MECHANICAL ENGINEERING (MEC-ENGR)

RESTRICTIONS

Courses under this subject code may have program (major, minor, certificate) specific enrollment restrictions. The Courses (https://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

MEC-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 includes: basic features, layer control, geometric constructions, othrographic projections, dimensioning and notes, tolerancing, section views, and working drawings. Introduction to 3D design with SolidWorks includes: part modeling, revolved features, sweeps, lofts, assembly modeling and engineering drawings. No previous 2D or 3D CAD experience is necessary to take this class.
Prerequisites: School of Science and Engineering Student.

MEC-ENGR 131 Engineering Graphics-3D design Credit: 1
Introduction to Engineering Graphics using the 3D Computer Aided Design tool SolidWorks. Introduction to 3D design with SolidWorks includes: part modeling,revolved features,sweeps,lofts,assembly modeling,and engineering drawings. Some previous 2D AutoCAD experience is required to take this class. NOTE: This class starts halfway through the semester by joining in with MEC-ENGR 130 when they finish AutoCAD and begin SolidWorks.
Prerequisites: Departmental consent.

MEC-ENGR 219 Computer Programming for Engineers Credits: 3
Analysis and synthesis of structured computer algorithms for solving engineering problems using high level programming tools such as Excel, Matlab, Fortran and/or C++.
Prerequisites: MATH 266 (preferred) or MATH 210.

MEC-ENGR 270 Engineering Analysis I Credits: 3
This is an applied course with emphasis on physics and engineering applications. Topics include engineering applications using conics, parametric equations, polar coordinates, vectors, solid analytic geometry, vector valued functions, multi-variable functions, partial derivatives (including applications), multiple integration, vector calculus including Green's Theorem, Curl and Divergence, line and surface integrals and Stoke's Theorem.
Prerequisites: MATH 268.

MEC-ENGR 272 Engineering Analysis Credits: 3
An applied course using differential equations in solutions to engineering problems. Topics include applications in first-order differential equations, linear higher-order equations, Laplace transform, Series solutions of linear ODEs (Taylor, Power, and Fourier), Numerical solutions, introduction to systems of differential equations.
Prerequisites: MATH 268 or MATH 220.

MEC-ENGR 285 Engineering Dynamics Credits: 3
Fundamentals of engineering dynamics, including kinematics and kinetics of particles and rigid bodies. Analysis based on forces and accelerations as well as energy and momentum methods.
Prerequisites: CIV-ENGR 275.

MEC-ENGR 299 Engineering Thermodynamics Credits: 3
Fluid properties, work and heat, first law, second law, entropy, applications to vapor and ideal gas processes.
Prerequisites: MATH 268 (preferred) or MATH 220; and PHYSICS 250.

MEC-ENGR 306 Numerical Analysis Credits: 3
Principles, analysis and application of numerical methods for the solution of engineering problems. Computer implementation.
Prerequisites: MEC-ENGR 272 or MATH 345; MEC-ENGR 219 or E&C-ENGR 216

MEC-ENGR 324 Mechanical Engineering Materials Lab Credits: 3
The nature of the structure of engineering materials. The relationship of material structure to the physical properties. Mechanical behavior of engineering materials. Introduction to the laboratory techniques used in studying the physical and mechanical properties of engineering materials. The material testing in this course is primarily of metallic materials. Physical and mechanical property variations as a result of various processing techniques are studied.
Prerequisites: CHEM 211, CHEM 211L, CIV-ENGR 276.

MEC-ENGR 324L Engineering Materials Lab Credit: 1
Introduction to the laboratory techniques used in studying the physical and mechanical properties of engineering materials. The material testing in this course is primarily of metallic materials. Physical and mechanical property variations as a result of various processing techniques are studied. Recommended preparation: Machine Shop Safety.
Co-requisites: MEC-ENGR 324.

