MECHANICAL ENGINEERING (MEC-ENGR)

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, orthographic 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.

MEC-ENGR 130L Engineering Graphics Lab Credits: 0
Supplemental lab instruction and assistance for MEC-ENGR 130.

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: 2D AutoCAD experience.

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.

MEC-ENGR 220 Electric Circuits Credits: 3
Introduction to electric circuits for civil and mechanical engineering students.

Prerequisites: MEC-ENGR 219, PHYSICS 250.
Co-requisites: MEC-ENGR 272.

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 II 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: MEC-ENGR 270.

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, PHYSICS 240.

MEC-ENGR 301 Fundamental Topics in Mechanical Engineering Credits: 3
Current and new technical developments in mechanical engineering.

MEC-ENGR 306 Computer-Aided Engineering Credits: 3

Prerequisites: CIV-ENGR 219, CIV-ENGR 319, MEC-ENGR 272.

MEC-ENGR 324 Engineering Materials Credits: 4
The nature of the structure of engineering materials. The relationship of material structure to the physical properties. Mechanical behavior of engineering materials.

Prerequisites: CHEM 211, CHEM 211L, CIV-ENGR 276, MEC-ENGR 299, Machine Shop Safety.
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:** MATH 345, MEC-ENGR 285.

**Co-Requisites:** MEC-ENGR 360.

**Cross Listings:** CIV-ENGR 351.

MEC-ENGR 352WI Instrumentation & Measurements Lab Credits: 5
Students will investigate random and systematic errors, and their effects on measurement uncertainty. Students will be introduced to various instrumentation equipment used in measuring displacement, velocity, acceleration, force, strain, fluid pressure, fluid velocity, fluid flow rate, and temperature.

**Prerequisites:** MEC-ENGR 220, CIV-ENGR 351, MEC-ENGR 299, Machine Shop Safety, RooWriter.

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.

**Co-requisites:** MEC-ENGR 324, CIV-ENGR 351.

MEC-ENGR 360 Thermal System Design 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 270, MEC-ENGR 299.

**Co-requisites:** CIV-ENGR 351.

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.

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, MEC-ENGR 285.

MEC-ENGR 390 Engineering Coop/Internship Credits: 0
Students may participate in structured Engineering Coop/Internship under the supervision of employer. They must carry out significant professional responsibilities and whatever additional assignments are determined by the employer.

**Prerequisites:** CIV-ENGR 211, MEC-ENGR 285.

MEC-ENGR 399 Heat and Mass Transfer Credits: 3

**Prerequisites:** MEC-ENGR 272, MEC-ENGR 360.

**Co-requisites:** MEC-ENGR 306.

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

MEC-ENGR 401AD Topics in Mechanical Engineering- Advance Dynamics and Modeling Credits: 3
Fundamental principles of advance rigid body dynamics with applications. Special mathematical techniques including Lagrangian and Hamiltonian methods.

MEC-ENGR 401CD Topics in Mechanical Engineering -- Applied CFD 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 399.

MEC-ENGR 401ID Topics in Mechanical Engineering Credits: 3
Kinematics and dynamics of rigid bodies in space. General theory of rotating coordinate frames, Eulers angles, Eulers equations of motion, angular momentum, work-energy principles.

**Prerequisites:** MEC-ENGR 285
MEC-ENGR 401MB Topics in Mechanical Engineering 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 401MS Topics in Mechanical Engineering Credits: 3
The incorporation of material selection in the design process will be considered.

Prerequisites: MEC-ENGR 324.

MEC-ENGR 401R Topics in Mechanical Engineering Credits: 3
Introduction to and analysis of the thermodynamic cycles and equipment used in Industrial Refrigeration. Applications of Industrial Refrigeration are also discussed.

Prerequisites: MEC-ENGR 299.

MEC-ENGR 401T Topics in Mechanical Engineering Credits: 3
This course covers the application of Newton's laws and thermodynamics to analysis of fluid flow in turbomachinery.

