

UMSL/Washington University Joint Undergraduate Engineering Program

General Information

The Joint Undergraduate Engineering Program of UMSL and Washington University was approved in 1993 by the University of Missouri and the Coordinating Board for Higher Education. The program is designed to offer course work beyond the pre-engineering courses at UMSL and the area community colleges. Pre-engineering and general education courses are offered at UMSL, and upper-level engineering courses are offered in the late afternoons, evenings and on Saturdays on the Washington University campus: this schedule permits students to co-op during the day at local engineering firms. Students will be admitted to the upper-division program only after they have completed an acceptable pre-engineering program. They can earn a bachelor of science in civil engineering (BSCIE), a bachelor of science in electrical engineering (BSEE), or a bachelor of science in mechanical engineering (BSME).

Mission Statement

The University of Missouri-St. Louis/Washington University Joint Undergraduate Engineering Program provides high quality accredited engineering education to a diverse student body, preparing them for successful engineering careers. The program strives to excite and nurture the intellectual, technical, professional and personal development of the students through a partnership that provides a mechanism for Washington University to share its campus, resources and personnel with the UMSL students, many of whom are place-bound individuals. The Joint Program educates students from the diverse St. Louis community to elevate their future to enter the engineering profession, thereby elevating the St. Louis region.

Program Educational Objectives

Our program aspires to make positive, substantive and lasting contributions to the lives of our students. The nontraditional and traditional students in the civil, mechanical and electrical engineering programs often have experience in engineering practice or the military. The program seeks to impart an education that inspires the graduates to constantly share their knowledge with others, to continually improve their knowledge and understanding, and to persistently adapt to change in technology and world needs. Graduates of the program are expected to develop and use professional skills that facilitate their continued career growth well beyond their graduation. Graduates should be able to apply their comprehensive education with the highest ethical standards within the engineering profession or a related field. The objectives are to:

- Meet the needs of employers of civil, mechanical, and electrical engineers, with an emphasis on the St. Louis region.
- Meet the expectations of graduate schools that our alumni attend.

Student Outcomes

The student outcomes are the skills and knowledge expected of all students at the time of their graduation. Faculty members will assess

these student outcomes. The student outcomes for the Joint Engineering Program are:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics;
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors;
3. an ability to communicate effectively with a range of audiences;
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts;
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives;
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions;
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The Joint Engineering Program degrees, the BSCIE, the BSEE, and the BSME are accredited by the Engineering Accreditation Commission of ABET. <https://www.abet.org>

Latin Honors

In accordance with the University's Latin Honors policy, candidates graduating from the University of Missouri St. Louis/Washington University Joint Undergraduate Engineering Program in the 2021-2022 Academic Year must meet the following GPA qualifications:

Summa Cum Laude	3.961
Magna Cum Laude	3.889
Cum Laude	3.671

Fees

Students register on the UMSL campus and pay UMSL fees plus an engineering fee for engineering courses. Limits on enrollments are determined by the availability of resources.

Career Outlook

Engineering is one of the few careers in which the bachelor's degree is a professional degree. Students earning a bachelor of science degree in one of the engineering disciplines are well qualified for entry-level engineering positions in a variety of businesses, industries, consulting firms, and government agencies. As society becomes increasingly dependent on technology, the outlook for all engineering disciplines becomes increasingly bright. Engineering careers typically rank at, or very near, the top of virtually any published rating of promising jobs for the 21st Century. Besides tackling challenging technical problems, roughly two-thirds of all engineers will have some level of management responsibility within ten years of receiving their bachelor's degrees. Many practicing engineers will eventually continue their education by pursuing graduate degrees on a part-time basis. Typical areas of graduate study include all advanced technical and scientific fields and management.

For Further Information

For information about enrolling in this program, please contact the UMSL/ Washington University Joint Undergraduate Engineering Program at 314-516-6800.

Degrees

Civil Engineering BSCIE
Electrical Engineering BSEE
Mechanical Engineering BSME

Minors

Civil Engineering
Electrical Engineering
Mechanical Engineering

Engineering Courses

ENGR 1010 Introduction to Engineering: 1 semester hour

This course, required of all new Freshman with an interest in Engineering, is designed to assist students in their transition to the university experience and to UMSL by giving students the knowledge and tools needed to succeed as scholars. Students will learn about faculty expectations, support services, and student life, as well as engineering.

ENGR 2310 Statics: 3 semester hours

Prerequisites: MATH 1900 and PHYSICS 2111. Statics of particles and rigid bodies. Equivalent systems of forces. Distributed forces; centroids. Applications to trusses, frames, machines, beams, and cables. Friction. Moments of inertia. Principle of virtual work and applications.

ENGR 2320 Dynamics: 3 semester hours

Prerequisites: MATH 2000 and ENGR 2310. Review of vector algebra and calculus. Kinematics of a particle. Newton's laws and the kinetics of a particle. Work and energy. Impulse and momentum. Kinematics of rigid bodies. General theorems for systems of particles. Kinetics of rigid bodies. The inertia tensor.

Joint Civil Engineering Courses

J C ENGR 1430 Introduction to Engineering Design: CAD & GIS: 2 semester hours

Prerequisites: Civil Engineering major. An introduction to engineering design in the context of civil engineering problems and applications. Students will learn the basics of GIS and computer-aided design and drafting concepts and techniques to learn the fundamentals of spatial reasoning and graphical representation. Introduction to terminology, symbols, multiple use blocks and details, origins and uses of survey data, contours, alignments, working with 2D and 3D, using both model space and layouts, dimensioning and dimension styles, attributes, and xrefs, and using templates. Freehand sketching, including pictorial and orthographic views, applied to the design process as well.