MEC-ENGR 351 Fluid Mechanics Credits: 3
Concepts of the statics and dynamics of fluids, with emphasis on principles of continuity, momentum and energy. Boundary layers, dimensional analysis and drag are covered briefly. Thorough treatment of pipe flow.
Prerequisites: MEC-ENGR 272 or MATH 345 and CIV-ENGR 275.

MEC-ENGR 352 Mechanical Instrumentation Lab Credits: 3
Static and dynamic errors: measurement and propagation of uncertainty: experiment design; instrumentation selection and calibration; measurement of voltage, resistance, amperage, displacement, velocity, acceleration, force, and strain
Prerequisites: CIV-ENGR 276

MEC-ENGR 356 Mechanical Component Design Credits: 3
Introduction to mechanical engineering design and its impact on human history, principles of design with ductile and brittle materials for static and dynamic loading, classical and reliability-based factors of safety, fracture mechanics in design, application to the design of selected machine components.
Prerequisites: CIV-ENGR 276.

MEC-ENGR 360 Applied Thermodynamics Credits: 3
Gas and vapor mixtures, cycles, availability, imperfect gases, thermodynamic relations, combustion, chemical equilibrium, power systems and design projects. Effects of design choices on the earth and living systems.
Prerequisites: MEC-ENGR 299.

MEC-ENGR 380 Manufacturing Methods Credits: 3
Introduction to manufacturing processes with emphasis on those aspects most relevant to methods, problems in force analysis, and practicum and experimentation in machine tool applications.
Prerequisites: MEC-ENGR 324.

Co-requisites: MEC-ENGR 324L.

MEC-ENGR 385 System Dynamics Credits: 3
Kinematics of mechanical systems. Introduction to the modeling and analysis of dynamic mechanical systems. Computer analysis.
Prerequisites: MEC-ENGR 272 (or MATH 345), and MEC-ENGR 285.

MEC-ENGR 399 Heat Transfer Credits: 3
Fundamentals of conduction, convection, and radiation heat transfer. Use of nondimensional parameters. Theory of heat exchangers.
Prerequisites: MATH 250 or MEC-ENGR 270; and MEC-ENGR 299, MEC-ENGR 351.

MEC-ENGR 399L Heat Transfer and Fluids Lab Credit: 1
Project-based course associated with MECH-ENGR 399. Course emphasis is on experiments related to thermodynamics, heat transfer and fluid mechanics. Proper experimental methods, data and uncertainty analysis related to thermal and fluid measurements are discussed.
Co-requisites: MEC-ENGR 399.

MEC-ENGR 400 Problems Credits: 1-6
Special design, experimental and analytical problems in mechanical engineering.
Prerequisites: Departmental consent.

MEC-ENGR 401 Topics in Mechanical Engineering Credits: 1-3
Current and new technical developments in mechanical engineering.
Prerequisites: You must be a senior mechanical engineering student to take this course.

Co-requisites: MEC-ENGR 492.

MEC-ENGR 406 Introduction to Biomaterials Credits: 3
The course covers the basics of biomaterials science and principles of biological systems followed by characterization of biomaterials, tissue engineering and bioprinting application, and drug delivery and challenges in clinical applications.
Prerequisites: MEC-ENGR 299.

MEC-ENGR 407 Advanced Dynamics and Modeling Credits: 3
Fundamental principles of advanced rigid body dynamics with applications. Special mathematical techniques including Lagrangian and Hamiltonian methods.
Prerequisites: MEC-ENGR 285 and MEC-ENGR 306.

MEC-ENGR 411 Introduction to Biomechanics Credits: 3
This course is to provide students with an introduction to the engineering principles of biomechanics.
Prerequisites: MEC-ENGR 219 or E&C-ENGR 216; and MEC-ENGR 285.

Co-requisites: MEC-ENGR 385 or E&C-ENGR 380.

MEC-ENGR 412 Biodynamics Credits: 3
Introduction to musculoskeletal biomechanics including: computational biomechanics, movement simulation, motor control and musculoskeletal tissues. Recommended preparation: MEC-ENGR 411.
Prerequisites: MEC-ENGR 411

MEC-ENGR 413 Experimental Biomechanics of Human Motion Credits: 3
The purpose of this course is to provide an opportunity for students to gain a hands-on, in-depth understanding of the experimental measurement and analysis techniques used to quantify the biomechanics of human motion.
Prerequisites: MEC-ENGR 411.