Prerequisites: MEC-ENGR 399.

MEC-ENGR 409 Fundamentals of Engineering Review Credit: 1
This course consists of a series of lectures given by different professors and is intended as a review class for all the subjects included in the Fundamentals of Engineering exam. Classes specifically focus on the review of equations and formulas included in the reference handbook published by NCEES.

MEC-ENGR 411 Introduction to Biomechanics Credits: 3
This course is to provide students with an introduction to the engineering principles of biomechanics.

Prerequisites: All junior-level coursework must be completed before taking this course.

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

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 Feedback Control Systems 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 420 Human Powered Vehicle Design Lab Credits: 3
Introduction to the science of human powered vehicles (HPV) providing the background necessary for the design of such vehicles. Students will learn and utilize engineering design practices and apply them toward the creation of an aerodynamic, highly engineered land based HPV.

Prerequisites: MATE111A Machine Shop Safety, Consent of instructor.

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.

Cross Listings: MEC-ENGR 5525.

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.

Cross Listings: MEC-ENGR 5526.
MEC-ENGR 440 Heating 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 447 Contracts and Law For Engineers Credits: 3
This course covers a broad range of substantive legal topics giving the student a grounding in the legal implications of certain situations that they may encounter during their careers. The course includes coverage of basic contract law, environmental regulations and compliance, construction law, antitrust law, intellectual property law, civil procedure, employment law, business entities (corporate law) product liability and criminal law and procedure. The objective of the course is to provide students with a fundamental understanding of the wide range of federal and state laws governing behavior in our complicated and rule of law driven society.
Prerequisites: Senior standing.

MEC-ENGR 449 Environmental Compliance, Auditing & Permitting Credits: 3
This course provides a high level overview of the most important statutes that have been enacted to protect the environment. The course covers regulation of hazardous waste, the Clean Air and Clean Water Acts, the Resource Conservation and Recovery Act, the All Appropriate Inquiry Rule and the law addressing sites contaminated with hazardous substances and the technology options employed to remediate those sites. In addition, the course provides coverage of environmental audits and emergency planning for extremely hazardous substances, the regulation of underground storage tanks, safe drinking water and the National Environmental Policy Act among other statutes.
Prerequisites: CIV-ENGR 449.

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 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: 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 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 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.

Cross Listings: MEC-ENGR 5560.
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.

Cross Listings: MEC-ENGR 5567.

MEC-ENGR 468 Introduction to Nuclear Engineering Credits: 3
This course provides an overview of nuclear engineering for non-nuclear engineers. The course deals primarily with nuclear reactors including topics dealing with nuclear and reactor physics, reactor kinetics and controls and radiation environment. The general reactor types are covered in some detail with other topics dealing with licensing, waste management, quality assurance, balance of plant systems (turbine island), and significant nuclear accidents are also covered. Recent design innovations including small modular reactors and fusion are discussed.
Prerequisites: MEC-ENGR 399.

Cross Listings: MEC-ENGR 5568.

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.
Cross Listings: MEC-ENGR 5570.

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

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.

Cross Listings: MEC-ENGR 5586.

MEC-ENGR 491 Internship Credits: 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.

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, MEC-ENGR 131

MEC-ENGR 495 Vehicle Dynamics Credits: 3
Analysis and prediction of the dynamic behavior of ground vehicles utilizing computer simulation. Mechanics of various suspension systems, tire-roadway interaction, vehicle aerodynamics, vehicle handling and steering characteristics.
Prerequisites: MEC-ENGR 385.

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: MEC-ENGR 356, MEC-ENGR 380, RooWriter.

MEC-ENGR 499 Intermediate Heat Transfer Credits: 3
Advanced topics in conduction, convection and radiation heat transfer including transient heat transfer, phase change and heat exchangers.
Prerequisites: MEC-ENGR 399, MEC-ENGR 351.