J C ENGR 2160 Surveying: 3 semester hours

Prerequisites: Civil Engineering major. Horizontal and vertical control surveys, including traverses, triangulation, trilateration, and leveling; basic adjustments of observations; geologic data; coordinate systems. Basic route surveying, including horizontal and vertical curves.

J C ENGR 3210 Computer Methods of Engineering Analysis: 2 semester hours

Prerequisites: MATH 2020, CMP SCI 1250 (may be taken concurrently), and Civil Engineering major. This course provides an introduction to engineering design and analysis utilizing numerical methods, spreadsheet functions, and database queries. Students will build on skills gained in CMP SCI 1250 to utilize a high level programming language and spreadsheet functions to develop techniques for civil engineering design and problem solving.

J C ENGR 3360 Civil Engineering Materials Lab: 1 semester hour

Prerequisites: J M ENGR 2410 and Civil Engineering major. This course and J M ENGR 3360 should be taken concurrently. Testing procedures, testing machines, use of laboratory equipment, analysis of data, and presentation of results. Laboratory tests on static tension, compression, bending, and torsion of metal specimens. Tests on wood. Determination of compressive and tensile strengths of concrete. Design of concrete mixes and verification of strength. Experiments in advanced topics in mechanics of materials.

J C ENGR 3410 Structural Analysis: 3 semester hours

Prerequisites: ENGR 2310, J M ENGR 2410 and Civil Engineering major. A review of the calculation of reactions, shear, and bending moment. Definition, construction and use of influence lines. Deflections for statically determinate structures using the work method. Analysis of statically indeterminate trusses using the method of consistent deformations. Analysis of continuous beams and planar frames using the consistent deformation, slope-deflection and moment distribution methods. The influence of span on strength, stability, and economy of structures. An introduction to structural analysis software.

J C ENGR 3420 Structural Design: 3 semester hours

Prerequisites: J M ENGR 2410, J C ENGR 3410 and Civil Engineering major. Fundamentals of structural design in steel, reinforced concrete, and timber. Familiarization with the sources of various design codes and practice in interpreting them. Computer graphics applications.

J C ENGR 3430 Civil Engineering Design CAD & GIS: 2 semester hours

Prerequisites: J C ENGR 1430 or J M ENGR 1413, and Civil Engineering major. This course provides an introduction to engineering design in the context of civil engineering. Students will build on skills gained in J C ENGR 1430 or J M ENGR 1413 to utilize computer-aided design software and GIS software to learn techniques of civil engineering design and problem solving.

J C ENGR 3460 Transportation Engineering: 3 semester hours

Prerequisites: Civil Engineering major. Fundamental treatment of the planning, engineering, design, and procedural aspects of multimodal transportation are covered. Intermodal freight and urban transportation planning processes and overview of environmental, energy, and economic issues are discussed.

J C ENGR 3520 Water and Wastewater Treatment: 3 semester hours

Prerequisites: J M ENGR 3700 (may be taken concurrently) and Civil Engineering major, or consent of instructor. Application of the basic principles of chemistry, microbiology, and fluid mechanics to the analysis of environmental problems, especially those involving control of water and land contamination. Properties of municipal and industrial wastewater, solid waste, and hazardous waste. Estimation of assimilative capacity and other characteristics of receiving waters. Introduction to unit processes and unit operations used in the treatment of municipal and industrial wastewater. Design of processes and facilities used for treating drinking water, wastewater, and sludge disposal. Waste minimization and recycling in both industrial and municipal settings.

J C ENGR 3760 Hydraulic Engineering: 3 semester hours

Prerequisites: J M ENGR 3700 and Civil Engineering major. The principles of open channel flow will be discussed and illustrated with practical examples. Methods for channel design, storm sewer, culvert and bridge analysis will be presented using the concepts of gradually-varied, steady flow. A design project using computerized analysis and design is used to implement concepts in a large practical application.

J C ENGR 4000 Independent Study: 1-3 semester hours

Prerequisites: Civil Engineering major and consent of instructor. Independent investigation of a civil engineering topic of special interest to a student performed under the direction of a faculty member.

J C ENGR 4190 Soil Mechanics: 3 semester hours

Prerequisites: J M ENGR 2410, J M ENGR 3700 and Civil Engineering major. Basic geology as it relates to index and classification properties of soil. Exploration, sampling, and testing techniques. Soil classification systems. clay minerals and soil structures. Compaction and stabilization. Capillary, shrinkage, swelling, and frost action in soils. Effective stress, permeability, seepage, and flow nets. Consolidation and consolidation settlements. stresses in soil. Time rate of consolidation. Mohr's circle, stress path, and failure theories. Shearing strength of sand and clays.

J C ENGR 4200 Soil Exploration and Testing: 1 semester hour

Prerequisites: J C ENGR 4190 (may be taken concurrently) and Civil Engineering major. Soil exploration; in-situ soil testing, laboratory testing of soil; processing of test data using a microcomputer; statistical analysis of test data; use of test results in the decision-making process.

J C ENGR 4600 Highway and Traffic Engineering: 3 semester hours

Prerequisites: J C ENGR 2160 and Civil Engineering major. Study of basic highway design and traffic circulation principles. Study of design elements of alignment, profile, cross section, intersection types, interchange types, and controlled access highways. Investigation of functional highway classification. Traffic volume, delay and accident studies. Analysis of highway capacity of uninterrupted flow, interrupted flow. Freeway, ramp and weaving sections.

