Mechanical Engineering

**MECH 1100** Introduction to Mechanical Engineering I (1 semester credit hour) Introduction to professional ethics, engineering design and quantitative methods; team projects designed to replicate decision processes in real-world situations; additional preparatory topics for Mechanical Engineering. BMEN 1100 or CE 1100 or CS 1200 or EE 1100 can substitute for this course. Credit cannot be received for more than one of the following: BMEN 1100, CE 1100, CS 1200, EE 1100 or MECH 1100. (1-1) Y

**MECH 1208** Introduction to Mechanical Engineering II (2 semester credit hours) The purpose of this course is to give students a general understanding of the broad range of technical areas and applications specific to the mechanical engineering profession. Course activities include team-oriented projects, and lectures by mechanical engineering experts. Prerequisite: MECH 1100. Prerequisites or Corequisites: (PHYS 2325 and PHYS 2125) and (MATH 2419 or MATH 2414). (1-1) Y

**MECH 1V95** Topics in Mechanical Engineering (1-9 semester credit hours) Subject matter will vary from semester to semester. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([0-9]-[0-9]) R

**MECH 2120** Mechanics of Materials Laboratory (1 semester credit hour) Laboratory course. The laboratory introduces techniques for measurements of mechanical properties and data analysis processes. Operation of materials test system to conduct experiments including tension, compression and bending to measure mechanical properties that include Young's modulus, yield strength, stress-strain curve, hardness, and impact energy absorption. Corequisite: MECH 2320. (0-3) S

**MECH 2310 (ENGR 2301)** Statics (3 semester credit hours) Lecture course. Course material includes vector representations of forces and moments, free body diagrams, equilibrium of particles, center of mass, centroids, distributed load systems, equivalent force systems, equilibrium of rigid bodies, trusses, frames and machines, internal forces in structural members, shear forces and bending moments in beams, friction, area and mass moments of inertia, the principle of virtual work. Prerequisites: MECH 1208 and (PHYS 2325 and PHYS 2125). Prerequisite or Corequisite: MATH 2415 or MATH 2419 or equivalent. (3-0) S

**MECH 2320 (ENGR 2332)** Mechanics of Materials (3 semester credit hours) Lecture course. Introduction to stress and deformation analysis of basic structural elements subjected to axial, torsional, bending, and pressure loads. Prerequisites: (MATH 2415 or MATH 2419 or equivalent) and MECH 2310. Corequisite: MEC 2120. (3-0) S

**MECH 2330 (ENGR 2302)** Dynamics (3 semester credit hours) Lecture course. Kinematics and kinetics of particles, planar rigid bodies, three-dimensional rigid bodies and equations of motion. Methods utilizing force and acceleration, work and energy and impulse and momentum are presented. Single degree of freedom vibration systems and simulation tools are introduced. Prerequisite: MECH 2310. Prerequisites or Corequisites: ENGR 2300 and MATH 2420. (3-0) S

**MECH 2340** Circuits and Applied Electronics (3 semester credit hours) The purpose of this course is to give students a general understanding of basic concepts in electronics geared specifically toward application. Course topics include: circuit components and theory (resistors, capacitors, inductors, component
networks), power concepts (AC, DC, single and 3-phase), basic microelectronics (semiconductors, diodes, transistors, op-amps, amplifiers), and digital design (number systems, logic circuits, common ICs). This course includes a laboratory component and team-based final project. Prerequisites: MATH 2420 and PHYS 2326 and MECH 1208. (2-3) Y

MECH 2V95 Topics in Mechanical Engineering (1-9 semester credit hours) Subject matter will vary from semester to semester. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([0-9]-[0-9]) R

MECH 3105 Computer Aided Design Laboratory (1 semester credit hour) Laboratory course associated with MECH 3305. Design activities involving CAD tools constitute a major portion of the course. Corequisite: MECH 3305. (0-3) S