MEC-ENGR 414 Material Science for Advanced Applications Credits: 3
Study of the physical and mechanical metallurgy of alloy systems of interest in engineering applications.
Prerequisites: MEC-ENGR 324.

MEC-ENGR 415 Control Systems Theory Credits: 3
Introduction to feedback control theory for linear dynamic systems. Topics include root locus analysis, frequency response analysis, and controller design.
Prerequisites: MEC-ENGR 385.

MEC-ENGR 416 Biomedical Device Design Credits: 3
Project based course which exposes students to the entire design process from problem definition to prototype validation for biomedical device applications. Projects in the course are sponsored by real clients from the local biomedical industry, medical clinicians, and/or research labs. The course will cover the following main components: Problem Definition, Concept Generation and Evaluation, Detailed Design, Prototyping and Testing, Project Management, Regulations and Standards, and Technical Communication.
Prerequisites: MEC-ENGR 492

MEC-ENGR 418 Advanced Fluid Mechanics Credits: 3
This course is a survey of advanced concepts of fluid mechanics and is an extension of Fluid Mechanics 351. Topics include review of fluid kinematics and conservation laws, introduction to tensor analysis; potential flows; boundary layer theory; lubrication theory and introduction to turbulence.
Prerequisites: MEC-ENGR 351 or CIV-ENGR 351

MEC-ENGR 424 Non-Metallic Engineering Materials Credits: 3
Structures, properties and applications of ceramics, glasses, cermets, polymers and composite materials.
Prerequisites: MEC-ENGR 324.

MEC-ENGR 425 Failure Analysis Credits: 3
Organize and perform a failure investigation. In addition, the course will cover the general procedures for a failure investigation and various failure mechanisms such as ductile fracture, brittle fracture, fatigue, wear, corrosion and elevated temperature.
Prerequisites: MEC-ENGR 324, MEC-ENGR 380.

MEC-ENGR 426 Introduction to Manufacturing Management Credits: 3
The objective of this course is to expose the student to various manufacturing management tools and techniques. Focus is on both the technical tools used in manufacturing as well as on the management tools needed to implement change in the manufacturing environment. As part of this course, students will research a successful company and present an analysis of manufacturing tools and techniques used.
Prerequisites: MEC-ENGR 380

MEC-ENGR 429 Additive Manufacturing Credits: 3
The course is intended for senior level mechanical engineering students. In this course, students will review in-depth processing methods, material characterizations, and challenges with current additive manufacturing techniques. Students will apply basic engineering numerical principles to the deployment of models to these unique processing methods, and determine solutions to challenging problems that are difficult to process. Content learned in the class will be toward an open-ended team-oriented design project exploiting the technology.
Prerequisites: CIV-ENGR 275 and MEC-ENGR 306 and MEC-ENGR 399.

MEC-ENGR 440 Heating Ventilation and Air Conditioning Credits: 3
General principles of thermodynamics, heat transfer, and fluid dynamics are used to calculate building loads, size equipment and ducts, and evaluate system performance in maximizing human comfort. Consideration of indoor air quality and human health.
Prerequisites: MEC-ENGR 360, MEC-ENGR 399.

MEC-ENGR 441 Intermediate Fluid Mechanics Credits: 3
Topics in potential and viscous flow theory, and computational fluid dynamics.
Prerequisites: MEC-ENGR 351.

MEC-ENGR 444 Composite Materials Credits: 3
A survey of composite materials used in engineering, emphasizing fiber-reinforced composites as well as laminate and particulate composites.
Prerequisites: MEC-ENGR 324.

