MENG Mechanical Engineering

MENG 1310 Manufacturing Processes Lab Manufacturing Processes Lab
1 Credit Hour. 0 Lecture Hours. 2 Lab Hours.
This course covers hands on introduction to various manufacturing, machining and fabrication processes including welding, thread cutting, and machining using lathe and mill.
Prerequisite(s): Mechanical or Manufacturing Engineering major or permission of department.

MENG 2110 Mechanical Engineering Case Studies in Design & Analysis
1 Credit Hour. 0 Lecture Hours. 2 Lab Hours.
The course includes fundamental techniques for creating, analyzing, synthesizing, and implementing design solutions to open-ended problems through team and individual efforts utilizing flexibility, adaptability, and creativity.
Prerequisite(s): A minimum grade of "C" in ENGR 1133.

MENG 2139 Numerical Methods in Engineering
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
Mathematical modeling and numerical solution of engineering related problems with emphasis on solution of linear and nonlinear equations, matrices, vectors, statistical data analysis, curve fitting, ordinary and partial differential equations. Prerequisite(s): Completion of MATH 2242 with a minimum grade of "C" and completion of ENGR 1121 or ENGR 1731 or concurrent enrollment in MFGE 2534.

MENG 3130 Mechanism Design
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course covers detailed concepts, functions and knowledge of the components of mechanisms, machine components and design tools. Analytical, mathematical and computer techniques for kinematic and dynamic analysis of mechanisms and machine components are introduced. A comprehensive project covers the mechanism synthesis and design experience using analytical and computer simulation tools.
Prerequisite(s): A minimum grade of "C" in ENGR 2232 or permission of instructor.

MENG 3135 Machine Design
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Prerequisite(s): A minimum grade of "C" in ENGR 3233 and MENG 2110 or permission of the department.

MENG 3233 Heat Transfer
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course will be an introduction to basic energy transport by conduction, convection, and radiation with applications to heat exchanger, extended surfaces etc.
Prerequisite(s): MATH 2243 and MATH 3230 and a minimum grade of "C" in ENGR 3431 and ENGR 3235 or permission of instructor.

MENG 3331 Materials Science
3 Credit Hours. 0.2 Lecture Hours. 0.3 Lab Hours.
The study of engineering materials such as metals, alloys, polymers, ceramics, and composites. Atomic structure and arrangement; control of the microstructure and mechanical properties, solidification, cooling curves and phase diagrams, mechanical testing, and strengthening mechanisms. Laboratory includes problem solving sessions and experiments on materials related to strengths, toughness, solidification, and metallography. Prerequisite(s): A minimum grade of "C" in CHEM 1146 or CHEM 1147 and ENGR 3233.

MENG 3333 Materials Processing
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
The course covers the study of traditional and modern processing techniques. The course will cover applications and use of different materials and their processing, metal-casting processes end equipment, forming and shaping processes and equipment, joining processes and equipment, molding, extrusion and fabrication of polymers, and composites processing and techniques. Laboratory includes problem solving sessions, experiments, and hands-on processing of materials.
Prerequisite(s): A minimum grade of "C" in MENG 3331 and MENG 1310 or permission of the department.

MENG 3521 Mechatronics Studio Laboratory
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
This course is an introduction to the theory and practice of engineering measurements, instrumentation, data acquisition, statistical analysis of data, controls and mechatronic systems and their applications integrated with computing. Topics include measurement fundamentals, applications of computing in measurement and mechatronic systems, sensors, analog signal processing, data acquisition and analysis, digital circuits, microcontroller programming and interfacing, actuators, and mechatronic system design.
Prerequisite(s): A minimum grade of "C" in ENGR 2131 and MENG 2139 and ENGR 3233.

MENG 3531 Introduction to Mechatronics
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
This course is an introduction to the theory and practice of engineering measurements, instrumentation, data acquisition, statistical analysis of data, controls and mechatronic systems and their applications integrated with computing. Topics include measurement fundamentals, applications of computing in measurement and mechatronic systems, sensors, analog signal processing, data acquisition and analysis, digital circuits, microcontroller programming and interfacing, actuators, and mechatronic system design.
Prerequisite(s): A minimum grade of "C" in ENGR 2131 and MENG 2139 and ENGR 3233.