J C ENGR 4630 Design of Steel Structures: 3 semester hours

Prerequisites: J C ENGR 3410, J C ENGR 3420, and Civil Engineering major. Behavior and design of steel frames by "allowable stress" and "maximum strength" based on deterministic and LRFD (Load-resistance factor design) methods. Design of beams, columns, beamcolumns, plate girders, connections, multistory frames, and bridge girders, Torsional design of steel structures. Plastic analysis and design of steel structures. Miscellaneous topics in structural steel construction and design.

J C ENGR 4640 Foundation Engineering: 3 semester hours

Prerequisites: J C ENGR 3420, J C ENGR 4190, J C ENGR 4200 and Civil Engineering major. Principal problems in design and construction of foundations for bridges and buildings. Bearing capacity of deep and shallow foundations; pressure on retaining walls and shallow foundations; pressure on retaining walls and slope stability; modern developments in piling, cofferdams, open caissons, pneumatic caissons.

J C ENGR 4660 Advanced Design of Concrete Structures: 3 semester hours

Prerequisites: J M ENGR 3360, J C ENGR 3410, J C ENGR 3420, and Civil Engineering major. Flexural behavior and design, strength and deformation of rectangular and nonrectangular sections, shear strength, beamcolumns, long columns, slab systems, design of frames, and footings will be covered.

J C ENGR 4670 Structural Design Projects: 3 semester hours

Prerequisites: J C ENGR 4630 and Civil Engineering major. Students carry out the complete design of typical and unusual building and bridge structures. Use of the computer as a design tool is emphasized. Projects are conducted in cooperation with production engineers.

J C ENGR 4720 Legal Aspects of Construction: 3 semester hours

Prerequisites: Junior standing or permission of instructor, and Civil Engineering major. A survey of the legal problems of the construction manager. Including but limited to, liability in the areas of contracts, agency, torts, insurance, bad judgement and oversight.

J C ENGR 4730 Construction Operations and Management: 3 semester hours

Prerequisites: Civil Engineering major. The construction industry, its development, components, and organization. Contracting methods. Applications and limitations. Selection of equipment using production analysis and economics. Field engineering, including form design, shoring, embankment design. Purchasing and change orders. Safety and claims.

J C ENGR 4740 Economic Decisions in Engineering: 3 semester hours

Same as J M ENGR 4730. Prerequisites: Civil Engineering major, Electrical Engineering major or Mechanical Engineering major. This course examines the principles of economics involved in engineering decisions. It looks at decisions between alternatives based on the efficient allocation of resources. Topics include the time element in economics, analytical techniques for economic studies and taxes.

J C ENGR 4830 Fundamentals of Surface Water Hydrology and Environmental Engineering: 3 semester hours

Prerequisites: J M ENGR 3700 and Civil Engineering major. The principles of the hydrologic cycle including precipitation, evaporation, transpiration, infiltration, runoff, streamflow, and groundwater will be discussed and illustrated. In addition, computational fundamentals of hydrologic analysis will be presented such as unit hydrographs, routing, data analysis, and flood frequency. Elements of quantitative problems in urban stormwater systems and management, water quality and urbanization. Concepts of sustainability and green engineering such as low impact development and other best management practices will be presented. Computer software will be utilized.

J C ENGR 4910 Hydrology and Hydraulic Design Project: 3 semester hours

Prerequisites: J M ENGR 3700, J C ENGR 3760, J C ENGR 4830 and Civil Engineering major. This course is designed to provide seniors in Hydrology and Hydraulics with a major design/facility plan project. The principals of hydrologic and hydraulic design will be utilized in developing the hydrology, hydraulics and floodplain analysis for a local watershed or land area. Hydrologic analysis is performed to size hydraulic systems and evaluate watershed and floodplain performance. The course is structured to apply hydrologic theory and modeling techniques to engineering hydrology and hydraulics for watershed analysis, floodplain delineation, and urban stormwater. The student will also consider the next generation of hydrologic computation, watershed evaluation and the importance of severe storm impacts and flood management. Consideration of sustainability and green infrastructure practices will also be included. A final written report and class presentation of the design project is included.

J C ENGR 4950 Fundamentals of Civil Engineering Review: 1 semester hour

Prerequisites: Senior standing and Civil Engineering major. A review and preparation of the most recent NCEES Fundamentals of Engineering (FE) Exam specifications for Civil Engineering students is offered in a classroom setting. Exam strategies will be illustrated using examples.

J C ENGR 4990 Senior Civil Engineering Seminar: 1 semester hour

Prerequisites: Senior standing and Civil Engineering major. Students will research assigned topics of importance to graduates entering the Civil Engineering profession and prepare oral presentations and a written report. Student presentations will be augmented by lectures from practicing professionals. Topics include professional registration, early career development, graduate study, effective presentations, construction quality, and case histories of civil engineering projects.

Joint Computer Science Courses**J CMP SC 1002 Introduction to Computing Tools: Matlab Skills: 1 semester hour**

Prerequisites: Electrical Engineering or Mechanical Engineering major. This course is aimed at the acquisition of MATLAB skills through hands-on familiarization and practice. Students practice the array, vector, and meshgrid representations, programming and plotting, and apply these skills to solve numerical problems and generate reports.

Joint Electrical Engineering Courses**J E ENGR 2300 Introduction to Electrical Networks: 3 semester hours**

Prerequisites: Electrical Engineering or Mechanical Engineering major. Elements, sources, and interconnects. Ohm's and Kirchoff's laws, superposition and Thevenin's theorem; the resistive circuit, transient analysis, sinusoidal analysis, and frequency response.