MEC-ENGR 446 Principles of Aircraft Design Credits: 3
Principles of Aircraft Design provides an overview of design methods for air vehicle systems, including fixed-wing airplanes and rotary-wing / vertical thrust vehicles such as helicopters, multi-rotors, and hybrid vehicles. The course explores topics in aerodynamics, structures, propulsion, stability, control, and performance.
Prerequisites: MEC-ENGR 385

MEC-ENGR 448 Flight and Road Vehicle Test Engineering Credits: 3
Flight and Road Vehicle Test Engineering provides an introduction to test techniques and analysis methods used to assess the characteristics of fixed-wing aircraft and wheeled road vehicle. Students will conduct four test activities using simulated, unmanned, and manned aircraft or road vehicles to determine handling qualities, dynamic model, response envelope limits, and performance.
Prerequisites: MEC-ENGR 446

MEC-ENGR 451 Power Plant Design Credits: 3
Preliminary component and system design. Optimum design of boilers, steam turbines, condensers and cooling towers and their integration into a system to minimize production costs and impact on the environment.
Prerequisites: MEC-ENGR 360, MEC-ENGR 399.

MEC-ENGR 452 Advanced Mechanics of Materials Credits: 3
Shear center; unsymmetric bending; curved beams; beams on elastic foundations; thick-walled cylinders. Energy methods. Torsion of noncircular sections. Theories of failure. Plate theory.
Prerequisites: CIV-ENGR 276.

MEC-ENGR 454 Power Generation Systems Credits: 3
Fundamentals of the power industry in a format suitable for all engineering disciplines. Survey of electric power systems, including fossil and nuclear steam cycles, combustion turbines, combines cycles, and renewable such as solar and wind. Introduction to major machinery components, systems, controls, and an overview of fuels, emissions, and emission control technologies.
Prerequisites: MEC-ENGR 299, MEC-ENGR 360, MEC-ENGR 399

MEC-ENGR 455 Digital Control of Mechanical Systems Credits: 3
Introduction to digital control systems. Topics include Z-transforms, sampling, stability analysis, and digital controller design.
Prerequisites: MATH 345, MEC-ENGR 415.

MEC-ENGR 457 Mechatronic System Design Credits: 3
Theory and application of mechatronic systems through course instruction, laboratory activities, and student projects.
Prerequisites: MEC-ENGR 306 and MEC-ENGR 385

Co-requisites: MEC-ENGR 415.

MEC-ENGR 458 Modern Control Systems Credits: 3
Controller design for multiple-input/multiple-output systems; controllability and observability; stochastic control problems; regulators and tracking controllers; observers.
Prerequisites: MEC-ENGR 415.

MEC-ENGR 459 Robotics and Unmanned Systems Credits: 3
Students will develop, implement, and evaluate various path following (point mass, rigid body, and Dubin's) and trajectory generation (configuration spaces, roadmaps, cell decomposition, etc.) concepts on simulation and experimental platforms.
Prerequisites: MEC-ENGR 306.

MEC-ENGR 460 Electromechanical Conversion Credits: 3
This course describes the operation and control of electro-mechanical devices such as motors transformers to mechanical civil engineering students, including an introduction to programmable logic controllers and variable speed drives.
Prerequisites: MEC-ENGR 220, MEC-ENGR 285.

MEC-ENGR 462 Applied Computational Fluid Dynamics Credits: 3
The fundamentals of computational fluid mechanics. Introduction to the governing equations and boundary conditions of viscous fluid flows, turbulence and its modelling, and how to solve a fluid flow problem using commercially available CFD software.
Prerequisites: MEC-ENGR 351 or CIV-ENGR 351; MEC-ENGR 360.

MEC-ENGR 464 Turbomachines Credits: 3
This course covers the practical application of thermodynamics, fluid dynamics, and dimensional analysis to the design of pumps, fans, compressors, and turbines.
Prerequisites: MEC-ENGR 351 or CiV-ENGR 351; MEC-ENGR 360.

MEC-ENGR 466 Applied Optimization and Decision Modeling Credits: 3
Introduction to mathematical programming techniques and applications. Linear and integer programming, transporation models, multiple objective and goal programming.
Prerequisites: MEC-ENGR 306.

