

# MECHANICAL ENGINEERING (MECHENG)

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For up-to-date information on when online courses from the Distance Campus are typically offered, see <https://www.uwplatt.edu/department/professional-program-support/course-offerings> (<https://www.uwplatt.edu/department/professional-program-support/course-offerings/>).

## **MECHENG 2630 Thermodynamics 3 Credits**

First and second laws of thermodynamics; thermodynamic properties of pure substances; applications of thermodynamic systems operating in steady state and transient processes; energy-systems analysis including vapor refrigeration and heat pump cycles.

**Components:** Class

**Prereqs/Coreqs:** P: "C-" or better in CHEMISTRY 1450 or CHEMISTRY 1240 and MATH 2740

## **MECHENG 3030 Mechanical Vibrations 3 Credits**

An introduction to the development of models for the analysis of vibrational systems. Will effectively model and analyze free and forced vibrations of single and multiple degree of freedom oscillatory systems. Includes a semester-long project involving the design, modeling, and prototyping of a practical vibrational system.

**Components:** Discussion, Class

**Prereqs/Coreqs:** P: MATH 3630, (MECHENG 3430 or COMPUTER 1430) and (GENENG 2230 or ENGRPHYS 3240), all with a 'C-' or better

## **MECHENG 3040 Engineering Materials 3 Credits**

A study of materials and their crystal structures, microstructures, molecular structures, and imperfections focusing on metals and their alloys. The relationship between structures, properties, and performance. Material failure. Laboratory work reinforces concepts through hands-on experience with several materials.

**Components:** Laboratory, Class

**Prereqs/Coreqs:** P: "C-" or better in CHEMISTRY 1450 or 1240, and ENGLISH 1230; C: GENENG 2340

## **MECHENG 3230 Manufacturing Processes 3 Credits**

Introduction to polymers. Shaping processes for thermoplastics, thermosets, and elastomeric materials. Primary metal manufacturing processes such as casting, forging, rolling and extrusion. Secondary processes such as forming, bending, drawing, and swaging. Mechanics and economics of metal cutting. Special processes such as powder metallurgy. Design and manufacturing. Manufacturing systems.

**Components:** Class

**Prereqs/Coreqs:** P: "C-" or better in MECHENG 3040 and GENENG 2340

## **MECHENG 3300 Fluid Dynamics 3 Credits**

Fluid properties; pressure, hydrostatics, and buoyancy; control volume analysis; mass, momentum, and energy conservations for moving fluids; Euler's equation and the Bernoulli's theorem applied to inviscid flows; dimensional analysis and similitude; viscous fluid flows, flow through pipes; boundary layers, and lift and drag on objects; compressible flows.

**Components:** Laboratory, Class

**Prereqs/Coreqs:** P: "C-" or better in (MATH 2840 and MECHENG 2630), and a C- or better in (GENENG 2230 or ENGRPHYS 3240)

## **MECHENG 3330 Design of Machine Elements 3 Credits**

Nonstandard loading, deflection analysis, failure theories for static and cyclic loading followed by safety considerations. Design and selection of a wide range of machine elements such as fasteners, springs, shafts, bearings, and gears. Open-ended design project.

**Components:** Laboratory, Discussion, Class

**Prereqs/Coreqs:** P: "C-" or better in MECHENG 3040, GENENG 2030, GENENG 2340, and MATH 2740

## **MECHENG 3430 Introduction to Computational Methods 3 Credits**

An introduction to structured programming with engineering applications. Fundamental programming concepts, algorithm development, and debugging. Introduce and apply concepts in linear algebra to engineering problems in statics, dynamics and other professional engineering courses. Problems include solving systems of linear equations, root finding, eigenvalues and eigenvectors, and regression.

**Components:** Laboratory, Class

**Prereqs/Coreqs:** P: MATH 2740

## **MECHENG 3640 Heat Transfer 3 Credits**

One and two-dimensional steady state heat conduction; transient heat conduction; numerical methods in conduction transfer; forced and free convection; heat exchanger principles; radiation heat exchange.

**Components:** Class, Laboratory

**Prereqs/Coreqs:** P: "C-" or better in (MECHENG 3430 or COMPUTER 1430) and MATH 3630; C: MECHENG 3300

**MECHENG 3720 Measurements and Instrumentation Laboratory 3 Credits**

Introduction to engineering laboratory equipment, experimental procedures, report writing, automated data acquisition, including computer programming and statistical analysis. Emphasis is on the experimental analysis of mechanical systems, including topics such as vibrations, strain gauges, and DC motors, along with the electronics used to instrument and measure these systems.