MENG 4430 Engineering Quality Control and Project Management
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
The course will introduce students to basic tools of engineering economy such as; interest rates, cash flow analysis, cost benefit analysis, and depreciation analysis that are used in comparing and evaluating multiple engineering projects on the basis of quantitative monetary parameters. Students will additionally be introduced to basic quality control techniques such as quality control charts and Six Sigma techniques for assuring product quality.
Prerequisite(s): A minimum grade of "C" in MENG 2110, MENG 3135, and MENG 3333.

MENG 4612 Mechanical Engineering Senior Seminar
1 Credit Hour. 0 Lecture Hours. 0 Lab Hours.
Students are introduced to topics essential for improving performance on the Fundamentals of Engineering Exam. Topics such as engineering economy, ethics, and global citizenship are reinforced, while topics such as electrical devices, mechanics, energy science, and numerical methods are reviewed.
Prerequisite(s): MATH 2243 and a minimum grade of "C" in ENGR 2131, ENGR 2232, ENGR 3233, ENGR 3235, MENG 2139, MENG 3233, and MENG 3331.
MENG 4811 Mechanical Engineering Research
1 Credit Hour. 0 Lecture Hours. 0 Lab Hours.
MENG 4811 is meant to be a research course that is an introduction to engineering research topics, experiment design, ethics, laboratory safety, data analysis, statistics, technical writing and presentation. Prerequisite(s): MATH 2243 and a minimum grade of "C" in ENGR 2112 and MENG 2139 and prior or concurrent enrollment in MENG 3521, MENG 3531.

MENG 4822 Research Project in Mechanical Engineering
2 Credit Hours. 0 Lecture Hours. 0 Lab Hours.
MENG 4822 is the supervised research project element of the MechE special topic sequence (including MENG 4811 MechE Research Seminar), which progresses from experiment/project design, implementation, and culminates in a final research report, presentation and/or honors thesis. Prerequisite(s): A minimum grade of "C" in MENG 3135 and MENG 3233 and MENG 3333, and MENG 3521, and MENG 3531, and previous or concurrent enrollment in MENG 4811 or permission of the department.

MENG 4899 Directed Study in Mechanical Engineering
1-3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.
An individualized study involving research and applications pertaining to Mechanical Engineering. Prerequisite(s): Senior standing, prior identification of a problem or study area, and permission of instructor.

MENG 5090 Selected Topics in Mechanical Engineering
1-9 Credit Hours. 1-9 Lecture Hours. 0-6 Lab Hours.
This course provides for study of Mechanical Engineering course topics not generally offered by the program. Prerequisite(s): Senior standing or Permission of instructor. Cross Listing(s): MENG 5090G.

MENG 5090G Selected Topics in Mechanical Engineering
1-3 Credit Hours. 1-3 Lecture Hours. 1-6 Lab Hours.
This course provides for study of Mechanical Engineering course topics not generally offered by the program. Graduate students will be required to complete a case study or other individualized advanced activity that undergraduate students will not be required to complete. Prerequisite(s): Graduate standing or permission of department. Cross Listing(s): MENG 5090.

MENG 5134 Vehicle Dynamics
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
This course covers fundamental concepts related to mathematical models and designs of automotive vehicle as multiple degree of freedom system. It also covers its dynamic performance under acceleration, braking, steering, rollover considering road loads, suspension system and tire characteristics. Emphasis is given to the stability of the vehicle under these dynamic conditions. Graduate students are expected to carry out research activities and submit research paper as their projects. Prerequisite(s): A minimum grade of "C" in MENG 2139 and MENG 2130 or permission of the department. Cross Listing(s): MENG 5134G.

MENG 5134G Vehicle Dynamics
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
This course covers fundamental concepts related to mathematical models and designs of automotive vehicle as multiple degree of freedom system. It also covers its dynamic performance under acceleration, braking, steering, rollover considering road loads, suspension system and tire characteristics. Emphasis is given to the stability of the vehicle under these dynamic conditions. Graduate students are expected to carry out research activities and submit research paper as their projects. Graduate students will be required to complete a case study or other individualized advanced research activity that undergraduate students will not be required to complete. Prerequisite(s): Mechanism Design or permission of the department. Cross Listing(s): MENG 5134.

