MECHANICAL ENGINEERING (MECH)

MECH 5020 - 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. Restriction: Restricted to CEDC graduate students. Cross-listed with MECH 4020. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate standing majors in the College of Engineering, Design and Computing
Typically Offered: Summer.

MECH 5025 - 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 or MECH 5020. Restriction: Restricted to CEDC graduate students. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 4020 or MECH 5020. Restriction: Restricted to CEDC graduate students.
Typically Offered: Fall, Spring.

MECH 5030 - 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 4030. Term offered: fall, spring. Max hours: 3 Credits.
Grading Basis: Letter Grade
Typically Offered: Fall, Spring.

MECH 5110 - 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. Restriction: Restricted to CEDC graduate students. Cross-listed with MECH 4110. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate students
Typically Offered: Fall, Spring.

MECH 5114 - 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. restriction: Restricted to CEDC graduate students. Cross-listed with MECH 4114. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate standing majors in the College of Engineering, Design and Computing

MECH 5120 - 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: Graduate standing or permission of instructor required. Cross-listed with MECH 4120. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate students

MECH 5121 - Introduction to Fluid Dynamics (3 Credits)
Physical properties of gases and liquids; kinematics of flow fields; equations describing viscous, heat-conducting Newtonian fluids. Exact solutions and rational approximations for low- and high-speed dissipative flows, surface and internal waves, acoustics, stability, and potential flows. Graduate standing or permission of instructor required. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate students

MECH 5122 - Macroscopic Thermodynamics (3 Credits)
Axiomatic presentation of fundamentals of classical thermodynamics (first law); energy, work and heat. Equilibrium, reversible, and irreversible processes; entropy production and the second law. Applications to stability and phase equilibrium. Irreversible thermodynamics and the Onsager reciprocal relations. Restriction: Graduate standing or permission of instructor required. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate students

MECH 5123 - Introduction to Continuum Mechanics (3 Credits)
Cartesian tensor notation. Deformation, strain, strain rate and compatibility. Definition of stress vector and tensor. Fundamental balance laws of mass, momentum and energy; entropy production inequality. Constitutive equations for elastic, viscoelastic and plastic materials; ideal, compressible, and viscous fluids. Beltrami-Mitchell and Navier-Stokes equations. Restriction: Graduate standing or permission of instructor required. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate students

MECH 5124 - Yield-Limited Behavior of Materials (3 Credits)
Analysis of material behavior within the "elastic range," with emphasis on the phenomenon of yield and factors that influence it. Examination of the theory of dislocations; study of strengthening mechanisms in solids. Consideration of various time-dependent but reversible (inelastic) deformation phenomena. Presentation of appropriate engineering case studies to augment various topics. Graduate standing or permission of the instructor required. Prereq: MECH 5143 with a grade of B- or higher. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 5143 with a grade of B- or higher Restriction: Restricted to graduate standing or higher

MECH 5133 - Theory of Inelastic Materials (3 Credits)
Mathematical theory of linear viscoelasticity. Finite elements models. Solution of boundary-value problems in linear viscoelasticity. Non-Newtonian flow. Selected topics in nonlinear material behavior. Graduate standing or permission of the instructor required. Prereq: MECH 5143 with a B- or higher. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 5143 with a grade of B- or higher Restriction: Restricted to graduate standing or higher

MECH 5141 - Viscous Flow (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. Restriction: Restricted to CEDC graduate students. Cross-listed with MECH 4141. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate standing majors in the College of Engineering, Design and Computing

MECH 5142 - Statistical Thermodynamics (3 Credits)
Introduces the molecular interpretation and calculation of thermodynamic properties of matter, thermodynamic probability, distribution functions, Schrodinger wave equations and solutions and ensemble theory. Applications to ideal and real gases, solids, liquids, radiation, conduction electrons, and chemical equilibrium. Restriction: Graduate standing or permission of instructor required. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate students

MECH 5143 - Theory of Elasticity (3 Credits)
Review of the basic equations of linear theory of elasticity. St. Venant torsion and flexure. Plane strain, plane stress, and generalized plane stress. Application of conformal mapping and Fourier transform techniques. Restrictoin: Graduate standing or permission of instructor required. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate students

MECH 5144 - Plasticity and Creep (3 Credits)
Inelastic deformation of materials such as metals, alloys, glasses, composites and polymers from the phenomenological and structural point of view. Case studies of plastic and creep deformations in engineering materials. Prereq: MECH 5143 with a grade of B- or higher and graduate standing or permission of the instructor required. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 5143 with a grade of B- or higher Restriction: Restricted to graduate standing or higher

