

MECHANICAL ENGINEERING (MECH)

MECH 1025 - CAD and Graphics for Mechanical Engineering (3 Credits)
Introduction to 3-D computer-aided design software, solid modeling, industry-standard engineering drawing practices, and engineering graphics. Applications to mechanical engineering. Prereq: High School Geometry and Algebra. Max Hours: 3 Credits.
Grading Basis: Letter Grade

MECH 1045 - Manufacturing Processes Design (3 Credits)
Basic manufacturing background will be provided to engineering students in order to: (1) apply manufacturing specifications to the design of mechanical devices, and (2) communicate with technical personnel in a production environment. Topics cover metal casting, bulk and sheet metal forming, material removal, and joining and fastening processes. Prereq: MECH 1025 with a C- or higher. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 1025 with a C- or higher.
Typically Offered: Fall, Spring.

MECH 1100 - Fundamentals of Computational Innovation (3 Credits)
Provides a foundation in computational thinking and practices. Students learn to take advantage of computational power in problem solving by writing simple programs, studying the underlying logic of hardware, and working with a variety of technologies. Cross-listed with ENGR 1100. Max hours: 3 Credits.
Grading Basis: Letter Grade
Typically Offered: Fall, Spring.

MECH 1200 - Fundamentals of Engineering Design Innovation (3 Credits)
This course introduces concepts of engineering design innovation at a variety of scales and disciplines. Participants will experience and explore core technology and design themes including design principles, processes, methods, modes of thinking, and social and cultural aspects of design. Cross-listed with CSCI 1200, CVEN 1200, ENGR 1200, ELEC 1201 and IWKS 2100. Max hours: 3 Credits.
Grading Basis: Letter Grade
Typically Offered: Fall, Spring, Summer.

MECH 2023 - Statics (3 Credits)
A vector treatment of force systems and their resultants; equilibrium of trusses, beams, frames, and machines, including internal forces and three-dimensional configurations, static friction, properties of areas, distributed loads and hydrostatics. Prereq: PHYS 2311 with a C- or higher. Coreq: MATH 2411. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: PHYS 2311 with a grade of C- or higher Coreq: MATH 2411
Typically Offered: Fall, Spring.

MECH 2024 - Introduction to Materials Science (3 Credits)
The development of the physical principles relating the structural features of materials to their observed properties. Prereq: ENGR 1130 or CHEM 1130 or (CHEM 2031 and CHEM 2038 and CHEM 1999AE). Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: ENGR 1130 or CHEM 1130 or (CHEM 2031 and CHEM 2038 and CHEM 1999AE) with a C- or higher.

MECH 2033 - Dynamics (3 Credits)
A vector treatment of dynamics of particles and rigid bodies, including rectilinear translation, central-force, and general motion of particles, kinematics of rigid bodies, the inertia tensor, plane motion of rigid bodies, energy and momentum methods for particles, systems of particles, and rigid bodies. Prereq: MECH 2023 with a C- or higher. Cross-listed with CVEN 3111. Term offered: spring, fall. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 2023 with a C- or higher.
Typically Offered: Fall, Spring.

MECH 2034 - Properties of Engineering Materials (1 Credit)
Experiments to determine material properties and the effect of processing on properties important in mechanical design. Materials include metal, polymers, and composites. Loadings include tension, compression, and bending under static, dynamic impact and creep states. Coreq: MECH 2024. Max hours: 1 Credits.
Grading Basis: Letter Grade
Coreq: MECH 2024

MECH 3010 - Elementary Numerical Methods and Programming (3 Credits)
A development of basic numerical methods used to solve engineering problems. Introduction to MATLAB to implement numerical simulations. Prereq: MECH 1100. Coreq: MATH 3195 (or MATH 3191 and MATH 3200). Restriction: Restricted to majors in CEDC Mechanical Engineering. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 1100. Coreq: MATH 3195 (or MATH 3191 and MATH 3200). Restricted to majors in CEDC Mechanical Engineering.
Typically Offered: Fall, Spring.

