard computer aided design (CAD) and simulation tools for VLSI circuits and systems. The students will be using these CAD tools in the following levels – schematic, layout, parasitic extraction, and circuit simulation.
Co-requisites: E&C-ENGR 330.

E&C-ENGR 453 Introduction to Wind Energy Systems Credits: 3
This course explores the power conversion and control of wind energy conversion systems (WECS) from the electrical engineering perspective. It provides a comprehensive and in-depth analysis of wind as a source of energy, aerodynamic of wind turbine, wind generators, system configurations, power converters, control schemes, and system design of various practical wind energy systems.
Prerequisites: E&C-ENGR 376

E&C-ENGR 455 Instrumentation and Control Credits: 3
The instrumentation and control of industrial processes and systems, introduction to Programmable Logic Controllers, and simulation modeling of various systems.
Prerequisites: E&C-ENGR 358.

E&C-ENGR 457 Fundamentals of Solar Photovoltaic Cells Credits: 3
The science and engineering of solar cell/solar photovoltaic (PV) spans several disciplines namely physics, chemistry, electronic and electrical engineering. Even though solar cell related researches are carried out in those traditional disciplines but it is not widely taught as a comprehensive course. This course highlights the fundamental science and engineering of solar PV devices, solar energy conversion as well as solar cell manufacturing issues. It covers from basic to modern solar PV devices, including typical solar cell materials, basic device physics, ideal and non-ideal models, device parameters and design, and device fabrication.
Prerequisites: E&C-ENGR 330 or E&C-ENGR 334.

E&C-ENGR 458 Automatic Control System Design Credits: 3
Techniques for feedback system design analysis: compensator design examples, state variable methods, non-linear systems, and sampled-data control systems.
Prerequisites: E&C-ENGR 380, E&C-ENGR 358.

E&C-ENGR 459 Introduction to Photovoltaic Systems Credits: 3
The course presents an updated background of world energy production and consumption, a summary of the solar spectrum, how to locate the sun, and how to optimize the capture of its energy, as well as the various components that are used in PV systems. Also studied are why certain photovoltaic (PV) designs are used in certain ways, as well as how the design process is implemented. Economic and environmental issues involved in PV design criteria are discussed along with the most recently available technology, design, and installation practices.

E&C-ENGR 460 Introduction to Power Systems Credits: 3
Magnetic circuitry in general and in machinery; DC machine theory, operation, applications, transformer circuits, synchronous machine theory, operation applications, basic principles of energy conversion, introduction to power electronics, and basic principles of power transmission and control.
Prerequisites: E&C-ENGR 376.

E&C-ENGR 463 Advanced Sustainable Energy Systems Engineering Credits: 3
Sustainable Energy Systems Engineering focuses on understanding the theory and application of emerging energy technologies, including solar, wind, biomass, oceanic, geothermal, hydropower, fuel cell (hydrogen), nuclear, and other more exotic energy sources. A premise of the course is that a sustainable energy technology must both be technically feasible and economically viable. Renewable energy sources will be highlighted with a focus on projections for a sustainable energy future. Graduate students will be assigned an additional project to work.
Prerequisites: E&C-ENGR 466.

E&C-ENGR 464 Smart Grid and SCADA Systems Credits: 3
This course introduces the various building blocks of a modern power grid such as renewable energy systems and communication technologies. The topics that will be discussed are distributed generation, microgrids, power system automation using SCADA, communication protocols for SCADA communication, smart meters, and demand response.
Prerequisites: E&C-ENGR 466.

E&C-ENGR 466 Power Systems I Credits: 3
Electric power system fundamentals, rotating machines in general, synchronous, induction and DC machines, methods of power system analysis and design, modeling of power systems components such as transmission lines, transformers and generators, and analysis of steady state operation of power system under balanced conditions.
Prerequisites: E&C-ENGR 376.

E&C-ENGR 467 Power Systems II Credits: 3
This course includes the following topics: power system matrices, power flow analysis, Gauss-Seidel and Newton-Raphson techniques, fast-decoupled load flow, economic dispatch, voltage control system, and power system control.
Prerequisites: E&C-ENGR 466.