MENG 5135 Vibration and Preventive Maintenance
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
Free and Forced Vibration of one and multi-degree of freedom systems will be covered. Applications of vibration analysis for preventive maintenance of mechanical systems will be introduced. Laboratories include basic vibration analysis and its applications. Prerequisite(s): Completion of MATH 3230 and a minimum grade of "C" in MENG 3130, MENG 3531, MENG 3521 or permission of the department. Cross Listing(s): MENG 5135G.

MENG 5135G Vibration and Preventive Maintenance
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
Free and Forced Vibration of one and multi-degree of freedom systems will be covered. Applications of vibration analysis for preventive maintenance of mechanical systems will be introduced. Laboratories include basic vibration analysis and its applications. Graduate students will be expected to independently research an additional topic, write a summary report, and present their findings to the class. Prerequisite(s): Completion of MENG 3531 and MENG 3130 and MATH 3230 or permission of department. Cross Listing(s): MENG 5135.

MENG 5136 Introduction to Finite Element Analysis
3 Credit Hours. 0.1 Lecture Hours. 0.4 Lab Hours.
This course will introduce students to the fundamentals of Finite Element Analysis. The students will develop a working knowledge of a commercial FEA software package and will model and analyze mechanical and thermal engineering systems using that software. The students will additionally develop an ability and competence in interpretation and analysis of FEA results. Prerequisite(s): A minimum grade of "C" in ENGR 2112, ENGR 3235, MENG 2139, MENG 3135, MENG 3233 or permission of the department. Cross Listing(s): MENG 5136G.

MENG 5136G Introduction to Finite Element Analysis
3 Credit Hours. 1 Lecture Hour. 4 Lab Hours.
This course will introduce students to the fundamentals of Finite Element Analysis. The students will develop a working knowledge of a commercial FEA software package and will model and analyze mechanical and thermal engineering systems using that software. The students will additionally develop an ability and competence in interpretation and analysis of FEA results. Graduate students will be required to complete a case study or other individualized advanced activity that undergraduate students will not be required to complete. Prerequisite(s): A minimum grade of "C" in MENG 2139 and MENG 3135 and MENG 3233 and ENGR 2112 and ENGR 3235 or permission of department. Cross Listing(s): MENG 5136.

MENG 5137 Mechanical System Design
3 Credit Hours. 0 Lecture Hours. 0.6 Lab Hours.
This is a senior design course requiring that students call upon all of their academic preparations in developing the solution of mechanical system problems. Prerequisite(s): A minimum grade of "C" in ENGR 2112 and ENGR 3235, MENG 3130, MENG 3135, MENG 3233, MENG 3333, (MENG 3531 or MENG 3521).

MENG 5137G Mechanical System Design
3 Credit Hours. 0.3 Lecture Hours. 0-6 Lab Hours.
This is a senior design course requiring that students call upon all of their academic preparations in developing the solution of mechanical system problems. Graduate students will be expected to independently research an additional topic, write a summary report, and present their findings to the class. Prerequisite(s): A minimum grade of "C" in MENG 3130 and MENG 3135 and MENG 3233 and MENG 3333 and MENG 3531 and ENGR 2112 and ENGR 3235. Cross Listing(s): MENG 5137, MENG 5137H.
MENG 5138 Composite Materials: Manufacturing, Analysis, and Design
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
This course introduces basics of fiber reinforced, and laminated composites, anisotropic theory, stress analysis, design and testing of composite materials. Topics include an overview of structure and processing of composite materials, classification of anisotropy, anisotropic constitutive models, classical laminate theory, failure theories, and test methods. The knowledge will be applied to a design of simple composite structural elements.
Prerequisite(s): A minimum grade of "C" in (MENG 3135 or MFGE 3131) and (MENG 3333 or MFGE 2531), or permission of the department.
Cross Listing(s): MENG 5138G.