J E ENGR 2320 Introduction to Electronic Circuits: 3 semester hours

Prerequisites: J E ENGR 2300 and Electrical Engineering major. Introduction to contemporary electronic devices and their circuit applications. Terminal characteristics of active semiconductor devices. Incremental and D-C models of junction diodes, bipolar transistor (BJTs), and metal-oxide semiconductor field effect transistors (MOSFETs) are developed and used to design single- and multi-stage amplifiers. Models of the BJT and MOSFET in cutoff and saturation regions are used to design digital circuits.

J E ENGR 2330 Electrical and Electronic Circuits Laboratory: 3 semester hours

Prerequisites: J E ENGR 2300 and Electrical Engineering major. Lectures and laboratory exercises related to sophomore topics in introductory networks and basic electronics.

J E ENGR 2340 Electrical Laboratory for Mechanical Engineers: 1 semester hour

Prerequisites: J E ENGR 2300 (may be taken concurrently) and Mechanical Engineering major. Laboratory in introductory electrical circuits and devices of relevance to mechanical engineers.

J E ENGR 2600 Introduction to Digital Logic and Computer Design: 3 semester hours

Prerequisites: CMP SCI 1250 and Electrical Engineering major. Digital computers and digital information-processing system; Boolean algebra, principles and methodology of logical design; machine language programming; register transfer logic; microprocessor hardware, software, and interfacing; fundamental of digital circuits and systems; computer organization and control; memory systems; arithmetic unit design. Occasional laboratory exercises.

J E ENGR 3300 Engineering Electromagnetic Principles: 3 semester hours

Prerequisites: Electrical Engineering major. Electromagnetic theory as applied to electrical engineering; vector calculus; electrostatics and magnetostatics; Maxwell's equations, including Poynting's theorem and boundary conditions; uniform plane-wave propagation; transmission lines- TEM modes, including treatment of general, lossless line, and pulse propagation; introduction to guided waves; introduction to radiation and scattering concepts.

J E ENGR 3310 Electronics Laboratory: 3 semester hours

Prerequisites: J E ENGR 2300, J E ENGR 2330 and Electrical Engineering major. Laboratory exercises for juniors covering topics in computer-aided measurements, computer simulation, and electronic circuits.

J E ENGR 3320 Power, Energy and Polyphase Circuits: 3 semester hours

Prerequisites: J E ENGR 2300 and Electrical Engineering major. Fundamental concepts of power and energy; electrical measurements; physical and electrical arrangement of electrical power systems; polyphase circuit theory and calculations; principal elements of electrical systems such as transformers, rotating machines, control, and protective devices, their description and characteristics; elements of industrial power system design.

J E ENGR 3360 Principles of Electronic Devices: 3 semester hours

Prerequisites: Electrical Engineering major. Introduction to the solid-state physics of electronic materials and devices, including semiconductors, metals, insulators, diodes and transistors, Crystals growth technology and fundamental properties of crystals. Electronic properties and band structure of electronic materials, and electron transport in semiconductor materials. Fabrication of pn junction diodes, metal-semiconductor junctions, and transistors and integrated circuit chips. Fundamental electrical properties of rectifying diodes and light-emitting diodes, bipolar transistors and field effect transistors. Device physics of diodes and transistors, large-signal electrical behavior and high-frequency properties.

J E ENGR 3370 Electronic Devices and Circuits: 3 semester hours

Prerequisites: J E ENGR 2320 and Electrical Engineering major. Introduction to semiconductor electronic devices: transistors and diodes. Device electrical DC and high-frequency characteristics. Bipolar transistors, field-effect transistors for analog electronics applications. Transistors fabrication as discrete devices and as integrated-circuit chips. Large-signal analysis of transistor amplifiers: voltage gain, distortion, input resistance and output resistance. Analysis of multitransistor amplifiers: Darlington, Cascode, and coupled-pair configurations. Half-circuit concepts, differential-mode gain, common-mode gain, and differential-to-single-ended conversion. Transistor current sources, active loads, and power-amplifier stages. Applications to operational amplifiers and feedback circuits.

J E ENGR 3510 Signals and Systems: 3 semester hours

Prerequisites: J E ENGR 2300, J E MATH 3170 and Electrical Engineering major. Elementary concepts of continuous-time and discrete-time signals and systems. Linear time-invariant (LTI) systems, impulse response, convolution, Fourier series, Fourier transforms, and frequency-domain analysis of LTI systems. Laplace transforms, Z-transforms, and rational function descriptions of LTI systems. Principles of sampling and modulation. Students participate weekly in recitation sections to develop oral communications skills using class materials.

J E ENGR 3620 Computer Architecture: 3 semester hours

Prerequisites: J E ENGR 2600 and Electrical Engineering major. Study of interaction and design philosophy of hardware and software for digital computer systems: Machine organization, data structures, I/O considerations. Comparison of minicomputer architectures.

J E ENGR 4000 Independent Study: 1-3 semester hours

Prerequisites: Electrical Engineering major and consent of instructor. Opportunities to acquire experience outside the classroom setting and to work closely with individual members of the faculty. A final report must be submitted to the department. Open as a senior elective only. Hours and credit to be arranged. Credit variable, maximum credit per semester 3 hours. Maximum program total credit 3 hours.

J E ENGR 4050 Reliability and Quality Control: 3 semester hours

Prerequisites: MATH 1320 and Electrical Engineering major. An integrated analysis of reliability and quality control function in manufacturing. Statistical process control, analysis, reliability prediction, design, testing, failure analysis and prevention, maintainability, availability, and safety are discussed and related. Qualitative and quantitative aspects of statistical quality control and reliability are introduced in the context of manufacturing.