MECH 3115 Fluid Mechanics Laboratory (1 semester credit hour) Laboratory course associated with MECH 3315. Wind tunnel calibration and survey, wind tunnel turbulence measurement, study of boundary layer on a flat plate, static stability, designing and conducting experiments. Prerequisite: MECH 3315; it is recommended that the laboratory is taken the next long semester after completion of MECH 3315. (0-3) S

MECH 3120 Heat Transfer Laboratory (1 semester credit hour) Laboratory course associated with MECH 3320. Course emphasis is on experiments related to thermodynamics, heat transfer, and fluid mechanics. Proper experimental methods, data and uncertainty analysis related to thermal and fluids measurements are discussed. Prerequisite: MECH 3320; it is recommended that the laboratory is taken the next long semester after completion of MECH 3320. (0-3) S

MECH 3150 Kinematics and Dynamics Laboratory (1 semester credit hour) Project-based course associated with MECH 3350. Laboratory course focused on performing a team design project of a mechanical system. Prerequisite: MECH 3350; it is recommended that the laboratory is taken the next long semester after completion of MECH 3350. (0-3) S

MECH 3305 Computer Aided Design (3 semester credit hours) Lecture course. Course material includes an introduction to Computer-Aided Design (CAD) tools and their applications to the geometric design and analysis of mechanical components and assemblies. CAD software will be used to generate sketches, curves, surfaces, solids, assemblies, and engineering drawing suitable for different manufacturing processes. Innovative team-oriented projects are integrated into the course. Prerequisites: MECH 1208 and ENGR 2300. Prerequisite or Corequisite: CS 1325 or CE 1337 or CS 1337 or TE 1337. Corequisite: MECH 3105. (3-0) S

MECH 3310 Thermodynamics (3 semester credit hours) Lecture course. This course focuses on introductory concepts and definitions of thermodynamics: energy and the first law of thermodynamics; evaluating properties and Ideal gas model; control volume analysis using energy; entropy and the second law of thermodynamics; refrigeration and power systems, Prerequisites: MECH 1208 and ENGR 3300 and PHYS 2325. Prerequisite or Corequisite: CHEM 1311. (3-0) S

MECH 3315 Fluid Mechanics (3 semester credit hours) Lecture course. Governing equations will be derived applying conservation of mass, momentum and energy to a control volume. The flow behavior will be studied using the integral form of the governing equations for mechanical engineering applications (turbines, pumps, moving bodies). Assuming inviscid and irrotational flow, potential theory, Bernoulli equation, and Stokes theorem on the circulation will be discussed. Analysis of engineering applications of
incompressible pipe systems, external aerodynamics, and computer solutions will be examined.
Prerequisites: MECH 2330 and ENGR 3300. Prerequisite or Corequisite: MECH 3310. (3-0) S

**MECH 3320** Heat Transfer (3 semester credit hours) Lecture course. This course focuses on steady state and time-dependent conduction in one- and two-dimensions; forced convection, internal and external flows; heat exchangers; introduction to radiation; elements of thermal system design. Prerequisites: MECH 3310 and MECH 3315. (3-0) S

**MECH 3350** Kinematics and Dynamics of Mechanical Systems (3 semester credit hours) Lecture course. Motion and interaction of machine elements and mechanisms. Kinematics, statics, and dynamics are applied for analysis and design of the parts of machines such as planar mechanisms, cams and gears. Prerequisites: ENGR 2300 and MATH 2420 and MECH 2330 and ENGR 3300. (3-0) S

**MECH 3351** Design of Mechanical Systems (3 semester credit hours) Lecture course. Design and analysis tools for mechanical systems. Design criteria based on reliability and functionality are introduced. Basic principles of stress and deflection analysis, application to mechanical components and systems. Failure design theory based on static and dynamic loads, stochastic considerations, and design of mechanical components such as shafts, bearing and shaft-bearing systems, gear and gear systems and mechanical joints. Prerequisites: MECH 2320 and ENGR 3300. Prerequisite or Corequisite: MECH 3350. (3-0) S