MENG 5138G Composite Materials: Manufacturing, Analysis, and Design
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
This course introduces basics of fiber reinforced, and laminated composites, anisotropic theory, stress analysis, design and testing of composite materials. Topics include an overview of structure and processing of composite materials, classification of anisotropy, anisotropic constitutive models, classical laminate theory, failure theories, and test methods. The knowledge will be applied to a design of simple composite structural elements. Graduate students will be required to complete a case study or other individualized advanced activity that undergraduate students will not be required to complete.
Prerequisite(s): A minimum grade of "C" in MENG 3135 or MFGE 3131 and MENG 3333 or MFGE 3531 or permission of department for graduate students.
Cross Listing(s): MENG 5138.

MENG 5139 Renewable Energy
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
The design, operation, and environmental and socio-economic impact of renewable energy systems will be presented with an engineering emphasis. Additionally, cycle evaluation and analysis of the renewable energy systems, the efficiency and power output of renewable energy systems, their benefits and costs will be determined. Graduate students will be required to complete an additional design project that involves a class presentation with a more advanced technical analysis.
Prerequisite(s): A minimum grade of "C" in MENG 3233 and ENGR 3431 and ENGR 3235 or permission of instructor. Cross Listing(s): MENG 5139G, TMAE 5139, TMAE 5139G.

MENG 5139G Renewable Energy
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
The design, operation, and environmental and socio-economic impact of renewable energy systems will be presented with an engineering emphasis. Additionally, cycle evaluation and analysis of the renewable energy systems, the efficiency and power output of renewable energy systems, their benefits and costs will be determined. Graduate students will be required to complete an additional design project that involves a class presentation with a more advanced technical analysis.
Prerequisite(s): A minimum grade of "C" in MENG 3233 and ENGR 3431 and ENGR 3235 or permission of department. Cross Listing(s): MENG 5139, TMAE 5139, TMAE 5139G.

MENG 5231G Tribology and Reliability
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
The course is an introduction to basic tribology concepts in mechanical engineering; it also includes the analysis engineering cases, and the fundamentals of reliability as they relate to mechanical engineering. Graduate students will be required to complete a case study or other individualized advanced research activity that undergraduate students will not be required to complete.
Prerequisite(s): A minimum grade of "C" in ENGR 3235 and MENG 3135 and MENG 3333 or permission of department. Cross Listing(s): MENG 5231.

MENG 5233 Wind Energy
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
This course provides an in-depth introduction to modern wind turbine technology and the development of the wind power industry. Students will learn general characteristics of the wind resource and the atmospheric boundary layer. They will also learn how to analyze wind data, estimate wind resources and use statistical techniques to estimate wind turbine energy production. Aerodynamic characteristics of various turbine (HAWT and VAWT) models design, blade design, airfoils design, blade number effect and optimization techniques will be discussed theoretically and computationally for various applications. This course provides the general principles of wind turbine loads, mechanics, rotor dynamics, and methods for modeling turbine structural response. Electrical aspects of wind turbines, turbine control, turbine materials and components will also be studied, as well as, turbine design and testing, wind turbine siting, system design and integration.
Prerequisite(s): Completion of MATH 2243 and a minimum grade of "C" in ENGR 2112, ENGR 2231, ENGR 3233, ENGR 3235, MENG 3130, MENG 3135, and (MENG 3531 or MENG 3521).
Cross Listing(s): MENG 5233G.

MENG 5233G Wind Energy
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
This course provides an in-depth introduction to modern wind turbine technology and the development of the wind power industry. Students will learn general characteristics of the wind resource and the atmospheric boundary layer. They will also learn how to analyze wind data, estimate wind resources and use statistical techniques to estimate wind turbine energy production. Aerodynamic characteristics of various turbine (HAWT and VAWT) models design, blade design, airfoils design, blade number effect and optimization techniques will be discussed theoretically and computationally for various applications. This course provides the general principles of wind turbine loads, mechanics, rotor dynamics, and methods for modeling turbine structural response. Electrical aspects of wind turbines, turbine control, turbine materials and components will also be studied, as well as, turbine design and testing, wind turbine siting, system design and integration. Graduate students will be expected to independently research an additional topic, write a summary report, and present their findings to the class.
Prerequisite(s): Completion of MATH 2243 and MENG 3130 and MENG 3135 and MENG 3531 and a minimum grade of "C" in ENGR 2112, ENGR 2231, ENGR 3233 and ENGR 3235.
Cross Listing(s): MENG 5233.