J E ENGR 4340 Solid State Power Circuits and Applications: 3 semester hours

Prerequisites: J E ENGR 2320, J E ENGR 3510, and Electrical Engineering major. Study of the strategies and applications of power control using solid-state semiconductor devices. Survey of generic power electronic converters. Applications to power supplies, motor drives, and consumer electronics. Introduction to power diodes, thyristors, and MOSEFETs.

J E ENGR 4350 Electrical Energy Laboratory: 3 semester hours

Prerequisites: J E ENGR 2330 and Electrical Engineering major. Experimental studies of principles important in modern electrical energy systems. Topics: power measurement, transformers, batteries, static frequency converters, thermoelectric cooling, solar cells, electrical lighting, induction, commutator, and brushless motors, synchronous machines.

J E ENGR 4360 Energy Alternatives: 3 semester hours

Same as J M ENGR 4360. Prerequisites: J E ENGR 2300 or J M ENGR 3200, and Electrical Engineering major or Mechanical Engineering major. This course introduces engineering analyses of the human uses of energy. Both non-renewable (e.g., oil, natural gas, coal, nuclear) and sustainable (e.g., hydropower, solar, wind, biomass) resources are covered. Topics include the engineer's role in harvesting, production, storage, conversion, delivery, and uses of energy. Students will learn system analysis, design, integration, optimization, and operational aspects of selected resources delivery systems, and end uses. Technical content will include site selection, conversion and delivery efficiency calculations, engineering economic analyses, control systems, and energy resource systematic classification. Students will be assessed based on homework, quizzes, tests, class participation, and projects.

J E ENGR 4410 Control Systems I: 3 semester hours

Same as J M ENGR 4310. Prerequisites: J E MATH 3170, J E ENGR 2300 and Electrical Engineering major or Mechanical Engineering major. Introduction to automatic control concepts. Block diagram representation of single and multiloop systems. Multi-input and multi-output systems. Control system components. Transient and steady-state performance; stability analysis; Routh, Nyquist, Bode, and root locus diagrams. Compensation using lead, lag and lead-lag networks. Synthesis by Bode plots and root-locus diagrams. Introduction to state-variable techniques, state-transition matrix, state-variable feedback.

J E ENGR 4440 Sensors and Actuators: 3 semester hours

Prerequisites: Electrical Engineering major. The course provides engineering students with basic understanding of two of the main components of any modern electrical or electromechanical system; sensors as inputs and actuators as outputs. This course is useful for those students interested in control engineering, robotics and systems engineering.

J E ENGR 4470 Robotics Laboratory: 3 semester hours

Prerequisites: Electrical Engineering major. Introduces the students to various concepts such as modeling, identification, model validation and control of robotic systems. The course focuses on the implementation of identification and control algorithms on a two-link robotic manipulator (the so-called pendubot) that will be used as an experimental testbed. Topics include: introduction to the mathematical modeling of robotic systems; nonlinear model, linearized model; identification of the linearized model: input-output and state-space techniques; introduction to the identification of the nonlinear model: energy-based techniques; model validation and simulation; stabilization using linear control techniques; a closer look at the dynamics; stabilization using nonlinear control techniques.

J E ENGR 4520 Power Systems Analysis: 3 semester hours

Prerequisites: J E ENGR 3320 and Electrical Engineering major. Introduction to the modeling and elements of power systems; machines, lines, and loads; load flow methods and applications; short circuit analysis using symmetrical components on symmetrical and unsymmetrical faults; methods of economic operation of power systems and contingency; state estimators, stability, and introduction of the independent system operator.

J E ENGR 4710 Communications Theory and Systems: 3 semester hours

Prerequisites: J E ENGR 3510, MATH 1320 and Electrical Engineering major. Introduction to the concepts of transmission of information via communication channels. Amplitude and angle modulation for the transmission of continuous-time signals. Analog-to-digital conversion and pulse code modulation. Transmission of digital data. Introduction to random signals and noise and their effects on communication. Optimum detection systems in the presence of noise. Elementary information theory. Overview of various communication technologies such as radio, television, telephone networks, data communication, satellites, optical fiber, and cellular radio.

J E ENGR 4720 Internet Communications: 3 semester hours

Prerequisites: Electrical Engineering major. This course will introduce and cover the architecture, protocols, security, and quality of service (QoS) of Internet Communications. Starting with the design principles and architecture of the Internet, communication applications such as Voice over IP (VoIP), video conferencing, and presence and instant messaging will be covered. Protocols developed by the Internet Engineering Task Force (IETF) including IP, TCP, UDP, DNS, SIP, XMPP, and ENUM will be studied. Latest areas of research including the Service Oriented Architecture (SOA) and peer-to-peer (P2P) architectures for Internet Communications will be covered.

J E ENGR 4730 Radar Systems: 3 semester hours

Prerequisites: J E ENGR 3510 and Electrical Engineering major. Overview of a radar system and examples of fielded radars. The block diagram representation of a radar. Review of signals. Introduction to common radar waveforms. How the environment can distort the waveform. Introduction to noise and clutter. How a target and clutter look like to a radar. Overview of the radar range equation and its multiple forms. Introduction and overview of noise sources present in a radar and their effect on performance. A more detailed look at radar waveforms in the presence of clutter and noise. Optimum detection systems in the presence of clutter and noise. Radar design from a systems engineering approach. Techniques to improve signal to noise ratio. A second look at fielded radars using what we have learned.

