

# Mechanical Engineering

## Courses

### **MENG 1204 Mechanical Engineering 3D Design: 2 semester hours**

Prerequisite: MATH 1030 or equivalent. Introduction to computer-aided drafting using CAD software and sketching to generate two- and three-dimensional drawings based on the conventions of engineering graphical communication; topics include spatial relationships, multi-view projections and sectioning, dimension, graphical presentation of data, and fundamentals of computer graphics.

### **MENG 3330 Instrumentation and Measurement: 3 semester hours**

Prerequisite(s): EENG 2310. Fundamentals of statistics, sensors, instrumentation, and measurement of mechanical phenomena such as temperature, flow, pressure, force, stress, displacement, and acceleration. Students will be introduced to electronics and measurement equipment, such as oscilloscopes, breadboards, function generators, digital data acquisition systems, integrated circuits strain gages, displacement meters, thermocouples, tachometers, dynamometers, filters, volume flow meters, velocity meters, pressure transducers, etc. Statistical analysis is integrated into the course, especially in the hands-on laboratories, where statistics is used to analyze and interpret acquired data.

### **MENG 3340 Properties of Material and Testing: 3 semester hours**

Prerequisite(s): ENGR 2332. This course provides an integrated approach to materials science and engineering. Students learn the important relationships between processing, microstructure, and the properties of materials. The course provides an introduction to basic characterization techniques for materials, such as microscopy, hardness testing, fracture testing and analysis, fatigue testing, and impact testing. In addition, material selection and heat treatment topics are covered. The course requires hands-on involvement by the students in the planning of experiments as well as data manipulation and analysis of results.

### **MENG 3350 System Dynamics and Control: 3 semester hours**

Prerequisite(s): MATH 2020, ENGR 2320, and CMP SCI 1250. Mathematical modeling and analysis of linear dynamic systems; performance and design of simple controllers. Modeling of linear systems via transfer functions and state-space models; analysis of systems in the time and frequency domain using transfer functions and state-space models; development of control techniques based on PID.

### **MENG 3350L System Dynamics and Control Lab: 1 semester hour**

Prerequisite(s): MENG 3350. A hands-on, team-based environment, students design, implement, and evaluate controllers -- especially PID -- or real-world dynamic systems such as motors, pendulums, or servomechanisms. They model system dynamics, identify transfer functions or state-space representations, execute time- and frequency-domain testing, and analyze closed-loop responses using MATLAB/Simulink or equivalent tools.

### **MENG 3360 Machine Design and Manufacturing: 3 semester hours**

Prerequisite(s): ENGR 2332 and concurrent enrollment in MENG 3340. Design and selection of machine components and connections. Stress analysis and modes of failure of materials used in machine components. The process for selection, design and failure analysis of various common machine elements. Subjects include reliability, safety factors, and the design of machine elements including shafts, roller bearings, brakes, clutches, gears, belt and chain drives, and additional topics such as screws, springs, journal bearings, and connections. Both static and cyclic loading are considered as part of the design and analysis process.

### **MENG 3370 Fluid Mechanics: 3 semester hours**

Prerequisite(s): MATH 2020, ENGR 2320 and ENGR 2330. An introduction to the basic concepts of fluid mechanics including the fundamental properties of fluids, fluid statics, kinematics of fluid motion, and similitude. The conservation of mass, energy, and momentum are introduced with applications to compressible and incompressible fluids. Laminar and turbulent boundary layers are introduced.

### **MENG 3370L Fluid Mechanics Lab: 1 semester hour**

Prerequisite(s): Concurrent enrollment in MENG 3370. The lab provides hands-on experiments to reinforce fundamental concepts in fluid mechanics. Students conduct experiments on fluid properties, flow measurement, pressure and velocity distributions, laminar and turbulent flow, losses in piping systems, and forces on immersed bodies. Emphasis is placed on experimental methods, data acquisition, error analysis, and comparison with theoretical models.

### **MENG 3380 Heat Transfer: 3 semester hours**

Prerequisite(s): MATH 2020 and MENG 3370. Thermal energy transfer mechanisms: conduction (steady, transient), convection (internal, external), radiation; lumped parameter method; heat exchangers; introduction to numerical methods. One-dimensional steady and transient conduction is studied for planar, cylindrical, and spherical geometries. The lumped capacitance analysis is used for transient conduction when appropriate. Analytical and numerical methods are presented for two-dimensional conduction problems. Convection heat transfer is studied in both internal and external geometries and under laminar and turbulent flow regimes. Radiation heat transfer is studied by considering both the general characteristics of radiation as well as the properties of radiating surfaces and radiation heat transfer between surfaces.