MENG 5234 Heating, Ventilating, and Air Conditioning
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
This is an introductory course in Heating, Ventilating, and Air Conditioning (HVAC) systems. In this course HVAC processes are analyzed and load calculations are performed in accordance with American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) practices.
Prerequisite(s): A minimum grade of "C" in ENGR 3431, ENGR 3235, MENG 3233 or permission of the department.
Cross Listing(s): MENG 5234G.

MENG 5234G Heating, Ventilating, and Air Conditioning
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
This is an introductory course in Heating, Ventilating, and Air Conditioning (HVAC) systems. In this course HVAC processes are analyzed and load calculations are performed in accordance with American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) practices. Graduate students will be required to complete a case study or other individualized advanced activity that undergraduate students will not be required to complete.
Prerequisite(s): A minimum grade of "C" in ENGR 3431, ENGR 3235, MENG 3233 or permission of department.
Cross Listing(s): MENG 5234.
MENG 5235 Combustion
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
This course is an introduction to the fundamentals of combustion processes, thermochemistry, chemical kinetics, simple chemical reactors, premixed and nonpremixed combustion, turbulent combustion and its practical applications including pollutant emissions.
Prerequisite(s): ENGR 3235, ENGR 3431, MENG 3233 or Permission of Instructor.
Cross Listing(s): MENG 5235G.

MENG 5237 Applied Combustion
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
This course is an introduction to the fundamentals of combustion processes, thermochemistry, chemical kinetics, simple chemical reactors, premixed and nonpremixed combustion, turbulent combustion and its practical applications, biofuel combustion, fuel surrogates, and pollutant emissions. Graduate students will be expected to independently research an additional topic, write a summary report, and present their findings to the class.
Prerequisite(s): A minimum grade of "C" in (ENGR 3235 or ENGR 3235), ENGR 3431 and MENG 3233.
Cross Listing(s): MENG 5237G.

MENG 5237G Applied Combustion
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
This course is an introduction to the fundamentals of combustion processes, thermochemistry, chemical kinetics, simple chemical reactors, premixed and nonpremixed combustion, turbulent combustion and its practical applications, biofuel combustion, fuel surrogates, and pollutant emissions. Graduate students will be expected to independently research an additional topic, write a summary report, and present their findings to the class.
Prerequisite(s): A minimum grade of "C" in MENG 3233 or permission of department.
Cross Listing(s): MENG 5237.

MENG 5238 Engine Development and Performance
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
The design, development, operation, and environmental impact of internal combustion engines will be presented in this course with an engineering emphasis. Additionally, cycle evaluation and analysis of the energy systems, the efficiency and power generation, their benefits and costs will be determined.
Prerequisite(s): A minimum grade of "C" in ENGR 3235, ENGR 3431, MENG 3233 and (MENG 3531 or MENG 3521).
Cross Listing(s): MENG 5238G.

MENG 5238G Engine Development and Performance
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
The design, development, operation, and environmental impact of internal combustion engines will be presented in this course with an engineering emphasis. Additionally, cycle evaluation and analysis of the energy systems, the efficiency and power generation, their benefits and costs will be determined. Graduate students will be expected to independently research an additional topic, write a summary report, and present their findings to the class.
Prerequisite(s): Completion of MENG 3521 and MENG 3233 or permission of department.
Cross Listing(s): MENG 5238.

MENG 5239 Biofuels Development and Testing
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
The development of biofuels for engine operation and their environmental impact will be presented with an engineering emphasis. Additionally, life cycle evaluation, analysis of the energy systems and their efficiency with biofuels, together with benefits and costs will be determined.
Prerequisite(s): A minimum grade of "C" in (CHEM 1146 or CHEM 1147), MENG 3233 and ENGR 3431.
Cross Listing(s): MENG 5239G.

MENG 5239G Biofuels Development and Testing
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
The development of biofuels for engine operation and their environmental impact will be presented with an engineering emphasis. Additionally, life cycle evaluation, analysis of the energy systems and their efficiency with biofuels, together with benefits and costs will be determined. Graduate students will be required to complete a more advanced capstone design project that involves a class presentation and a more advanced technical analysis.
Prerequisite(s): MENG 3233 and a minimum grade of "C" in ENGR 3431 or permission of department.
Cross Listing(s): MENG 5239.