MECH 3012 - Thermodynamics (3 Credits)
Introduces thermodynamic properties and state relationships, processes and cycles with work and heat transfer. Applications of the first and second laws to energy-related engineering systems. Prereq: MATH 1401 and PHYS 2311 with a C- or higher. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MATH 1401 and PHYS 2311 with a C- or higher

MECH 3021 - Introduction to Fluid Mechanics (3 Credits)
Applies exact and approximate theories to engineering problems in fluids. Examples include potential flow theory, Euler's equations for inviscid fluids, Bernoulli's equations, Navier-Stokes equations, and pipe flow. Prereq: MECH 2033, MECH 3012 and MATH 2421 with a grade C- or higher. Restricted to majors in CEDC Mechanical Engineering. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 2033, MECH 3012 and MATH 2421 with a grade C- or higher. Restricted to majors in CEDC Mechanical Engineering.

MECH 3027 - Measurements (3 Credits)
Principles of digital and analog measurements; systems for sensing, transporting, modifying, and outputting information; systematic and random error analysis. The laboratory includes a variety of instruments and components illustrating fundamental experimental measurement techniques and methods. Prereq: MECH 3030 or ELEC 3030, MATH 3195 or (MATH 3191 & MATH 3200) with a C- or higher. Restriction: Restricted to majors in CEDC Mechanical Engineering. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 3030 or ELEC 3030, MATH 3195 or (MATH 3191 MATH 3200) with a C- or higher. Restricted to majors in CEDC Mechanical Engineering.

MECH 3028 - Laboratory of Mechanical Measurements (1 Credit)

Modern techniques for Mechanical measurements. Laboratory includes techniques for the calibration of transducers and analysis of Statistical uncertainty. Data Acquisition Systems used for Signal acquisition and measurement of common mechanical quantities, such as displacement, velocity, acceleration and force. Design and characterization of a second order measurement system based on strain gages. Coreq: MECH 3027.

Max Hours: 1 Credit.

Grading Basis: Letter Grade

Coreq: MECH 3027

MECH 3031 - Fluids/Thermal Laboratory (1 Credit)

Laboratory exercise in compressible and incompressible fluid flow; steady state and transient heat transfer. Prereq: MECH 3012 with a grade of C- or higher. Coreq: MECH 3021. Restriction: Restricted to majors in CEDC Mechanical Engineering. Term offered: spring, fall. Max hours: 1 Credits.

Grading Basis: Letter Grade

Prereq: MECH 3012 with a C- or higher. Coreq: MECH 3021. Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing

Typically Offered: Fall, Spring.

MECH 3032 - Electric Circuits and Systems Lab (1 Credit)

Basic electrical engineering lab for MECH majors. Coreq: MECH 3030 or ELEC 3030. Restriction: Restricted to majors in CEDC Mechanical Engineering. Max Hours: 1 Credits.

Grading Basis: Letter Grade

Coreq: MECH 3030 or ELEC 3030 Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing

MECH 3035 - Design of Mechanical Elements (3 Credits)

Review of mechanics of materials and stress analysis; detailed design of various machine elements such as fasteners, springs, brakes and gears. Includes design project. Prereq: MECH 2024 and MECH 3043 with a grade C- or higher. Coreq: MECH 1045. Restriction: Restricted to majors in CEDC Mechanical Engineering. Max Hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: MECH 2024 and MECH 3043 with a grade C- or higher. Coreq: MECH 1045. Restricted to majors in CEDC Mechanical Engineering.

Typically Offered: Spring, Summer.

MECH 3042 - Heat Transfer (3 Credits)

Basic laws of heat transfer by conduction, convection, and radiation with engineering design applications. Includes design project. Prereq: MECH 3021 with a grade C- or higher. Restriction: Restricted to majors in CEDC Mechanical Engineering. Max Hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: MECH 3021 with a C- or higher Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing

MECH 3043 - Strength of Materials (3 Credits)

Application of exact and approximate theories of stress and displacement to engineering problems in solids. Examples include torsion of rods and bending of beams. Combined stresses, principal stresses and energy methods are examined. Prereq: MECH 2023 or CVEN 2121 with a C- or higher. Max Hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: MECH 2023 or CVEN 2121 with a C- or higher

Typically Offered: Fall, Spring.