E&C-ENGR 468 Electric Power Distribution Systems Credits: 3
Operation and design of utility and industrial distribution systems including distribution system planning; load characteristics; application of distribution transformers; design of subtransmission lines, distribution substations, primary systems, secondary systems; application of capacitors; voltage regulation and reliability.
Prerequisites: E&C-ENGR 466.

E&C-ENGR 473 Introduction to Power System Protection Credits: 3
This course covers in broad details several topics on power system protection. Emphasis will be on theoretical and applied understanding of fault analysis, instrument transformers, protective relays, and substation protection and control schematics. Determination of numerical relay settings for distribution system protection, transmission line protection, transformer protection, and bus protection will be discussed in detail. ASPEN Oneliner will be used for relay settings and coordination.
Prerequisites: E&C-ENGR 466.

E&C-ENGR 474 Introduction to Communication Systems Credits: 3
This course is an introduction to principles and fundamentals of communication systems and covers the following topics: signal representation and analysis, analog and digital modulation techniques, error control channel coding, properties of communications media, and overview of modern systems and latest cellular technology.
Prerequisites: COMP-SCI 394R, E&C-ENGR 380.

E&C-ENGR 475 Data Compression Credits: 3
The study of big data compression, such as for speech, audio, text, video, and graph signals, is important for Internet and mobile networks. Selected topics include information theory for uncertainty, entropy coding like Huffman coding, arithmetic coding, image and video prediction, transforms, quantization and compression, graph signal and data compression, and deep learning based compression.

E&C-ENGR 477 Introduction to Wireless Networking Credits: 3
Principles of the design and analysis of wireless networks. Study of medium access control, administration routing and adaptation to the complexities of the wireless environment. Investigation of networking issues in the IEEE 802.11 family of standards, IEEE 802.15 (Bluetooth), Long Term Evolution, cellular, satellite, ad hoc, and sensor networks.
Prerequisites: COMP-SCI 394R.

E&C-ENGR 479 Introduction to Computer Vision Credits: 3
This course focuses on topics of computer vision, teaching computers how to understand images. Introductory topics include image formation, color and texture features, homograph, key points detection, aggregation, subspace methods in image modeling, and deep learning based image segmentation and classification, with applications in photography, media and entertainment, education, defense and medicine. The course is project based and emphasis hands on experiences for students to solve real world problems.
Prerequisites: E&C-ENGR 380.

E&C-ENGR 480 Digital Signal Processing Credits: 3
Concepts, analytic tools, design techniques used in computer processing of signals: signal representation, sampling, discrete-time system analysis, recursive/non-recursive filters, design/implementation of digital filters.
Prerequisites: E&C-ENGR 380.

E&C-ENGR 484 Digital Image Processing Credits: 3
Fundamentals of digital image processing hardware and software, including digital image acquisition, display, compression, transforms and segmentation. Recommended preparation: Experience in a high-level programming language.
Prerequisites: E&C-ENGR 380.

E&C-ENGR 486 Pattern Recognition Credits: 3
Pattern recognition techniques of applications such as automatic recognition for speech, visual inspection systems, clinical medicine, automatic photographic recognition systems and advanced automation systems.
Prerequisites: E&C-ENGR 380.

E&C-ENGR 491 Internship Credits: 0-6
Students may participate in structured internships under the joint supervision of an employer and a faculty member. The student must carry out significant professional responsibilities that also have academic merit. The number of credit hours is based on the quality of the academic experience. Available for credit/nocredit only and students must be in good standing with at least 18 credit hours of EC-ENGR courses counting towards the degree.
Prerequisites: Departmental consent.

E&C-ENGR 497 Directed Readings Credits: 1-4
Readings in an area selected by an undergraduate student in consultation with a faculty member. Arrangements must be made prior to registration.
Prerequisites: Departmental consent.

E&C-ENGR 499 Undergraduate Research Credits: 1-3
Completion of a project, including a final written report, under the direction of a faculty member. A prospectus must be accepted prior to registration.
Prerequisites: Departmental consent.