MENG 5331 Automation and Computer Integrated Manufacturing Systems
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
This course will cover the fundamental concepts in manufacturing, automation, and various topics in production and control systems. These include numerical control, industrial robots, computer integrated manufacturing systems, flexible manufacturing system, and process monitoring and control.
Prerequisite(s): A minimum grade of "C" in ENGR 1133 and (ENGR 1121, ENGR 1731 or MFGE 2534) and (MENG 3333 or MFGE 2533) or permission of the department.
Cross Listing(s): MENG 5331G.

MENG 5331G Automation and Computer Integrated Manufacturing Systems
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
This course will cover the fundamental concepts in manufacturing, automation, and various topics in production and control systems. These include numerical control, industrial robots, computer integrated manufacturing systems, flexible manufacturing system, and process monitoring and control. Graduate students will be required to complete a case study or other individualized advanced activity that undergraduate students will not be required to complete.
Prerequisite(s): A minimum grade of "C" in ENGR 1133 and ENGR 1731 or MFGE 2534 and MENG 3333 or MFGE 2533 or permission of department.
Cross Listing(s): MENG 5331.

MENG 5333 Robot Dynamics, Design and Analysis
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
An integrated treatment of robot kinematics, dynamics and control is introduced with an emphasis on analysis, design and programming of robots and their applications. Topics include planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots; forward and inverse kinematics, differential kinematics, manipulability, workspace design; planar and spatial multi-rigid-body-dynamics, dynamic models of robots; introduction to computer vision; robot programming; and robot control. Students will be engaged in laboratory activities to study kinematics, dynamics, programming and real-time control of robotic systems that include manipulators, mobile robots, and unmanned aerial vehicles (UAVs).
Prerequisite(s): A minimum grade of "C" in MENG 3130 and MENG 3531 or MENG 3521.
Cross Listing(s): MENG 5333G.
MENG 5333G Robot Dynamics, Design and Analysis
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
An integrated treatment of robot kinematics, dynamics and control is introduced with an emphasis on analysis, design and programming of robots and their applications. Topics include planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots; forward and inverse kinematics, differential kinematics, manipulability, workspace design; planar and spatial multi-rigid-body-dynamics, dynamic models of robots; introduction to computer vision; robot programming; and robot control. Students will be engaged in laboratory activities to study kinematics, dynamics, programming and real-time control of robotic systems that include manipulators, mobile robots, and unmanned aerial vehicles (UAVs). Graduate students will be expected to independently research an additional topic, write a summary report, and present their findings to the class.
Prerequisite(s): Completion of MENG 3531 and MENG 3130 or permission of department.
Cross Listing(s): MENG 5333.

MENG 5431 Compressible Flow
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
This course introduces the basic equations and concepts of compressible flow. The generalized equations and solutions are developed and solved for: one-dimensional moving and normal shocks, oblique shocks, expansion fans, compressible flow with friction, and compressible flow with heat transfer. Software will be utilized to solve compressible flow problems.
Prerequisite(s): A minimum grade of "C" in ENGR 2112, ENGR 3235, or MENG 3233.
Cross Listing(s): MENG 5431G.

MENG 5431G Compressible Flow
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
This course introduces the basic equations and concepts of compressible flow. The generalized equations and solutions are developed and solved for: one-dimensional moving and normal shocks, oblique shocks, expansion fans, compressible flow with friction, and compressible flow with heat transfer. Software will be utilized to solve compressible flow problems. Graduate students will be expected to independently research an additional topic, write a summary report, and present their findings to the class.
Prerequisite(s): MENG 3233 or permission of department.
Cross Listing(s): MENG 5431.

MENG 5432 Applied Computational Fluid Dynamics
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
This course introduces the numerical techniques applied to the solution of fluid flow and heat transfer problems. The Finite Difference and Finite Volume methods are used to discretize and numerically solve the governing equations of heat transfer and fluid mechanics. Commercial computational fluid dynamics software is utilized for the analysis of heat transfer and fluid mechanics problems.
Prerequisite(s): A minimum grade of "C" in MENG 3233.
Cross Listing(s): MENG 5432G.