**MECH 3360** Introduction to Materials Science (3 semester credit hours) This course provides an intensive overview of materials science and engineering focusing on how structure/property/processing relationships are developed and used for different types of materials. The course illustrates roles of materials in modern technology by case studies of advances in new materials and process. Topics include atomic structure, crystalline solids, defects, failure mechanisms, phase diagrams and transformations, metal alloys, ceramics, polymers as well as their mechanical, thermal, electrical, magnetic and optical properties. Prerequisites: CHEM 1311 and (MATH 2415 or MATH 2419 or equivalent) and PHYS 2326 or instructor consent required. (Same as ECS 3310 and MSEN 3310) (3-0) Y

**MECH 3370** Applied Thermodynamics (3 semester credit hours) This course extends the coverage of thermodynamics beyond that found in an introductory Thermodynamics. Applications are emphasized by examining the use of thermodynamic concepts to analyze various devices, systems, and processes. The course includes a more advanced treatment of fundamental thermodynamic concepts as well as an introduction to several advanced topics of relevance to mechanical engineering such as energy, reacting and non-reacting mixtures, psychometrics, and combustion. Prerequisites: MECH 3310 and MECH 3315. (3-0) Y

**MECH 3380** Introduction to Computational Design and Analysis (3 semester credit hours) This course covers analytical and computer-based methods to design and analyze engineering structures. The course builds on prerequisite knowledge in mechanical engineering design, mechanics of materials, physics, engineering mathematics, and computer programming. The scope includes fundamentals of product design requirements, evaluation of stress and deformations in solids with complex geometries, and manufacturing process considerations. The course introduces 1-D boundary value problems, numerical solution methods (finite element analysis), and various computational tools to assess failure criteria. Additional topics include identifying linear vs. nonlinear structural problems, function approximation tools to reduce simulation time, and design optimization techniques. Computer programming and computer-based solid modeling/analysis tools are integrated into the course to facilitate the design and evaluation of
complex, real-world problems. Prerequisites: CS 1325 and MATH 2420 and MECH 2320 and MECH 3305 or equivalents. (3-0) Y

**MECH 3V95** Topics in Mechanical Engineering (1-9 semester credit hours) Subject matter will vary from semester to semester. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([0-9]-[0-9]) R

**MECH 4110** Systems and Controls Laboratory (1 semester credit hour) Laboratory course associated with MECH 4310. Course focused on the modeling and parameter estimation of dynamical systems, and the design of control systems. Prerequisite: MECH 4310; it is recommended that the laboratory is taken the next long semester after completion of MECH 4310. (0-3) S

**MECH 4301** Intermediate Mechanics of Materials (3 semester credit hours) Course material includes topics such as principal stresses; constitutive relations, thermal strains; stress concentration, brittle and ductile failure; fracture and fatigue; two-dimensional linear elasticity; material plasticity; energy concepts, unit load method, Castigliano’s theorems; St. Venant theory, shear center; curved beams; introduction to plates. Prerequisites: MECH 2320 and ENGR 3300. (3-0) Y

**MECH 4310** Systems and Controls (3 semester credit hours) Lecture course. Introduction to linear control theory. General structure of control systems. Mathematical models including differential equations, transfer functions, and state space. Transient response and steady-state error. Performance, stability, root-locus method, Bode diagram, and Nyquist plot. Compensation design using PID, phase-lead, and phase-lag controllers. Prerequisites: ENGR 2300 and MATH 2420 and MECH 2330. Prerequisite or Corequisite: MECH 3315. (3-0) S

**MECH 4320** Applications of Computational Tools in Thermal Fluid Science (3 semester credit hours) Introduction to the methods used to simulate fluid flow and heat transfer, with an emphasis on the selection and use of commercial analysis packages. This course covers basic numerical analysis and the application of these techniques to the solution of the relevant transport equations in thermal-fluid science. Discussion of how engineering problems can be formulated and solved using various commercial software packages. Prerequisite: MECH 3320. (3-0) Y

