Mechanical Engineering (MECH)

Courses

MECH 1000. Design: Introduction to Mechanical Design & Rapid Prototyping. 3 Hours.
An introduction to mechanical design and rapid prototyping required for Mechanical Engineering majors and open to makers. Students learn about mechanism design through design projects and rapid prototyping. Topics include: computer-aided design, dimensioning, tolerances, standard mechanical components, linkages, cams, gears, and 3D printing. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the Mechanical Engineering Program at DSU. 2. Know: TIE Center & Intellectual Property; CAD, 3D parts to 2D schematics; standard mechanical components and design for cost; the engineering design process; 3D printing technology & materials; 3D printing software; tolerances and probability distributions; Microsoft Word, PowerPoint, and Excel; Friction, joints, and fits; linkage design and CAD motion study; gear and gear train design; Cam and follower design. Course fee required. Corequisite: MECH 1005. FA.

MECH 1005. Design: Introduction to Mechanical Design & Rapid Prototyping Lab. 0 Hours.
Lab portion of MECH 1000. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use 3D printing slicing software. 2. Operate 3D printers. 3. Load and unload 3D prints. Corequisite: MECH 1000. FA.

MECH 1100. Design: Manufacturing Processes. 3 Hours.
An introduction to manufacturing processes required for Mechanical Engineering majors and open to makers. Students learn about various manufacturing processes through lecture and tours of local manufacturing facilities. Topics include: advantages and limitations of common manufacturing methods, component assembly, quality control, and manufacturing economics. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe both the technical and business considerations of various manufacturing processes seen in local manufacturing facilities. 2. Compare the advantages and disadvantages of different manufacturing processes when determining how to manufacture a part. 3. Develop and construct a solution to a defined task using manufacturing methods taught in the course. 4. Employ basic experimental techniques to examine the effectiveness of multiple manufacturing processes. 5. Summarize a wide range of manufacturing processes, including reduction, consolidation, and additive techniques. FA.

MECH 1150. Design: Prototyping Techniques. 2.5 Hours.
Prototyping required for Mechanical Engineering majors and open to makers. Students learn the following prototyping techniques through hands-on training: basic machining, manual and CNC milling and turning, laser/plasma/EDM/waterjet cutting, laying composites, injection/blow molding, lost wax/foam casting, welding, vacuum forming, electroplating, post processing of 3D printed parts, and the use of adhesives and fasteners. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Compare the advantages and disadvantages of different prototyping techniques when creating a product. 2. Demonstrate competency in various prototyping techniques, including machining, casting, coating, and plastic extrusion. 3. Design, model, and create prototypes that meets specified design criteria using modern and varied prototyping techniques. Course fee required. Prerequisite: MECH 1000 (Grade C- or higher). FA.

MECH 1200. Mechatronics: Coding. 3 Hours.
An introduction to coding required for Mechanical Engineering majors and open to makers. Students learn and apply the fundamentals of procedural and graphical programming to control microcontrollers, create user interfaces, and perform engineering analysis. The course culminates in a major design project that will be presented to the public at Dixie Design Day. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the following software products Matlab, Simulink, and Microcontrollers. 2. Produce order of operations, data types, variables, arrays functions. 3. Produce common functions. 4. Write scripts and debug scripts for errors. 4. Produce 2D plotting. 5. Write conditional statements and logic, loops, custom functions and scope, strings, complex numbers, matrices. 6. Produce 3D plotting. 7. Format cells arrays and structures, Input and output functions (I/O). 8. Produce graphical programming using Simulink and event-based programming using App Designer. Course fee required. Prerequisite: MECH 1000 (Grade C- or higher). Corequisite: MECH 1205. SP.

MECH 1205. Mechatronics: Coding Lab. 1 Hour.
Lab portion of MECH 1200. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand microcontrollers, interfacing, and flashing; taking data from sensors; moving motors; Matlab control of microcontrollers; Simulink control of microcontrollers; and Dixie Design Day preparation. Corequisite: MECH 1200. SP.