J E ENGR 4820 Digital Signal Processing: 3 semester hours

Prerequisites: J E ENGR 3510 and Electrical Engineering major. Introduction to analysis and synthesis of discrete-time linear time-invariant (LTI) systems. Discrete-time convolution, discrete-time Fourier transform, Z-transform, rational function descriptions of discrete-time LTI systems. Sampling, analog-to-digital conversion and digital processing of analog signals. Techniques for the design of finite impulse response (FIR) and infinite impulse response (IIR) digital filters. Hardware implementation of digital filters and finite register effects. The discrete Fourier transform and the fast Fourier transform (FFT) algorithm.

J E ENGR 4950 Fundamentals of Electrical Engineering Review: 1 semester hour

Prerequisites: Senior standing and Electrical Engineering major. A review and preparation of the most recent NCEES Fundamentals of Engineering (FE) Exam specifications for Electrical Engineering students is offered in a classroom setting. Exam strategies will be illustrated using examples.

J E ENGR 4980 Electrical Engineering Design Projects: 3 semester hours

Prerequisites: Senior standing and Electrical Engineering major. Working in teams, students address design tasks assigned by faculty. Each student participates in one or more design projects in a semester. Projects are chosen to emphasize the design process, with the designer choosing one of several paths to a possible result. Collaboration with industry and all divisions of the university is encouraged.

J E ENGR 4990 Electrical Engineering Senior Seminar: 1 semester hour

Prerequisites: Senior standing and Electrical Engineering major. This course focuses on personal and professional development to prepare graduates entering the electrical engineering profession. Topics may include personality characteristics, diversity, team dynamics, professionalism, early career development, graduate study, effective presentations, and case histories of electrical engineering projects. Performance is based on class participation, oral presentations, and written reports.

Joint Engineering Communication Courses***J E COMM 2000 Engineering Studio I: 1 semester hour***

Prerequisites: Civil Engineering or Electrical Engineering or Mechanical Engineering major. This one credit hour seminar introduces a holistic, professional formation approach to engineering education. This seminar will help students build real-world understanding of business, ethics, and society; integrate real-world perspective with traditional coursework; and build their own professional identity. Students will learn from local leaders in industry and work in teams to explore modern problems and solutions. This course must be taken during the first semester of the upper level engineering program.

Joint Engineering Mathematics Courses***J E MATH 3170 Engineering Mathematics: 4 semester hours***

Prerequisites: MATH 2020 or equivalent, and Electrical Engineering or Mechanical Engineering major. The Laplace transform and applications; series solutions of differential equations, Bessel's equation, Legendre's equation, special functions; matrices, eigenvalues, and eigenfunctions; Vector analysis and applications; boundary value problems and spectral representation; Fourier series and Fourier integrals; solution of partial differential equations of mathematical physics.

Joint Mechanical Engineering Courses***J M ENGR 1413 Introduction to Engineering Design: CAD: 2 semester hours***

Prerequisites: Civil Engineering or Mechanical Engineering major. An introduction to engineering design in the context of mechanical engineering. Students learn the fundamentals of spatial reasoning and graphical representation. Freehand sketching, including pictorial and orthographic views, are applied to the design process. Computer modeling techniques provide accuracy, analysis, and visualization tools necessary for the design of devices and machines. Topics in detailing design for production, including fasteners, dimensioning, tolerancing, and creation of part and assembly drawings are also included.

J M ENGR 1414 Introduction to Engineering Design: Project: 2 semester hours

Prerequisites: Mechanical Engineering major. An introduction to engineering design in the context of mechanical engineering. Students complete a series of labs and assignments that introduce physical phenomena related to mechanical engineering. The course proceeds to a design contest in which the students design and build from a kit of parts a more significant machine that competes in a contest held at the end of the course. The students also get to complete an individual design project on a topic which they select.

J M ENGR 2110 Machine Shop, Fabrication, and Prototyping: 2 semester hours

Prerequisites: Mechanical Engineering major. Basic machine shop and mechanical fabrication skills, including blacksmithing and industrial electrical control. "Design and build" activities will emphasize appropriate design for fabrication. Students learn machine shop skills including precision measurement, work holding, sawing, drilling, turning, and milling. Completion of the course provides certification to use the Washington University engineering machine shop.

J M ENGR 2410 Mechanics of Deformable Bodies: 3 semester hours

Prerequisites: MATH 1900, ENGR 2310, and Civil Engineering or Mechanical Engineering major. Normal and shear stresses and strains. Stress-strain diagrams. Hooke's law and elastic energy. Thermal stresses. Stresses in beams, columns, torsional members, and pressure vessels. Elastic deflection of beams and shafts. Statically indeterminate structures. Mohr's circle of stress. Stability concepts.

J M ENGR 3010 Computer Aided Design: 3 semester hours

Prerequisites: J M ENGR 1413 and Mechanical Engineering major. Computer aided design, analysis and optimization of parts and assemblies; solid modeling of complex surfaces, creation of detail drawings, dimensioning and tolerancing; assembly modeling, assembly constraints, interference checking; motion constraints, force and acceleration analysis, thermal analysis; part optimization for weight, strength and thermal characteristics using SolidWorks software. Solid modeling for additive manufacturing and 3D printing topics included.

J M ENGR 3110 Mechanical Design and Machine Elements: 3 semester hours

Prerequisites: J M ENGR 2410 and Mechanical Engineering major. Provides a thorough overview of the steps in the engineering design process and introduces analytical/quantitative techniques applicable to each step. Topics include recognition of need, specification formulation, concept generation, concept selection, embodiment, and detail design. Includes an introduction to several classes of machine elements such as shafts, bearings, gears, brakes, and threaded fasteners. Underlying analytical models of the machine elements are presented along with guidelines about designing and choosing such elements for practical applications. Students complete a case study project to conclude the course.