**Components:** Laboratory, Class

**Prereqs/Coreqs:** P. 'C-' or better in MATH 4030, GENENG 2930, MECHENG 3430, and MATH 3630

**MECHENG 3830 Mechanisms and Machines 3 Credits**

Design and analysis of mechanisms and machines. A study of simple machines such as linkages, geared systems, and cam-follower systems. Topics include mechanism motion and performance (position, velocity, acceleration, force transmission, etc.), actuators, and design considerations to improve machine performance. The use of a customer-based, systematic design process to design and develop a working mechanism.

**Components:** Discussion, Laboratory, Class

**Prereqs/Coreqs:** P. A grade of "C-" or better in GENENG 2230 or ENGRPHYS 3240 and GENENG 2030

**MECHENG 3950 Mechanical Engineering Cooperative Education 2 Credits**

Work experience in industry under the direction of the College of Engineering, Mathematics and Science Cooperative Education and Internship Program. During the co-op, the student is expected to work for an industry for a semester and a summer.

**Components:** Field Studies

**Prereqs/Coreqs:** P. 'C-' or better in GENENG 2130 and MECHENG 2630. Student must be in a degree granting program and must not have taken MECHENG 4930 Senior Design

**MECHENG 3970 Mechanical Engineering Internship 1 Credit**

Work experience in industry under the direction of the College of Engineering, Mathematics and Science Cooperative Education and Internship Program. This program is designed to cover the summer work experience. The internship is designed to provide experiential learning to the student during the summer period.

**Components:** Field Studies

**Prereqs/Coreqs:** P. 'C-' or better in GENENG 2130 and MECHENG 2630. Student must be in a degree granting program and must not have taken MECHENG 4930 Senior Design

**MECHENG 4230 Design & Control of Manufacturing Systems 3 Credits**

Design and implementation of manufacturing processes using the process control model. Uses the evaluation of material removal manufacturing processes to uncover process parameters, then utilizes the manipulation of these characteristics to improve processes. Various manufacturing epistemologies will be reviewed for their strengths and weaknesses. Common industrial methodologies will be used to understand the process as it develops. Methodologies reviewed will include capability studies, poka yoke, 5/6S, GRR, DOE, SPC, Lean, ISO 9000, QS, TQS, DFSS, flow diagrams, cause/effect diagrams, control plans, TRIZ, value engineering, design for X, histograms, pareto charts, and creating test plans for product and process validation. Students will participate in a process design project at an industry location utilizing methodologies acquired in class.

**Components:** Class

**Prereqs/Coreqs:** P. "C-" or better in MATH 4030 and MECHENG 3230. Must be in a degree granting program

**MECHENG 4330 Automatic Controls 3 Credits**

Modeling, characteristics, performance, and stability of feedback control systems including Nyquist stability. Design and analysis of feedback control systems using root locus and frequency response methods. Bode plots, PID controllers, and lead-lag compensators. Laboratory demonstrates the practical application of theoretical concepts.

**Components:** Laboratory, Class

**Prereqs/Coreqs:** P. "C-" or better in (GENENG 2930 or EE 2210) and (MECHENG 3030 or ENGRPHYS 3240)

**MECHENG 4340 Noise Control 3 Credits**

This technical elective provides an introduction to acoustics, with an emphasis on noise reduction and hearing conservation. Topics include the wave equation, sound intensity and power, hearing conservation, standing waves, room acoustics, sound instrumentation and measurement, barriers, mufflers and silencers, gear noise, enclosures, and building criteria.

**Components:** Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3030 or ELECTENG 3220

**MECHENG 4430 Advanced Materials 3 Credits**

Discussion of specialty materials in engineering design and design for manufacture with an emphasis on developing the ability to select materials appropriate for given applications, with due consideration being given to all factors that influence material selection. A wide range of engineering materials including polymers, composites, nanomaterials, smart materials, and biomaterials are discussed along with additional current topics and material advances.

**Components:** Class, Laboratory

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3040

**MECHENG 4440 Failure of Materials 3 Credits**

Various failure modes including fatigue and fracture of materials are covered. Included are stress-life and strain-life analysis, fracture mechanics, stress concentration influences and variable amplitude loading. Exposure to design using commercially available software gives the students experience designing realistic components subjected to variable fluctuating load histories. Mechanical testing principles and principles for recognition of fatigue failure from fracture surfaces are also introduced in the course.