### **MENG 3380L Heat Transfer Lab: 1 semester hour**

Prerequisite(s): Concurrent enrollment in MENG 3380. The lab reinforces the heat transfer principles taught in MENG 3380. Students perform team-based, hands-on experiments to explore conduction (steady-state and transient across planar, cylindrical, and spherical geometries), convection (internal and external, laminar and turbulent), and radiation heat transfer. Key topics include lumped capacitance methods, heat exchanger performance, and validation of theoretical and numerical models using modern instrumentation such as thermocouples, data acquisition systems, and heat flux sensors.

### **MENG 3390 Product Development and Prototyping Lab: 1 semester hour**

Prerequisite(s): ENGR 2332. The Lab reviews the process for product development from concept to prototypes and explores various aspects of prototyping. It also explores an integrated approach to additive manufacturing and reverse engineering. The course introduces basic operating procedures for Fused Deposition Modeling (FDM) printers and gives instruction on repair, troubleshooting, and print optimization techniques. The laboratory examines the important relationships between 3D printing parameters and the final objects material properties. In addition, reverse engineering and rapid prototyping topics are covered.

### **MENG 4000 Special Topics in Mechanical Engineering: 3 semester hours**

Prerequisite(s): Consent of instructor. This course covers a special topic in mechanical engineering to be determined by recent developments in the field. May be repeated for credit provided the subject is different.

**MENG 4440 Introduction to Composite Materials: 3 semester hours**

Prerequisite(s): MENG 3340. This course introduces the fundamental principles and applications of composite materials in engineering. Topics include the classification and properties of composites, manufacturing processes, and common forms of composite structures. Students will study micromechanics of materials, orthotropic lamina behavior, laminate theory, and methods of failure analysis. The course also examines the effects of thermal and environmental conditions on composite performance. Emphasis is placed on analytical modeling, structural design considerations, and current trends in advanced composite applications across aerospace, automotive, marine, and biomedical industries.

**MENG 4450 Computational Fluid Dynamics: 3 semester hours**

Prerequisite(s): MENG 3370 and MENG 3380. This course introduces the theory and application of computational methods in fluid dynamics (CFD) and heat transfer. Topics include discretization techniques, numerical solution of the governing equations, grid generation, stability and convergence analysis, and implementation of boundary conditions. Students will gain hands-on experience with commercial CFD software to model internal and external flows, heat transfer, and design-related applications. Emphasis is placed on interpreting results, validating simulations, and applying CFD as a predictive tool in mechanical engineering design and research.

**MENG 4460 Renewable Energy Systems Laboratory: 1 semester hour**

Prerequisite(s): MENG 3370 or instructor consent. This laboratory course provides hands-on experience with renewable energy technologies, including solar, wind, and fuel cell systems. Students will perform experiments on photovoltaic and solar thermal modules, test small-scale wind turbines in a wind tunnel, and evaluate fuel cell and energy storage performance. Emphasis is placed on data acquisition, efficiency analysis, system integration, and comparison of experimental results with theoretical models.

**MENG 4490 Advanced Manufacturing: 3 semester hours**

Prerequisite(s): MENG 3390. This course explores modern production paradigms that harness automation, additive and subtractive processes, digitalization, and sustainable manufacturing techniques. Students learn to design, simulate, and analyze integrated manufacturing workflows, from CAD/CAM and robotics to smart factory systems, equipping them to lead in Industry 4.0 environments.

**MENG 4980 Mechanical Engineering Senior Design I: 2 semester hours**

Prerequisite(s): Concurrent enrollment in MENG 3360 and MENG 3380; senior standing. This course is the first of a two-part sequence of courses that make up the capstone design experience in the program preceding MENG 4990. Topics covered include project planning and design including concept generation, concept selection, market analysis, design with realistic constraint, costing and project planning. Students work in teams on an industrially-sponsored project or other project approved by the faculty to develop specifications and a project plan, perform necessary background research, begin to solve the problem, and make a presentation to the sponsor and committee members.

**MENG 4990 Mechanical Engineering Senior Design II: 2 semester hours**

Prerequisite(s): MENG 4980 and senior standing. Students perform technical analysis and initial testing on the concepts developed in the prior semester during the fulfillment of MENG 4980 course. Students work with the machine shop and/or use the 3D printing equipment to develop a prototype for evaluating their design specifications. Delivery of formal presentation to the sponsor and the committee member as well as a written report including CAD models, simulation files, experimental data is part of the fulfillment of the course.