MECH 3045 - Principles of Additive Manufacturing (3 Credits)

This course will introduce students to additive manufacturing (AM) techniques and design for additive manufacturing (DfAM). Additive manufacturing is no longer thought of as simply "rapid prototyping," but is influencing the way manufacturing is performed at almost every level of the product lifecycle. It will influence practically every manufacturing system of the future. This course will cover the fundamentals, applications, and implications of AM such that students will understand why and when to use AM, as well as challenge their traditional thinking of design and what is possible. At the end of this course, students should be able to: (1) Describe the 7 processes of AM, and understand their advantages and limitations. (2) Have hands-on experience in using several different AM processes, including building, modifying, and repairing their own AM machine. (3) Understand the wide variety of AM applications beyond prototyping. This includes tooling, production, performance improvement, customization, art, and more. (4) Understand how AM can be used in a product's lifecycle from beginning to end. (5) Use "generative design software" and "topology optimization" to unlock complex designs to be created with AM. (6) Assess the cost and value of AM processes. Prereq: MECH 1045 and MECH 2024 with a grade of C- or higher. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: MECH 1045 and MECH 2024 with a grade of C- or higher.

MECH 3939 - Internship (1-3 Credits)

Undergraduate internship course for credit. Must be approved by department and handled subject to experiential learning office rules. Max Hours: 3 Credits.

Grading Basis: Letter Grade

MECH 4020 - Biomechanics (3 Credits)

Static and dynamic biomechanical analysis, effects of mechanical loading on bone and cartilage, design considerations in orthopaedic devices, muscle function, biomechanics of human movement, cardiovascular biomechanics. Prereq: MECH 2023, 2033, MATH 3195 or 3200 with a C- or higher. Cross-listed with MECH 5020 Term offered: Fall, Spring. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: MECH 2023, 2033, MATH 3195 or 3200 Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing

Typically Offered: Fall, Spring.

MECH 4023 - System Dynamics (3 Credits)

Modeling, simulation, and analysis of single and multiple degree-of-freedom dynamical mechanical systems. Matrix methods for linear systems. State-variable models. Laplace transforms. Control system analysis and design using root locus and frequency response methods. Prereq: MECH 2033 and MATH 3195 or MATH 3191 and MATH 3200, and MECH 3010, and MECH 3043 or CVEN 3121. Max hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: MECH 2033 and MATH 3195 or MATH 3191 and MATH 3200, and MECH 3010, and MECH 3043 or CVEN 3121.

Typically Offered: Fall.

MECH 4025 - Advanced Biomechanics (3 Credits)

This course provides training in computational and experimental methods for biomechanical engineering analysis. Topics include finite element analysis of biological systems, orthopedic device design, medical imaging analysis, mechanical characterization of biological tissues, and biomechanics of human movement. Prereq: MECH 4020.

Max Hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: MECH 4020

MECH 4030 - Experimental and Computational Methods of Human Movement (3 Credits)

The objective of this course is to provide an overview of the various experimental and computational tools to measure and study human movement. Using a motion capture laboratory and musculoskeletal modeling, these tools will be used to develop a thorough understanding of how engineering principles can be used to address the major challenges of human movement biomechanics, with a primary emphasis on experimental measurement methods and simulations of movement. These tools will be used to explore the interaction of musculoskeletal properties, including whole-body and joint level biomechanics, with the environment during dynamic motion. Course topics include neuromuscular mechanics, balance performance, inverse dynamics, simulation of dynamic muscle-tendon mechanics, and musculoskeletal model development. Cross-listed with MECH 5030. Term offered: fall, spring. Max hours: 3 Credits.
Grading Basis: Letter Grade
Typically Offered: Fall, Spring.

MECH 4035 - Senior Design I (3 Credits)

Group and individual projects to design engineering components and systems. Design methodology, product specs, creativity, design reviews, communication, presentations, and report writing are emphasized. MECH 4035 and MECH 4045 form a one year sequence and must be taken consecutively. Prereq: MECH 3035 with a grade C- or higher and 40 hours of MECH courses. Restriction: Restricted to majors in CEDC Mechanical Engineering. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 3035 with a grade C- or higher and 40 hours of MECH courses. Restricted to majors in CEDC Mechanical Engineering.