MECH 2010. Solid Mechanics: Statics. 3 Hours.
Fundamentals of static analysis required for Mechanical Engineering majors. Students learn to analyze bodies in equilibrium. Topics include: force vectors, equilibrium of particles and rigid bodies, structural analysis, internal forces, friction, centroids, and moments of inertia. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply principles of statics to analyze and solve engineering problems that relate to forces, rigid bodies, and moments of inertia. 2. Compare the difference between theoretical and experimental values when evaluating physical statics systems and articulate reasons for these differences. 3. Identify and breakdown real-world problems into solvable statics problems using appropriate simplifying assumptions. 4. Describe the basic concepts of statics, including force vectors, equilibrium, structural analysis, internal forces, center of gravity and moments of inertia. Corequisites: MATH 1220 AND PHYS 2210. FA.
MECH 2030. Solid Mechanics: Dynamics. 3 Hours.
Fundamentals of dynamic analysis required for Mechanical Engineering majors. Students learn to analyze bodies not in equilibrium. Topics include: force, acceleration, work, energy, impulse, and momentum of particles and rigid bodies. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Produce free body diagrams of complex engineering systems using appropriate simplifying assumptions. 2. Demonstrate the relationship between acceleration, velocity, position, and forces in multiple coordinate systems. 3. Assess the validity of proposed solutions to specific problems using principles of dynamics. 4. Describe the basic concepts of dynamics, including kinematics, work & energy, and impulse &momentum for particle, rigid body, and planar systems. Prerequisites: MECH 1200 (Grade C- or higher) AND PHYS 2210 (Grade C- or higher). SP.

MECH 2160. Solid Mechanics: Materials Science. 3 Hours.
Fundamentals of materials science required for Mechanical Engineering majors. Students learn about properties and microstructure of metals, ceramics, polymers, and composites. Topics include: atomic bonding and structure, diffusion, modes of material failure, phase diagrams, and material selection. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand materials science; atomic bonding; crystalline structure; crystal defects and noncrystalline structure; diffusion; mechanical behavior; thermal behavior; failure analysis and prevention; phase diagrams; kinetics - heat treatment; metals, ceramics, and glasses; polymers and composites; electronic materials; optical and magnetic materials; and materials in engineering design. Prerequisites: CHEM 1210 (Grade C- or higher) AND MATH 1220 (Grade C- or higher; can be enrolled concurrently). SP.

MECH 2210. Mechatronics: Circuits. 2 Hours.
Fundamentals of circuit analysis required for Mechanical Engineering majors and open to makers. Students learn to analyze DC and AC circuits through lecture and laboratory experiments. Topics include: resistive circuits, inductance and capacitance, transients, diodes, transistors, operational amplifiers, and transformers. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of circuits; resistive circuits, inductance and capacitance; transients (1st order); steady-state sinusoidal analysis (AC); diodes; field-effect transistors; bipolar junction transistors; operational amplifiers; and magnetic circuits and transformers. Corequisites: PHYS 2220 AND MECH 2215. Prerequisite: MECH 1200 (Grade C- or higher). FA.

MECH 2215. Mechatronics: Circuits Lab. 1 Hour.
Lab portion of MECH 2210. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand electronic testing equipment, safety, procedures; voltage dividers and wheatstone bridge; 1st order transients, capacitor discharge; resonance; diodes, rectifiers, and LEDs; MOSFETs and BJTs; and op-amps. Corequisite: MECH 2210. FA.

MECH 2250. Mechatronics: Sensors & Actuators. 3 Hours.
Fundamentals of sensors and actuators required for Mechanical Engineering majors and open to makers. Students learn to implement sensors and actuators into an internet of things (IoT) application through lecture and laboratory experiments. Topics include: data acquisition, signal conditioning, uncertainty analysis, sensors and measurements, actuator control, and IoT. The course culminates in a major design project that will be presented to the public at Dixie Design Day. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of measurement methods; internet of things (IoT); Static and dynamic characteristics of signals; measurement system behavior; probability and statistics; uncertainty analysis; analog electrical devices and measurements; sampling, digital devices, and data acquisition; temperature measurements; pressure and velocity measurements; flow measurements; and strain measurements. Corequisite: MECH 2255. Prerequisite: MECH 2210 (Grade C- or higher); and MATH 2250 (can be concurrently enrolled) or MATH 2280 (can be concurrently enrolled). SP.