J M ENGR 3200 Thermodynamics: 3 semester hours

Prerequisites: MATH 1900, CHEM 1111 and PHYSICS 2111, and Electrical Engineering or Mechanical Engineering major. Classical thermodynamics; thermodynamic properties; work and heat; first and second laws. Entropy, irreversibility, availability. Application to engineering systems.

J M ENGR 3250 Material Science for J M ENGR: 4 semester hours

Prerequisites: CHEM 1111 and Mechanical Engineering major. Introduces the chemistry and physics of engineering materials. Emphasis on atomic and molecular interpretation of physical and chemical properties, the relationships between physical and chemical properties, and performance of an engineering material.

J M ENGR 3360 Material Science for J C ENGR: 3 semester hours

Prerequisites: CHEM 1111 and Civil Engineering major. Introduces the chemistry and physics of engineering materials. Emphasis on atomic and molecular interpretation of physical and chemical properties, the relationships between physical and chemical properties, and performance of an engineering material.

J M ENGR 3700 Fluid Mechanics: 3 semester hours

Prerequisites: MATH 2020 and ENGR 2320, Civil Engineering major or Mechanical Engineering major. Fundamental concepts of fluids as continua. Viscosity. Flow field: velocity, vorticity, streamlines. Fluid statics: hydrostatic forces manometers. Conservation of mass and momentum. Incompressible inviscid flow. Dimensional analysis and similitude. Flow in pipes and ducts. Flow measurement. Boundary-layer concepts. Flow in open channels.

J M ENGR 3710 Principles of Heat Transfer: 3 semester hours

Prerequisites: J M ENGR 3200, J M ENGR 3700 and J E MATH 3170, and Mechanical Engineering major. Introductory treatment of the principles of heat transfer by conduction, convection, or radiation. Mathematical analysis of steady and unsteady conduction along with numerical methods. Analytical and semiempirical methods of forced and natural convection systems. Heat exchangers: LMTD and e-NTU analysis. Boiling and condensation heat transfer. Radiation between blackbody and real surfaces. Radiation network analysis.

J M ENGR 3721 Fluid Mechanics Laboratory: 1 semester hour

Prerequisites: J M ENGR 3700 and Civil Engineering or Mechanical Engineering major. Physical laboratory exercises focusing on fluid properties and flow phenomena covered in J M ENGR 3700. Calibration and use of a variety of equipment; acquisition, processing, and analysis of data by manual as well as automated methods.

J M ENGR 3722 Heat Transfer Laboratory: 1 semester hour

Prerequisites: J M ENGR 3721, J M ENGR 3710 and Mechanical Engineering major. Physical laboratory exercises, including some numerical simulations and computational exercises, focusing on heat-transfer phenomena covered in J M ENGR 3710. Calibration and use of variety of laboratory instrumentation; acquisition, processing, and analysis of data by manual as well as automated methods; training in formal report writing.

J M ENGR 4000 Independent Study: 1-3 semester hours

Prerequisites: Mechanical Engineering major and consent of instructor. Independent investigation of a mechanical engineering topic of special interest to a student performed under the direction of a faculty member.

J M ENGR 4110 Mechanical Engineering Design Project: 3 semester hours

Prerequisites: J M ENGR 3110 and Mechanical Engineering major. Small student teams complete design projects subject to various constraints (e.g. economic, safety, legal, environmental, ethical), and appropriate codes and standards. Teams first perform a background information study, which is followed by a specification and conceptual design study. Embodiment and fabrication plans are produced for the chosen concept. The results of an engineering analysis study influence the final design of a working prototype, which is built and demonstrated. This is "documented" in an appropriate manner (e.g. a CAD model) that allows others to reproduce a version, and it is "published" so that other interested parties learn of its existence.

J M ENGR 4120 Design of Thermal Systems: 3 semester hours

Prerequisites: J M ENGR 3200 and Mechanical Engineering major. Analysis and design of advanced thermo-fluid systems. Student teams participate in the design process which could involve research, design formulation, codes, standards, engineering economics, a design project report, and formal presentations. Topics include: thermal-fluid systems and components, such as power, heating, and refrigeration systems, pumps, fans, compressors, combustors, turbines, nozzles, coils, heat exchangers and piping.

J M ENGR 4170 Dynamic Response of Physical Systems: 2 semester hours

Prerequisites: ENGR 2320 and J E MATH 3170, and Mechanical Engineering major. Free and forced vibration of mechanical systems with lumped inertia, springs, and dampers. Methods of Laplace transform, complex harmonic balance, and Fourier series. Electrical analogs. Introduction to Lagrange's equations of motion and matrix formulations. Transient response of continuous systems by partial differential equations, by rayleigh methods, and by lumped parameters. Must be taken concurrently with J M ENGR 4180.

J M ENGR 4180 Dynamic Response Laboratory: 1 semester hour

Prerequisites: J M ENGR 4170 and J M ENGR 4180 must be taken during the same semester. Laboratory problems focusing on materials covered in J M ENGR 4170.

J M ENGR 4250 Material Selection in Engineering Design: 3 semester hours

Prerequisites: J M ENGR 3250 and Mechanical Engineering major. Analysis of the scientific bases of material behavior in the light of research contributions of the last 20 years. Development of a rational approach to the selection of materials to meet a wide range of design requirements for conventional and advanced applications. Although emphasis will be placed on mechanical properties, other properties of interest in design will be discussed, e.g., acoustical, optical and thermal.