**MECH 4330** Intermediate Fluid Mechanics (3 semester credit hours) Lecture course. Key concepts such as: stability, buoyancy, conservation of momentum and angular momentum, and potential flow will be reviewed. Working mechanism of fluid machinery (such as pumps, gas turbines engines, fans) as well as open channel flows (river) will be discussed in detail. An introduction to the effects of compressibility will be given and the equations of normal shocks and streamlined isentropic tubes will be derived. Prerequisite: MECH 3315. (3-0) Y

**MECH 4340** Mechanical Vibrations (3 semester credit hours) Lecture course. This course covers harmonic and periodic motion including both damped and undamped free and forced vibration, single- and multi-degree-of-freedom systems and matrix techniques suitable for computer simulations. Prerequisites: ENGR 2300 and MATH 2420 and ENGR 3341 and MECH 2330. (3-0) Y

**MECH 4360** Introduction to Nanostructured Materials (3 semester credit hours) Lecture course. The emphasis in this course is to introduce the science of the building blocks of nanostructured materials, their chemical and structural characterization, material behavior, and the technological implications of these materials. Special attention is devoted to presenting new developments in this field and future
perspectives. Prerequisites: MECH 2320 and MECH 3310. (3-0) Y

**MECH 4370** Introduction to MEMS (3 semester credit hours) This course will target an audience of motivated senior-level undergraduates, with the goal of providing an introduction to M/NEMS fabrication techniques, selected device applications, and the design tradeoffs in developing systems. Prerequisites: CH EM 1311 and (MECH 3330 and MECH 3350 and PHYS 2126 and PHYS 2326) or ((CE 3110 or EE 3110) and (CE 3310 or EE 3310) and PHYS 2125 and PHYS 2325). (Same as EE 4371) (3-0) Y

**MECH 4380** HVAC Systems (3 semester credit hours) Lecture course. This course is an introduction to the analysis and design of heating, ventilation, air conditioning, and refrigeration systems. The emphasis is on the application of fundamental heat transfer and fluid mechanics principles to the analysis of HVAC systems. Topics include: introduction to human comfort and health requirement, heating and cooling load calculations and air distribution systems. Prerequisite: MECH 3320. (3-0) Y

**MECH 4381** Senior Design Project I (3 semester credit hours) Project-based capstone course. Student groups design, build, and test a device that solves an open-ended mechanical engineering design problem. **MECH 4381** focuses on background research, design, and engineering analysis, **MECH 4382** on prototype construction and testing. As designated MECH Writing-Intensive Courses, **MECH 4381** and **MECH 4382** also focus on the refinement of students' engineering communications skills and their use of writing as a critical-thinking and learning tool. Prerequisites: MECH 3305 and MECH 3320 and MECH 3351 and MECH 4310 and ECS 3390. (3-0) Y

**MECH 4382** Senior Design Project II (3 semester credit hours) Project-based capstone course. Student groups design, build, and test a device that solves an open-ended mechanical engineering design problem. **MECH 4381** focuses on background research, design, and engineering analysis, **MECH 4382** on prototype construction and testing. As designated MECH Writing-Intensive Courses, **MECH 4381** and **MECH 4382** also focus on the refinement of students' engineering communications skills and their use of writing as a critical-thinking and learning tool. Prerequisite: MECH 4381. (3-0) Y

**MECH 4399** Senior Honors in Mechanical Engineering (3 semester credit hours) For students conducting independent research for honors theses or projects. Instructor consent required. (3-0) R

**MECH 4V95** Topics in Mechanical Engineering (1-9 semester credit hours) Subject matter will vary from semester to semester. May be repeated for credit as topics vary (9 semester credit hours maximum). Faculty advisor consent required. ([0-9]-[0-9]) R

**MECH 4V96** Individual Instruction in Mechanical Engineering (1-6 semester credit hours) Selected advanced topics in mechanical engineering. For letter grade credit only. May be repeated for credit as topics vary (6 semester credit hours maximum). Instructor consent required. ([1-6]-0) R

**MECH 4V98** Undergraduate Research in Mechanical Engineering (1-9 semester credit hours) Topics will vary from semester to semester. Credit/No Credit only. May be repeated for credit (9 semester credit hours maximum). Instructor consent required. ([1-9]-0) R