MECHANICAL ENGINEERING (MEC-ENGR)

Courses

MEC-ENGR 5500 Problems Credits: 1-6
Supervised investigation in mechanical engineering to be presented in the form of a report.
Prerequisites: You must be a mechanical engineering student to take this course.

MEC-ENGR 5501 Advanced Topics In Mechanical Engineering Credits: 3
Prerequisites: You must be a mechanical engineering student to take this course.

MEC-ENGR 5501AD Advanced Topics in Mechanical Engineering Credits: 3
Advanced Topics in Mechanical Engineering

MEC-ENGR 5501MS Advanced Topics in Mechanical Engineering Credits: 3

MEC-ENGR 5501SM Advanced Topics in Mechanical Engineering Credits: 2
This course is for high school science teachers who have attended the ASM International Second Year Teachers Camp and have demonstrated the use of camp material in the classroom.

MEC-ENGR 5501TC Advanced Topics in Mechanical Engineering Credits: 2
This course is for high school science teachers who have attended the ASM International Teachers camp and have demonstrated the use of camp material in the classroom.

MEC-ENGR 5505 Imaging Techniques in Materials Science Credits: 3
Introduction to imaging techniques, including x-rays, neutron beams, electron beams and acoustic energy, to study material properties and structure.
Prerequisites: MEC-ENGR 324.

MEC-ENGR 5506 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. Knowledge of engineering materials or thermodynamics is helpful.

MEC-ENGR 5507 Advanced Dynamics and Modeling Credits: 3
Fundamental principles of advance rigid body dynamics with applications. Special mathematical techniques including Lagrangian and Hamiltonian methods.

MEC-ENGR 5511 Introduction to Biomechanics Credits: 3
This course is to provide students with an introduction to the engineering principles of biomechanics.

MEC-ENGR 5512 Biodynamics Credits: 3
Introduction to musculoskeletal biomechanics including: computational biomechanics, movement simulation, motor control and musculoskeletal tissues.
Prerequisites: MEC-ENGR 5511.

MEC-ENGR 5513 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 5511.

MEC-ENGR 5514 Material Science for Advanced Application Credits: 3
Study of the physical and mechanical metallurgy of alloy systems of interest in engineering applications.
Prerequisites: MEC-ENGR 324.

MEC-ENGR 5516 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.

MEC-ENGR 5518 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

MEC-ENGR 5525 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 5526 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.

MEC-ENGR 5529 Additive Manufactuirng Credits: 3
The course is intended for senior level mechanical engineering students graduates. 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.

MEC-ENGR 5533 Advanced Thermodynamics Credits: 3
Statistical methods of evaluating thermodynamic properties. Elements of quantum mechanics, statistical mechanics and kinetic theory applied to topics of engineering thermodynamics.
Prerequisites: MEC-ENGR 360, MEC-ENGR 399.

MEC-ENGR 5542 Introduction to Computational Fluid Dynamics and Heat Transfer Credits: 3
Introduction to the principles and development of the finite-difference approximations to the governing differential equations of viscous and inviscid fluid flow, as well as heat transfer. Introduction to discretization methods and the calculation of flow fields, convection, diffusion and conduction.
Prerequisites: MEC-ENGR 399, MEC-ENGR 441.

MEC-ENGR 5543 Industrial Refrigeration 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 5546 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 5548 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 or MEC-ENGR 5546

MEC-ENGR 5549 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 211, MEC-ENGR 285.

MEC-ENGR 5554 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 5557 Mechatronics System Design Credits: 3
Theory and application of mechatronic systems through course instruction, laboratory activities, and student projects.
Prerequisites: MEC-ENGR 352 and MEC-ENGR 415.

MEC-ENGR 5558 Intermediate Dynamics Credits: 3
Development of kinematics and dynamics of rigid bodies in three-dimensional space including: general theory of rotating coordinate frames, Eulers angles, Eulers equations of motion, angular momentum, work-energy principles, and Kane's method for creation and simulation of dynamic models.
Prerequisites: MEC-ENGR 285.

MEC-ENGR 5559 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. Prior coursework in computer aided engineering and mechatronics recommended.

MEC-ENGR 5562 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. Recommended preparation: MEC-ENGR 360 and MEC-ENGR 351.

MEC-ENGR 5564 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. Recommended preparation: MEC-ENGR 360 and MEC-ENGR 351.

MEC-ENGR 5567 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 5568 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.

MEC-ENGR 5570 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 5572 Advanced Statistics Credits: 3
The objective of this course is to review the concepts and methods of undergraduate first course in statistical analysis and extend the student's understanding to cover topics typically covered in a second course in applied engineering statistics. Concepts, techniques, interpretation, and use of results are stressed. Focus is on the application of the methods discussed, rather than the mechanics of derivation.
Prerequisites: CIV-ENGR 319.

MEC-ENGR 5574 Linear Programming for Engineering Optimization Credits: 3
This course will cover techniques and applications of engineering optimization using linear programming techniques. The main topics will be the simplex algorithm, sensitivity analysis, duality, network models, and integer programming. Main applications will include transportation, shipments, and utility planning. Stochastic models, game theory, non-linear programming, and heuristic optimization techniques will be briefly mentioned, but not explored in detail. At the conclusion of the course the student should be able to formulate and solve optimization problems in several areas of engineering.
Prerequisites: MEC-ENGR 306.

MEC-ENGR 5575 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 5586 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: CIV-ENGR 275, MATH 5517, MEC-ENGR 130.