J M ENGR 4310 Control Systems I: 3 semester hours

Same as J E ENGR 4410. Prerequisites: J E MATH 3170, J E ENGR 2300 and Electrical Engineering major or Mechanical Engineering major. Introduction to automatic control concepts. Block diagram representation of single and multiloop systems. Multi-input and multi-output systems. Control system components. Transient and steady-state performance; stability analysis; Routh, Nyquist, Bode, and root locus diagrams. Compensation using lead, lag and lead-lag networks. Synthesis by Bode plots and root-locus diagrams. Introduction to state-variable techniques, state-transition matrix, state-variable feedback.

J M ENGR 4360 Energy Alternatives: 3 semester hours

Same as J E ENGR 4360. Prerequisites: J E ENGR 2300 or J M ENGR 3200, and Electrical Engineering major or Mechanical Engineering major. This course introduces engineering analyses of the human uses of energy. Both non-renewable (e.g., oil, natural gas, coal, nuclear) and sustainable (e.g., hydropower, solar, wind, biomass) resources are covered. Topics include the engineer's role in harvesting, production, storage, conversion, delivery, and uses of energy. Students will learn system analysis, design, integration, optimization, and operational aspects of selected resources delivery systems, and end uses. Technical content will include site selection, conversion and delivery efficiency calculations, engineering economic analyses, control systems, and energy resource systematic classification. Students will be assessed based on homework, quizzes, tests, class participation, and projects.

J M ENGR 4630 Nanotechnology: Concepts and Applications: 3 semester hours

Prerequisites: Mechanical Engineering major. The aim of this course is to introduce to students the general meaning, terminology and ideas behind nanotechnology and its potential application in various industries. The topics covered will include nanoparticles - properties, synthesis and applications, carbon nanotubes - properties, synthesis and applications, ordered and disordered nanostructured materials and their applications, quantum wells, wires and dots, catalysis and self-assembly, polymers and biological materials, nanoelectronics and nanophotonics, nanomanufacturing and functional nano-devices, health effects and nanotoxicity etc.

J M ENGR 4700 Sustainable Environmental Building Systems: 3 semester hours

Prerequisites: Mechanical Engineering major. Sustainable design of building lighting and HVAC systems considering performance, life-cycle cost and downstream environmental impact. Criteria, codes and standards for comfort, air quality, noise/vibration and illumination. Life cycle and other investment methods to integrate energy consumption/conservation, utility rates, initial cost, system/component longevity, maintenance cost and building productivity. Direct and secondary contributions to acid rain, global warming and ozone depletion.

J M ENGR 4706 Aircraft Performance: 3 semester hours

Prerequisites: Mechanical Engineering major. This course introduces the principles and applications of aerodynamics to determine the performance of typical jet engine and propeller airplanes. The performance calculations include flight conditions of takeoff, climb, level flight, and landing. The topics covered also include range and endurance computation, turning flight, flight envelope, constraint analysis and design process. The knowledge and skill gained in this course can be readily applied in the preliminary design of an airplane.

J M ENGR 4730 Economic Decisions in Engineering: 3 semester hours

Same as J C ENGR 4740. Prerequisites: Civil Engineering major, Electrical Engineering major or Mechanical Engineering major. This course examines the principles of economics involved in engineering decisions. It looks at decisions between alternatives based on the efficient allocation of resources. Topics include the time element in economics, analytical techniques for economic studies and taxes.

J M ENGR 4810 HVAC Analysis and Design I: 3 semester hours

Prerequisites: Mechanical Engineering major. Moist air properties and the psychrometric chart. Classic moist air processes and design procedures for heating and cooling systems. Design of heating, ventilating, and air conditioning systems for indoor environmental comfort and health. Basics of heat transfer in building structures. Solar radiation effects on building heat transfer. Calculation procedures for the analysis of heating and cooling loads in buildings.

J M ENGR 4820 HVAC Analysis and Design II: 3 semester hours

Prerequisites: Mechanical Engineering major. Energy calculations to estimate the quantity of energy needed to heat and cool building structures. Fundamentals of incompressible flow, basics of centrifugal pump performance, and design procedures for water piping systems. Space air diffuser design to assure that temperatures, humidities, and air velocities within occupied spaces are acceptable. Air duct design and fan analysis for optimally distributing air through building air duct systems. Performance analysis of refrigeration systems, including the effects of pressure losses and heat transfer. Direct contact heat and mass transfer.

J M ENGR 4900 Engineering Project Management: 3 semester hours

Prerequisites: Electrical Engineering or Mechanical Engineering major. Basic fundamentals and advanced concepts of engineering project management applicable to projects and programs, both large and small. Project management skills, techniques, systems, software and application of management science principles will be covered and related to research, engineering, architectural, and construction projects from initial evaluations through approval, design, procurement, construction and startup.

J M ENGR 4950 Fundamentals of Mechanical Engineering Review: 1 semester hour

Prerequisites: Mechanical Engineering major. A review and preparation of the most recent NCEES Fundamentals of Engineering (FE) Exam specifications for Mechanical Engineering students is offered in a classroom setting. Exam strategies will be illustrated using examples.

J M ENGR 4990 Mechanical Engineering Senior Seminar: 1 semester hour

Prerequisites: Mechanical Engineering major. Personal and professional development to prepare graduates entering the mechanical engineering profession. Topics may include personality characteristics, diversity, team dynamics, professionalism, early career development, graduate study, effective presentations, and case histories of mechanical engineering projects. Performance is based on class participation, oral presentations, and written reports.