MEC-ENGR 467 Fuel Cells and Renewable Energy Systems Credits: 3
This course will provide an overview of the fundamental phenomena that govern the design and operation of fuel cells. The thermodynamics of fuel cell systems will be explored including operation of ideal fuel cells and the physical and chemical phenomena that lead to losses within the fuel cell. The course will provide the methods and techniques required to analyze the performance of low, medium, and high temperature fuel cells within an overall energy system. The fueling of fuel cells from renewable resources will also be discussed.
Prerequisites: MEC-ENGR 399.

MEC-ENGR 470 Experimental Design & Analysis Credits: 3
Presentation of concepts and methods of statistical analysis and the design of experiments. Concepts, techniques, interpretation, and use of results are stressed. Focus is on experimental strategy and objectives, and the application of the methods discussed, rather than the mechanics of derivation. Major sections include: a review of hypothesis testing and basic analysis of variance techniques; single factor experiments including 2k and 3k design, confounding, and Taguchi philosophy; nested and split plot designs; analysis of covariance and an introduction to response surface methods.

MEC-ENGR 475 Advanced Control Theory Credits: 3
Advanced Control Theory is designed as a follow-on to MEC-ENGR 415 Control Systems Theory. The class addresses situations in which the strategies employed in classical control theory fail to meet the control objectives. Specifically, these are situations in which the controller is constrained or in which the dynamics are complicated, uncertain, or time-varying.
Prerequisites: MEC-ENGR 415 and MEC-ENGR 385

MEC-ENGR 484 Vibration Analysis Credits: 3
Vibration theory with application to mechanical systems.
Prerequisites: MEC-ENGR 306, MEC-ENGR 385.

MEC-ENGR 486 Applied Finite Element Analysis Credits: 3
The study of advanced simulation techniques for the solution to engineering problems. The use of Finite Element Method toward solving mechanical, structural, vibration and potential flow problems will be explored. The use of current commercial simulation tools will be used extensively.
Prerequisites: MEC-ENGR 306, MEC-ENGR 324, MEC-ENGR 385, MEC-ENGR 399.

MEC-ENGR 491 Internship Credits: 0-6
For International students who must register to cover off-campus employment which is approved as related to their degree by their departmental advisor and ISAO.
Prerequisites: Departmental consent.

MEC-ENGR 492 Mechanical Design Synthesis I Credits: 3
Introduction to and application of the Engineering Design Process including: product development, needs identification, benchmarking, information gathering, concept generation, creativity methods, concept selection, professional and ethical responsibilities, and computer-aided design and rapid prototyping applications. A comprehensive design project including 3D CAD models and functioning prototypes is required.
Prerequisites: MEC-ENGR 130 or MEC-ENGR 131 or BMD-ENGR 215; senior standing.

Co-requisites: MEC-ENGR 356 and MEC-ENGR 324; or MEC-ENGR 406.

MEC-ENGR 493 Intermediate Dynamics Credits: 3
Theoretical discussion of kinematics and dynamics of rigid bodies in three-dimensional space. General theory of rotating coordinate frames, Euler's angles, Euler's equations of motion, angular momentum, work-energy principles, and Kane's method.
Prerequisites: MEC-ENGR 285, MEC-ENGR 385

MEC-ENGR 494 Robotic System Identification Credits: 3
Students will develop, implement, and evaluate various system identification and parameter estimation techniques. Students will quantify estimation accuracy through both theoretical and experimental exercises.
Prerequisites: MEC-ENGR 285, MEC-ENGR 306, MEC-ENGR 352.

MEC-ENGR 496WI Mechanical Design Synthesis Credits: 3
Modern design theories and methodologies, with emphasis on the initial stages of the design process. Effect of design choices on the earth and living systems. Principles of embodiment design and life-cycle considerations. A comprehensive group design project is required. The course satisfies the Writing Intensive requirement.
Prerequisites: ENGLISH 225, MEC-ENGR 492, and MEC-ENGR 356.