MECH 2255. Mechatronics: Sensors & Actuators Lab. 1 Hour.
Lab portion of MECH 2250. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand data acquisition; sensors and associated circuits; filtering; various motors and control of motors using microcontrollers; integrating sensor data and motor control with ThingSpeak; and Dixie Design Day preparation. Corequisite: MECH 2250. SP.

MECH 3200. Mechatronics: Systems & Controls. 3 Hours.
Fundamentals of systems and controls required for Mechanical Engineering majors. Students learn to model and control multi-domain systems through lecture and laboratory experiments. Topics include: mechanical, electrical, electromechanical, fluidic, and thermal systems, time and frequency domain analysis, feedback control, and control system design. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of systems and controls; dynamic response and Laplace transforms; mechanical systems: block diagrams and state variables; electrical and electromechanical systems; fluid and thermal systems; time domain analysis; frequency domain analysis; feedback control systems; control system design; and compensator design. Corequisite: MECH 3205. Prerequisites: MECH 3200, AND MECH 2250, AND MATH 2270 OR MATH 2280 (All Grade C- or higher). FA.

MECH 3205. Mechatronics: Systems & Controls Lab. 0.5 Hours.
Lab portion of MECH 3200. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Observe, test, and model --mechanical translational system. 2. Observe, test, and model -- mechanical rotational and translational system. 3. Observe, test, and model -- electromechanical system. 4. Observe, test, and model -- fluidic system. 5. Explore P, I and D and PID control. Corequisite: MECH 3200. FA.
MECH 3250. Mechatronics: Machinery. 3 Hours.
Fundamentals of machine design required for Mechanical Engineering majors. Students learn to design mechanical components in power transmission systems. Topics include: failure criteria, fatigue, and analytical and finite-element analysis of stress in shafts, fasteners, joints, springs, bearings, and gears. The course culminates in a major design project that will be presented to the public at Dixie Design Day. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand machine design; load and stress analysis; finite element analysis basics in CAD; failures resulting from static loading; fatigue failure resulting from variable loading; shafts and shaft components; screws, fasteners, and the design of non-permanent joints; welding, bonding, and the design of permanent joints; mechanical springs; rolling-contact bearings; lubrication and journal bearings; gears; spur and helical gears; and bevel and worm gears. Corequisite: MECH 3255. Prerequisites: MECH 3200 AND MECH 3300 AND MECH 2160 (All Grade C- or higher). SP.

MECH 3255. Mechatronics: Machinery Lab. 1 Hour.
Lab portion of MECH 3250. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand structural health monitoring; hydraulics and pneumatics; vibration table test; power transmission; and Dixie Design Day preparation. Corequisite: MECH 3250. SP.

MECH 3300. Solid Mechanics: Strength of Materials. 4 Hours.
Fundamentals of strength of materials required for Mechanical Engineering majors. Students learn to analyze stress, strain, and deflection in deformable bodies through lecture and laboratory experiments. Topics include: stress and strain, mechanical properties of materials, axial loading, torsion, bending, transverse shear, combined loadings, stress and strain transformations, deflection in beams and shafts, column buckling, and energy methods. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of strength of materials; stress; strain; mechanical properties of materials; axial loading; torsion; bending; transverse shear; combined loadings; stress transformations; strain transformations; design of beams and shafts; deflection of beams and shafts; buckling of columns; and Energy Methods. Corequisites: MATH 2210 AND MECH 3305. Prerequisite: MECH 2010 (Grade C- or higher). FA.

MECH 3305. Solid Mechanics: Strength of Materials Lab. 0.5 Hours.
Lab portion of MECH 3300. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know tension/compression; hardness testing; shear; beam bending; column buckling; and failure design competition. Corequisite: MECH 3300. FA.

MECH 3600. Thermo-fluids: Thermodynamics. 4 Hours.
Fundamentals of thermodynamics required for Mechanical Engineering majors. Students learn to apply the laws of thermodynamics to open and closed systems through lecture and laboratory experiments. Topics include: energy transfer, laws of thermodynamics, power cycles, refrigeration and heat pump cycles, gas mixtures, psychrometrics, combustion, and chemical and phase equilibrium. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Analyze thermodynamic systems, including open and closed systems, using appropriate models and simplifications. 2. Arrange complex thermodynamic cycles into simpler systems to evaluate cycle efficiency, output power, and input power. 3. Design and report on a thermodynamic cycle that satisfies specific customer needs, with suitable consideration of efficiency, economics, and environmental impact. 4. Summarize basic concepts of thermodynamics, including properties of pure substances, thermodynamic laws, entropy, gas mixtures, psychrometrics, and combustion. Prerequisites: PHYS 2210 AND MATH 2210 (Both Grade C- or higher). SP.