**Components:** Laboratory, Discussion, Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3040 and MECHENG 3330

**MECHENG 4450 Composite Materials 3 Credits**

This course provides an introduction to composite materials and structures used in engineering applications. Topics covered include the following: properties and microstructure of high-strength fiber materials (glass, carbon, polymer, ceramic fibers) and matrix materials (polymer, metal, ceramic, and carbon matrices); specific strength and stiffness of high-performance composites; rule of mixtures; stress, strain transformations; elastic properties of a single orthotropic ply; laminated plate theory; failure criteria; design of composite structures and components; effects of temperature and moisture.

**Components:** Class

**Prereqs/Coreqs:** P. MECHENG 3330

**MECHENG 4500 Biomedical Engineering 3 Credits**

An overview of the human physical system as a context for engineering design. Introduction to the functional basis of physiologic systems. Instrumentation, biomechanics, and design of medical devices. Principles of accessibility, and universal design.

**Components:** Class, Discussion

**Prereqs/Coreqs:** P. Senior standing or consent of instructor

**MECHENG 4520 Power Plant Design 3 Credits**

Analysis and design of steam power systems. Combustion turbines. Renewable energy. Environmental aspects and economics of power generation. Recent developments, future trends, and societal issues in power industry.

**Components:** Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 2630

**MECHENG 4550 Heat Transfer Applications 3 Credits**

Review of conduction, convection, and radiation heat transfer. Extension to variable properties and more complex geometries. Current heat transfer problems and applications such as electronic cooling, heat pipes, capillary pumped loops, and cryogenic heat transfer. Survey of currently used correlations and numerical techniques. Application of current state-of-the-art to design problems.

**Components:** Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3640

**MECHENG 4560 Computational Fluid Dynamics 3 Credits**

Introduction to computational fluid dynamics (CFD) with emphasis on using a commercial software package. Concepts of consistency, stability, convergence, scheme order, and turbulence modeling from the practitioner's viewpoint are covered. Simulations of steady and unsteady flows, compressible and incompressible flows, forced and natural convection heat transfer, and internal and external flows are performed. The students will learn to interpret CFD results and validation techniques.

**Components:** Laboratory, Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3300, (MECHENG 3430 or COMPUTER 1430), and MATH 3630

**MECHENG 4600 Energy Systems Design 3 Credits**

Design and analysis of energy generation, conversion, and storage systems with emphasis on renewable energy such as solar, wind, biomass, geothermal and hydroelectric. Solar energy emphases may include electrical power generation, flat plate and concentrating collectors, and/or control systems. Wind energy emphases may include generation, storage and/or grid-connection. Biomass emphases may include primary sources, conversion and upgrading, and/or distribution.

**Components:** Class

**Prereqs/Coreqs:** P or C: MECHENG 3640

**MECHENG 4630 Internal Combustion Engine Design 3 Credits**

Design of internal combustion engines for various applications. Gasoline engines, diesel engines, 4 stroke cycles and 2 stroke cycles.

**Components:** Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3640

**MECHENG 4640 Mechanical Design of Internal Combustion Engines 3 Credits**

An overview of the mechanical components of an internal combustion engine. Course will focus on the design and analysis of various components such as crankshafts, pistons connecting rods, cylinder design, valvetrain components, and camshafts.

**Components:** Class

**Prereqs/Coreqs:** P. 'C-' or better in MECHENG 2630; C: MECHENG 3330

**MECHENG 4650 Environmental Control Design 3 Credits**

Theory and design of heating, air conditioning and refrigeration units. Heating and cooling loads for air conditioning, heat pump, psychrometry.

**Components:** Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3640 and MECHENG 4730

**MECHENG 4720 Thermal Systems Laboratory 2 Credits**

Instrumentation and measurement techniques in thermal systems; verification of basic principles; laboratory tests on components of thermal systems; experimental approach for solving engineering problems; application of computer to data acquisition and data processing.

**Components:** Laboratory

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3300 and MECHENG 3640. Must be in a degree granting program; C: MECHENG 3720

**MECHENG 4730 Thermo-Fluid Systems Design 3 Credits**

A course treating the concepts of Thermodynamics, Fluid Mechanics, Heat Transfer, and mechanics in a unified presentation. Particular emphasis will be directed towards applications to actual physical systems including the gas power cycles, refrigeration cycles, heat exchangers, ideal gas mixtures, psychrometrics and 1st law combustion. Some design of devices involved in these applications will also be included.

**Components:** Discussion, Laboratory, Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3300 and MECHENG 3640. Must be in a degree granting program

**MECHENG 4740 Mechanical Systems Design 3 Credits**

Advanced topics in the design of machines and mechanical systems. Selection of machine elements implementing the design process and considering factors such as: the environment, manufacturability, assembly, ergonomics, aesthetics, safety, societal impact, reliability and maintainability. Also, economic factors, fits and tolerances, design communication and ethics. Application of fundamental concepts via a project.