MEC-ENGR 5594 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. Prior course work in engineering dynamics, computer aided engineering and instrumentation recommended.

MEC-ENGR 5595 Microscale Heat Transfer Credits: 3
Review of existing models. Concept of thermal lagging and the second-law admissibility. Applications to low temperatures, thermal processing of thin-film devices; amorphous materials; advanced composites.
Prerequisites: MEC-ENGR 399.

MEC-ENGR 5599 Research Credits: 1-99
Independent investigation in field of mechanical engineering to be presented as a thesis.
Prerequisites: You must be a mechanical engineering student to take this course.

MEC-ENGR 5601 Doctoral Topics In Mechanical Engineering Credits: 3
Prerequisites: You must be a mechanical engineering student to take this course.

MEC-ENGR 5603 Directed Readings in Mechanical Engineering Credits: 1-3
Faculty supervised readings course.
Prerequisites: Graduate standing and must be a mechanical engineering student.

MEC-ENGR 5610 Seminar Credit: 1
Review recent investigations, projects of major importance in mechanical engineering.
Prerequisites: You must be a mechanical engineering student to take this course.

MEC-ENGR 5616 Theory of Plasticity Credits: 3
Plastic yield conditions and stress-strain relations. Behavior of elastic-perfectly plastic members. Plain strain in plastic members.
Prerequisites: MEC-ENGR 5621, MEC-ENGR 5622.

MEC-ENGR 5618 Multibody System Dynamics Credits: 3
Fundamental principles of advanced rigid body dynamics with applications. Special mathematical techniques including Lagrangian and Hamiltonian methods.
Prerequisites: MEC-ENGR 285.

MEC-ENGR 5621 Continuum Mechanics Credits: 3
Introductory course in the mechanics of continuous media. Basic concepts of stress, strain, constitutive relationships; conservation laws are treated using Cartesian tensor notation. Examples from both solid and fluid mechanics investigated.
Prerequisites: CIV-ENGR 276, MATH 345, MEC-ENGR 351.

MEC-ENGR 5622 Theory of Elasticity Credits: 3
Stress and strain at a point. General equations of elasticity. Plane stress, plain strain problems; torsion of prismatic bars. Energy methods.
Prerequisites: MEC-ENGR 5621.

MEC-ENGR 5623 Theory Of Plates And Shells Credits: 3
Bending of plates with various loading and boundary conditions. Deformations,stresses in thin shells.
Prerequisites: MEC-ENGR 5621.

MEC-ENGR 5624 Theory of Elastic Stability Credits: 3
Buckling of columns, beams,rings, curved bars, thin plates, shells.
Prerequisites: MEC-ENGR 5621.

MEC-ENGR 5627 Dynamics of Machinery Credits: 3
Dynamic balancing or rotating and reciprocating components of turbo-machinery and internal combustion engines. Gas torque analysis, vibration stress analysis and equivalent systems. Numerical and graphical techniques.
Prerequisites: MEC-ENGR 484.

MEC-ENGR 5630 Boundary Layer Theory Credits: 3
Fluid motion at high Reynolds Number. Derivation of Navier-Stokes equations and boundary layer equations. Methods of solution. Transition to turbulent flow. Completely developed turbulent flow.
Prerequisites: MEC-ENGR 441.

MEC-ENGR 5636 Heat Transfer-Convection Credits: 3
Concepts including fluid dynamics, conservation laws, thermal boundary layer theory, forced convection in laminar and turbulent flows, and free convection will be developed and applied.
Prerequisites: MEC-ENGR 399

MEC-ENGR 5637 Heat Transfer-Radiation Credits: 3
Advanced study of engineering radiation heat transfer. Concepts of electromagnetic theory. Development of thermal radiation laws from thermodynamic laws. Analysis of grey and non-grey systems with intervening gases. Study of recent literature.
Prerequisites: MEC-ENGR 399.

MEC-ENGR 5639 Introduction to Two Phase Flow Credits: 3
The fundamental principles of two-phase flow with applications to a variety of homogeneous mixture as well as separated liquid-liquid, gas-solid, liquid-solid, and gas-liquid flow problems, including steady or transient, laminar or turbulent conditions.
Prerequisites: MEC-ENGR 441.

MEC-ENGR 5643 Industrial Refrigeration Credits: 3
Introduction to and analysis of the thermodynamic cycles and equipment used in Industrial Refrigeration. Applications of Industrial Refrigeration are also discussed.

MEC-ENGR 5660 Combustion Credits: 3
Study of advanced topics in flames and combustion. Detonation and deflagrations, supersonic combustion, air pollution.
Prerequisites: MEC-ENGR 441.

MEC-ENGR 5679 Dynamics of Structures Credits: 3
Study of the dynamic behavior of structures. Analysis of equivalent lumped parameter systems for the design of structures in a dynamic environment.
Prerequisites: CIV-ENGR 276 (or CIV-ENGR 421), MEC-ENGR 484 (or MATH 345, MEC-ENGR 285).

MEC-ENGR 5685 Advanced Vibration Analysis Credits: 3
Advanced topics in vibration theory and its application to Mechanical systems. Topics include vibration analysis of multi-degree of freedom, distributed and nonlinear systems, random vibration analysis, and vibration control.
Prerequisites: MEC-ENGR 484.

MEC-ENGR 5699 Research And Dissertation Credits: 1-9
Doctoral dissertation research.
Prerequisites: You must be a mechanical engineering student to take this course.