MENG 5432G Applied Computational Fluid Dynamics
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
This course introduces the numerical techniques applied to the solution of fluid flow and heat transfer problems. The Finite Difference and Finite Volume methods are used to discretize and numerically solve the governing equations of heat transfer and fluid mechanics. A commercial computational fluid dynamics software is utilized for the analysis of heat transfer and fluid mechanics problems. Graduate students will be expected to independently research an additional topic, write a summary report, and present their findings to the class.
Prerequisite(s): MENG 3233 or permission of department.
Cross Listing(s): MENG 5432.

MENG 5433 Analysis of Energy Systems
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
The course will introduce students to the design and analysis of energy systems. The students will use the concepts of thermodynamics, fluid mechanics and heat transfer to analyze various energy systems. The course will also offer an introduction to compressible flow, associated with the energy systems. The students will develop a working knowledge of a commercial CFD software package and model and analyze the energy systems using the software.
Prerequisite(s): MATH 2243, MATH 3230, MATH, and a minimum grade of C in ENGR 2231, ENGR 3431, ENGR 3235, and MENG 3233. Cross Listing(s): MENG 5433G.

MENG 5433G Analysis of Energy Systems
3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.
The course will introduce students to the design and analysis of energy systems. The students will use the concepts of thermodynamics, fluid mechanics and heat transfer to analyze various energy systems. The course will also offer an introduction to compressible flow, associated with the energy systems. The students will develop a working knowledge of a commercial CFD software package and model and analyze the energy systems using the software.
Prerequisite(s): ENGR 2231, MATH 2243, MATH 3230, ENGR 3431, ENGR 3235, and MENG 3233.
Cross Listing(s): MENG 5433.

MENG 5434 Heat Transfer Principles and Applications
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course will cover intermediate concepts related to conduction, convection and radiation heat transfer. Analytical solution methods for steady and transient conduction in one and two dimensions are developed and utilized. The continuity, momentum, and energy equations are derived and used in fundamental heat transfer applications. Radiation exchange between surfaces with and without participating media is presented and analyzed.
Prerequisite(s): MATH 5530 or permission of department. Cross Listing(s): MENG 5434G.

MENG 5434G Heat Transfer Principles and Applications
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course will cover intermediate concepts related to conduction, convection and radiation heat transfer. Analytical solution methods for steady and transient conduction in one and two dimensions are developed and utilized. The continuity, momentum, and energy equations are derived and used in fundamental heat transfer applications. Radiation exchange between surfaces with and without participating media is presented and analyzed.
Prerequisite(s): MATH 5530 or permission of instructor.

MENG 5536 Mechanical Controls
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
An understanding of the elements of classical control theory will be developed. Students will be introduced to the concept of feedback and its properties; the concept of stability and stability margins; and the different tools that can be used to analyze these properties. Students will also develop a working knowledge of the basics of linear control techniques.
Prerequisite(s): A minimum grade of "C" in MENG 2139 and MENG 3130 and (MENG 3531 or MENG 3521) or permission of instructor.
Cross Listing(s): MENG 5536G.
MENG 5536G Mechanical Controls
3 Credit Hours. 0.2 Lecture Hours. 0.2 Lab Hours.
An understanding of the elements of classical control theory will be developed. Students will be introduced to the concept of feedback and its properties; the concept of stability and stability margins; and the different tools that can be used to analyze these properties. Students will also develop a working knowledge of the basics of linear control techniques. Graduate students will be required to complete a case study or other individualized advanced activity that undergraduate students will not be required to complete.
Prerequisite(s): MENG 2139 and MENG 3130 and MENG 3531 or permission of department.
Cross Listing(s): MENG 5536.

MENG 5890G Selected Topics in Mechanical Engineering
1-3 Credit Hours. 1-3 Lecture Hours. 1-2 Lab Hours.
This course is scheduled on an infrequent basis to explore special areas in applied engineering. Graduate students will be required to complete a case study or research project not required of undergraduate students.
Prerequisite(s): Permission of department.

MENG 5891 Special Problems in Mechanical Engineering
1-6 Credit Hours. 0 Lecture Hours. 2-12 Lab Hours.
Individual and specialized study in the areas of mechanical engineering not otherwise covered in the students' curriculum.
Prerequisite(s): Senior standing and identification of a problem or study area and permission of instructor.
Cross Listing(s): MENG 5891G.