**Components:** Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3330

**MECHENG 4750 Computational Methods in Engineering 3 Credits**

Use of digital computers to solve equations encountered in mechanical engineering problems. Numerical integration and differentiation, solution of linear and nonlinear equations, ordinary and partial differential equations (finite element and finite difference methods), systems of equations (matrix equations). Programming using Python. How to choose the proper numerical method, and pitfalls that lead to bad solutions.

**Components:** Class

**Prereqs/Coreqs:** P. "C-" or better in MATH 3630 and [(MECHENG 3430) or (COMPUTER 1430 and ENGRPHYS 3240)]

**MECHENG 4800 Finite Element Method 3 Credits**

Introduction to the finite element method. Emphasis on truss, beam and frame analysis, plane stress, plane strain, axisymmetric and three-dimensional stress analysis. Dynamic analysis and field problems, such as heat transfer. Readily available finite element computer programs utilized to solve stress analysis, heat transfer and other engineering related problems.

**Components:** Discussion, Class, Laboratory

**Prereqs/Coreqs:** P. "C-" or better in MATH 3630, MECHENG 3330, and (MECHENG 3430 or COMPUTER 1430)

**MECHENG 4820 Advanced Manufacturing Processes 3 Credits**

The course covers non-traditional manufacturing processes. Additive manufacturing for polymers, metals, ceramics and composite materials. Laser material processes such as laser welding, forming and surface modification. Friction stir welding, electro-chemical machining, and electric discharge machining and wire cutting.

**Components:** Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3230

**MECHENG 4830 Mechatronics 3 Credits**

Study of electro-mechanical systems and their interfaces. Programming of microcontrollers, fractional-horsepower motors, sensors, programmable logic controllers (PLC's), and control electronics. Binary number systems and logic are introduced. Application of control theory. Project.

**Components:** Laboratory, Class

**Prereqs/Coreqs:** C: MECHENG 4330

**MECHENG 4840 Advanced Vibrations 3 Credits**

Modeling and analysis of single and multiple-degree of freedom systems. Free and forced vibrations. Vibrations applications such as rotating balancing, whirling, vibration instruments, vibration isolation, and suspension. Computer applications involving matrices, eigenvalues, eigenvectors, and differential equations. Design of mechanical systems involving vibrations. Vibration suppression design. Vibration of continuous systems.

**Components:** Discussion, Laboratory, Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3030, or ENGRPHYS 3240 and ELECTENG 3220

**MECHENG 4850 Computer-Aided Engineering 3 Credits**

Use of current tools in the design, simulation, optimization, representation and manufacture of mechanical systems. Solid modeling and computer assembly of mechanical systems and top down assembly. Presentations by industry experts in technologies enabled by 3D CAD including additive manufacturing, tool path generation, computational fluid dynamics, finite element analysis, virtual reality, and rendering.

**Components:** Laboratory, Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3830

**MECHENG 4930 Senior Design Project 3 Credits**

Team based projects, primarily from industry. Rigorous application of design processes and methods. Consideration of real-life technical, economic, social, aesthetic, environmental and other constraints. Consideration of several related topics such as creativity, analysis, synthesis, project management, scheduling, time management, engineering ethics, communication, personality types, product safety and liability, copyrights and patents, design for manufacture, economics, and robust engineering. Integration of technical and management knowledge in an open-ended design environment. Oral and written reports. Open to graduating seniors only.

**Components:** Laboratory, Discussion, Class

**Prereqs/Coreqs:** P. "C-" or better in MECHENG 3230, MECHENG 3330, MECHENG 3830, BME 3030 (BME emphasis students only), and either MECHENG 3720 or BME 3230. Must be in a degree granting program; C: MECHENG 4330, MECHENG 4720, and MECHENG 4730

**MECHENG 4940 Undergraduate Research 2-3 Credits**

Introduction to research methods in mechanical engineering, literature review, data analysis, and design. A written report will be submitted to the sponsoring faculty member. A student may register for two to three credits in a given semester for a maximum of three credits.

**Components:** Research

**Prereqs/Coreqs:** P. Junior standing and permission of department chair

**MECHENG 4980 Current Topics in Engineering 1-3 Credits**

In-depth study of a current topic of interest to the engineering profession. The topic to be covered will be identified in the course title.

**Components:** Discussion, Laboratory, Class

**MECHENG 4990 Independent Study 1-3 Credits**

Advanced study in the area of specialization.

**Components:** Independent Study

**Prereqs/Coreqs:** P. senior standing and consent of department chair