MECH 3605. Thermo-fluids: Thermodynamics Lab. 0.5 Hours.
Lab portion of MECH 3600. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know heat engine experiment; gas laws; flame temperature; humidity and dew point; and air conditioning. Corequisite: MECH 3600. SP.

MECH 3650. Thermo-fluids: Heat Transfer. 3 Hours.
Fundamentals of heat transfer required for Mechanical Engineering majors. Students learn to analyze conduction, convection, and radiation heat transfer through lecture and laboratory experiments. Topics include: steady state and transient conduction, forced and natural convection, boiling and condensation, heat exchangers, and radiation heat transfer. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of heat transfer; heat conduction equation; steady state heat conduction; transient heat conduction; numerical methods in heat transfer; fundamentals of convection; forced convection; natural convection; boiling and condensation; heat exchangers; radiation heat transfer; and mass transfer. Corequisite: MECH 3655. Prerequisites: MATH 3500 AND MECH 3700 (both Grade C- or higher). SP.

MECH 3655. Thermo-fluids: Heat Transfer Lab. 0.5 Hours.
Lab portion of MECH 3650. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know thermal conductivity of materials; 1D conduction heat transfer -- rod; 2D conduction heat transfer -- plate; 1D conduction and convection heat transfer -- rod; heat exchangers; convection heat transfer -- stirring; and radiation cube. Corequisite: MECH 3650. SP.

MECH 3700. Thermo-fluids: Fluid Mechanics. 4 Hours.
Fundamentals of fluid mechanics required for Mechanical Engineering majors. Students learn to analyze fluids through lecture and laboratory experiments. Topics include: fluid statics, conservation of mass, work and energy of moving fluids, fluid momentum, dimensional analysis and similitude, viscous flow within enclosed surfaces, pipe flow, compressible flow, and turbomachines. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of fluid mechanics; fluid statics; linematics of fluid motion; conservation of mass; work and energy of moving fluids; fluid momentum; dimensional analysis and similitude; viscous flow within enclosed surfaces; analysis and design for pipe flow; viscous flow over external surfaces; compressible flow; and turbomachines. Corequisites: MATH 3500 AND MECH 3705. Prerequisites: MATH 2210 AND MECH 2030 AND MECH 3600 (All Grade C- or higher). FA.
MECH 3705. Thermofluids: Fluid Mechanics Lab. 0.5 Hours.
Lab portion of MECH 3700. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know hydraulic lift; major and minor losses in pipe flow; flow visualization and drag force for various objects; airfoil lift and drag; pressure distribution over a cylinder; slats and flaps; boundary layer growth; and pumps. Corequisite: MECH 3700. FA.

MECH 4000. Design: Product Design I. 3 Hours.
First course in the product design series required for Mechanical Engineering majors. Students work in teams to develop a product through customer needs identification, concept generation and selection, concept testing, benchmarking, design parameter specification, engineering analysis, and critical function prototyping. The course culminates in an alpha prototype and formal design review of the product with faculty and industry leaders. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know product design; product development process; product planning and project management. 2. Identify customer needs. 3. Understand product specifications; concept generation; concept selection; concept testing & robust design; design for manufacturing; prototyping; product architecture; patents and intellectual property; and product development economics. Corequisite: ENGL 3010. Prerequisites: MECH 3650 AND MECH 3250 AND MECH 1100 AND MECH 1150 (All Grade C- or higher). FA.

MECH 4010. Design: Product Design II. 3 Hours.
Second course in the product design series required for Mechanical Engineering majors. Student teams further develop their product through engineering analysis, beta testing, economic analysis, design for manufacturing, design reviews, and documentation. The course culminates in a final product that will be presented to the public at Dixie Design Day. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know product specifications; project logistics; design reviews; product documentation; and Dixie Design Day preparation. Prerequisite: MECH 4000 (Grade C- or higher). SP.