MENG 5891G Special Problems in Mechanical Engineering
1-3 Credit Hours. 1-3 Lecture Hours. 0-2 Lab Hours.
Individual and specialized study in the areas of mechanical engineering not otherwise covered in the students' curriculum. Graduate students will be required to complete a case study or other individualized advanced activity that undergraduate students will not be required to complete.
Prerequisite(s): Graduate standing and identification of a problem or study area and permission of department.

MENG 5895 Special Problems in Mechanical Engineering
1-3 Credit Hours. 1-3 Lecture Hours. 0-2 Lab Hours.
Individual and specialized study in the areas of mechanical engineering not otherwise covered in the students' curriculum. Graduate students will be required to complete a case study or other individualized advanced activity that undergraduate students will not be required to complete.
Prerequisite(s): Graduate standing and identification of a problem or study area and permission of department.

MENG 5136 or permission of department.

MENG 5138 Mechatronics II
3 Credit Hours. 0.2 Lecture Hours. 0.3 Lab Hours.
This course is designed to provide further fundamental information to understand the fusion of mechanical engineering, electrical engineering, and computer data acquisition/programming and their relationship to the field of Mechatronics. This course emphasizes the interfacing of microcomputers with sensors and actuators, hybrid (analog/digital) design, digital logic and analog circuitry, micro-computer architecture, assembly language programming, signal conditioning, filters, analog-to-digital and digital-to-analog conversion, and the interface of data acquisition systems with the control process.
Prerequisite(s): A minimum grade of "C" in MENG 7136 or permission of department. Cross Listing(s): TMAE 7137.

MENG 7239 Intermediate Fluid Mechanics
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
In this course, the basic equations for multidimensional flow fields with ideal fluids and compressible fluids are derived. Advanced topics in fluid mechanics, including potential flow, boundary layer flow, compressible flow, and open channel flow are presented. Analytical techniques for solving problems are presented.
Prerequisite(s): MATH 5530 or permission of department.

MENG 7431 Mechanics of Deformable Solids
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course is an introduction to the fundamental mechanics of linear elasticity and elasto-plasticity, formulation and solution of simple static boundary value problems. Topics covered include constitutive equations for isotropic media, field equations for elastic solids, plane strain/plane stress and some classic analytical solutions, stress functions and potential methods.
Prerequisite(s): MENG 3331 and MATH 5530 or permission of department.

MENG 7432 Fracture Mechanics
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course is an introduction to linear elastic and elastic-plastic fracture, their fundamental concepts and applications. Topics include microstructural effects on fracture, toughening mechanisms, crack growth resistance, interface fracture mechanics, fatigue damage, fatigue crack growth models and mechanisms.
Prerequisite(s): MATH 5530 and a minimum grade of "C" in ENGR 3233 or permission of department.

MENG 7530 Research in Mechanical Engineering
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
A study of modern research methods and their application to the preparation of the thesis and technical reports. Cross Listing(s): TMAE 7530.

MENG 7890 Selected Topics in Mechanical Engineering
1-3 Credit Hours. 1-3 Lecture Hours. 0-2 Lab Hours.
This course is scheduled on an infrequent basis to explore special areas of applied engineering.
Cross Listing(s): TMAE 7890.

MENG 7891 Special Problems in Mechanical Engineering
1-3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.
Individual and specialized study in the areas of applied engineering not otherwise covered in the program. Students must submit a proposal of the special problem for approval by the faculty member of record. Credit will be assigned commensurate with the magnitude of the study. Cross Listing(s): TMAE 7891.

MENG 7895 Independent Study
1-3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.
Independent study is available for students to undertake individualized experimentation, research, study related to applied engineering, or a capstone project. The specific topic will be approved by a faculty member in the program, and credit will be assigned commensurate with the magnitude of the study.
Cross Listing(s): TMAE 7895.
MENG 7999 Thesis
1-6 Credit Hours. 0 Lecture Hours. 0 Lab Hours.
This course focuses on the preparation and completion of the thesis.
Cross Listing(s): TMAE 7999.