MECH 4045 - Senior Design II (3 Credits)

Student teams manufacture and construct and/or redesign mechanical parts or assemblies that they designed in previous course (MECH 4035). A proposal, oral progress reports, and a final written report and demonstration are required. MECH 4035 and MECH 4045 form a one year sequence and must be taken consecutively. Prereq: MECH 4035 with a C- or higher. Restriction: Restricted to majors in CEDC Mechanical Engineering. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 4035 with a grade of C- or higher Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing

MECH 4110 - Numerical Methods for Engineers (3 Credits)

Introduces numerical analysis. Solution of linear and nonlinear equation systems. Numerical methods for ordinary and partial differential equations. Engineering applications. Prereq: MATH 3195 or (3191 and 3200) with a C- or higher. Restriction: Restricted to majors in CEDC Mechanical Engineering. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MATH 3195 OR (MATH 3191 and 3200) with a C- or higher Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing.

MECH 4114 - Designing with Composites (3 Credits)

Analysis and design of polymers and polymer-based composites. Failure criteria include static strength, stiffness, creep, fatigue, impact and fracture toughness. Design criteria include strength-to-weight ratio and cost-to-strength ratio. Prereq: MECH 3043 or CVEN 3121 with a C- or higher. Restriction: Restricted to majors in CEDC Mechanical Engineering. Cross-listed with MECH 5114. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 3043 or CVEN 3121 with a C- or higher Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing

MECH 4116 - Robotics (3 Credits)

Introduces kinematics, dynamics, and control of robot manipulators. Emphasis is placed on computer use in control of actual robots and in computer simulation of mathematical models of robots. Students must turn in a project report based on the computer simulation. Prereq: MECH 3065 with a C- or higher. Restriction: Restricted to majors in CEDC Mechanical Engineering. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 3065 with a C- or higher Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing

MECH 4120 - Methods of Engineering Analysis (3 Credits)

Selected topics from real analyses with applications to engineering analyses. Topics include vector calculus, ordinary differential equations, partial differential equations, and calculus of variations. Prereq: MATH 3195 or (MATH 3191 and MATH 3200) with a C- or higher. Restriction: Restricted to majors in CEDC Mechanical Engineering. Cross-listed with MECH 5120. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MATH 3195 OR (MATH 3191 and 3200) with a C- or higher Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing.

MECH 4141 - Fluid Mechanics (3 Credits)

Viscous incompressible fluid flows. Topics include derivation of equations governing viscous compressible fluid motion; specializations to simple flows; boundary-layer theory; similarity solutions; introduction to turbulence and Reynolds stresses. Prereq: MECH 3021 with a grade of C- or higher. Restriction: Restricted to majors in CEDC Mechanical Engineering. Cross-listed with MECH 5141. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 3021 with a C- or higher Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing

MECH 4142 - Thermal Energy Systems (3 Credits)

Detailed engineering design of thermal/fluids systems. Students work in teams on a project selected for entire class. Projects are similar to typical ones from industry. Course stresses creativity, synthesis, design judgment, and analysis of real-world problems. Oral and written presentations are required. Prereq: MECH 3010, MECH 3012, MECH 3021, and MECH 3042 with a grade of C- or higher. Restriction: Restricted to majors in CEDC Mechanical Engineering. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 3010, MECH 3012, MECH 3021 and MECH 3042 with a grade of C- or higher. Restricted to majors in CEDC Mechanical Engineering.
Typically Offered: Fall, Spring.

MECH 4147 - Engineering Economy (3 Credits)

Applies economic and financial principles to evaluation of engineering alternatives. Calculation of annual costs, present worth, and prospective rates of return on investment. Review of systems analysis techniques, including simulation, linear programming, and project scheduling. Restriction: Restricted to MECH majors at the junior or higher level standing within the College of Engineering, Design and Computing. Cross-listed with CVEN 4077. Max Hours: 3 Credits. Semester Hours: 3 to 3 Grading Basis: Letter Grade

Restriction: Restricted to MECH majors at the junior or higher level standing within the College of Engineering, Design and Computing

MECH 4163 - Rigid-Body Dynamics (3 Credits)

Review of Newtonian dynamics, Lagrange's equations for particles, systems, and rigid bodies. Conservative and non-conservative systems, moments of inertia, principal axes, angular momentum and Euler equations. Illustrations from spinning bodies, including tops, gyro-compass and rotating machinery. Prereq: MECH 2033 or CVEN 3111, MATH 3195 or (MATH 3191 and MATH 3200) with a grade of C- or higher. Restriction: Restricted to majors in CEDC Mechanical Engineering. Cross-listed with MECH 5163. Max Hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: MECH 2033 or CVEN 3111 and (MATH 3195 or MATH 3191 and MATH 3200) with a grade of C- or higher. Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing

MECH 4175 - Finite Element Analysis in Machine Design (3 Credits)

Students learn basic theory of finite element analysis (FEA) as it applies to stress analysis and design of mechanical components. Commercial package will be used giving students practical experience in the use of FEA. Prereq: MECH 3035 with a grade of C- or higher. Restriction: Restricted to majors in CEDC Mechanical Engineering. Cross-listed with MECH 5175. Max Hours: 3 Credits.

Grading Basis: Letter Grade

Prereq: MECH 3035 with a grade of C- or higher Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing

MECH 4177 - Renewable Energy (3 Credits)

This course bridges the introductory and intermediate levels for renewable energy and the intermediate levels for wind energy. It offers cutting-edge insights into renewable energy, with a focus on wind energy, covering topics such as renewable energy sources, wind resource assessment, wind turbine aerodynamics, wind turbine wake modeling, wind farm simulation, and wind farm layout optimization. Various state-of-the-art tools widely utilized in academia and industry will be introduced. Prereq: Requires prerequisite course of MECH 3012 (minimum grade D-). Restriction: Restricted to CEDC majors. Cross-listed with MECH 5177. Term offered: Fall, Spring. Max Hours: 3 Credits.

Grading Basis: Letter Grade

Requires prerequisite course of MECH 3012 (minimum grade D-).

Restricted to CEDC majors.

Typically Offered: Fall, Spring.

MECH 4178 - Solar Engineering (3 Credits)

This course provides the student with the basic ideas and calculation procedures on how solar processes work and how their performance can be predicted. Recommended Prereq: MECH 3012. Cross-listed with MECH 5178. Max Hours: 3 Credits.

Grading Basis: Letter Grade

MECH 4188 - Introduction to Turbulence (3 Credits)

This course provides an introduction to turbulence, a major topic in fluid mechanics with a wide range of applications in engineering and science. Students learn the fundamental concepts and statistical tools associated with this topic, the modeling of turbulence, and their applications to free-shear flows (e.g., jets and wakes), wall-bounded shear flows (e.g., channels, pipes and boundary layers) and heat transport.

The course provides an opportunity to explore the use of commercial computational fluid dynamics (CFD) software for turbulence simulations.

Prereq: Requires prerequisite course of MECH 3021 (minimum grade D-).

Restriction: Restricted to majors in CEDC Mechanical Engineering. Cross-listed with MECH 5188. Term offered: Fall, Spring. Max hours: 3 Credits

Grading Basis: Letter Grade

Requires prerequisite course of MECH 3021 (minimum grade D-).

Restricted to majors in CEDC Mechanical Engineering.

Typically Offered: Fall, Spring.

MECH 4208 - Special Topics (3 Credits)

Subject matter to be selected from topics of current technological interest. Credit to be arranged. Cross-listed with MECH 5208. Repeatable. Max hours: 9 Credits.

Grading Basis: Letter Grade

Repeatable. Max Credits: 9.

Typically Offered: Fall, Spring, Summer.

MECH 4228 - Special Topics (3 Credits)

Repeatable. Max hours: 9 Credits.

Grading Basis: Letter Grade

Repeatable. Max Credits: 9.

Typically Offered: Fall, Spring, Summer.

MECH 4238 - Special Topics (3 Credits)

Restriction: Restricted to majors in CEDC Mechanical Engineering.

Repeatable. Term offered: Fall, Spring. Max Hours: 9 Credits.

Grading Basis: Letter Grade

Repeatable. Max Credits: 9.

Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing

Typically Offered: Fall, Spring.

MECH 4840 - Independent Study (1-3 Credits)

This category is intended for upper division level special topics which students may wish to pursue on their own initiative, with guidance from a professor who agrees to limited consultation on the work and to award credit when the project is completed. Restriction: Restricted to majors in CEDC Mechanical Engineering. Repeatable. Max hours: 9 Credits.

Grading Basis: Letter Grade with IP

Repeatable. Max Credits: 9.

Restriction: Restricted to MECH majors within the College of Engineering, Design and Computing