MECH 5161 - Compressible Flow (3 Credits)
Energy, continuity, and momentum principles applied to compressible flow; one-, two-, and three-dimensional subsonic, supersonic and hypersonic flows. Normal and oblique shocks, and method of characteristics. Prereq: MECH 5141 with a grade of B- or higher and graduate standing or permission of the instructor required. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 5141 with a B- or higher Restriction: Restricted to graduate standing or higher

MECH 5162 - Heat Transfer I (3 Credits)
Review of equations governing transport of heat by conduction and radiation. Analytical and numerical solution of boundary value problems representative of heat conduction in solids. Radiation properties of solids, liquids and gases; transport of heat by radiation. Prereq: Graduate standing or permission of instructor required. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate students

MECH 5163 - Dynamics (3 Credits)
Review of Newtonian dynamics, Lagrange's equation 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. Restriction: Restricted to CEDC graduate students. Cross-listed with MECH 4163. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate standing majors in the College of Engineering, Design and Computing
Typically Offered: Fall, Spring.

MECH 5166 - Computerized Numerical Control (CNC) Manufacturing (3 Credits)
Modern manufacturing engineering concepts using computerized numerical control (CNC). The students learn state-of-the-art CNC methodologies, including digitizing, drawing, generating codes, and manufacturing using modern CNC machines. Prereq: Graduate standing or permission of instructor required. Cross-listed with MECH 4166. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate students

MECH 5172 - Heat Transfer II (3 Credits)
Review of equations governing transport of heat in fluids in motion. Description of heat transfer in free and forced convection, including laminar and turbulent flow. Dimensional analysis and heat transfer correlations, numerical methods and combined heat transfer mechanisms. Graduate standing or permission of the instructor required. Prereq: MECH 5141 with a B- or higher. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 5141 with a B- or higher Restriction: Restricted to graduate standing or higher

MECH 5175 - Finite Element Stress Analysis (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. Graduate standing or permission of the instructor required. Prereq: MECH 5143 with a B- or higher. Cross-listed with MECH 4175. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 5143 with a grade of B- or higher Restriction: Restricted to graduate standing or higher

MECH 5177 - 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. Restriction: Restricted to graduate students in the College of Engineering, Design, and Computing. Cross-listed with MECH 4177. Term offered: Spring. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate students
Typically Offered: Spring.

MECH 5178 - 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. Prereq: Graduate standing or permission of instructor required. Cross-listed with MECH 4178. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate students

MECH 5180 - Advanced Heat Transfer (3 Credits)
This course provides fundamental concepts and applicable mathematical techniques for understanding the physics of various modes of heat transfer. Topics include heat conduction in finite and semi-infinite domains, phase change, microscale heat conduction, laminar forced and free convection, turbulence forced and free convection, and thermal radiation. Prereq: Graduate standing or permission of instructor required. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Graduate level students.

MECH 5182 - Microscale Transport Phenomena (3 Credits)
This course provides the foundations on the physics of microscale transport phenomena, where continuum effects break down, with applications in MEMS and NEMS. Topics include gas microflows, liquid microflows, surface tension-driven flows, electrokinetics transport, kinetic theory, simulation techniques, lattice Boltzmann methods. Restriction: Restricted to graduate students in the College of Engineering, Design and Computing. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to graduate standing majors in the College of Engineering, Design and Computing

MECH 5188 - Introduction to Turbulence (3 Credits)
This course provides an introduction to turbulence, which is ubiquitous in nature and having a wide range of applications in engineering. The chaotic phenomena in such a class of flows poses major challenges in their understanding and modeling. The topics covered in this course include the statistical 4 tools and spectral analysis for turbulence description, basic equations of motion and flow instability, Reynolds decomposition of flow, energy transport by mean and turbulence motions, turbulence scales, vortex motion, classical turbulent flow configurations, such as free shear flows (jets, wakes, mixing layers) and wall bounded flows (channels, boundary layers), Kolmogorov and other phenomenological theories, and turbulence modeling. Restriction: Restricted to students with graduate standing, or permission of instructor. Cross-listed with MECH 4188. Term offered: Fall, Spring. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to students with graduate standing.
Typically Offered: Fall, Spring.

MECH 5208 - Special Topics (3 Credits)
Subject matter to be selected from topics of current technological interest. Credit to be arranged. Restriction: Restricted to CEDC graduate students. Cross-listed with MECH 4208. Repeatable. Max hours: 9 Credits.
Grading Basis: Letter Grade
Repeatable. Max Credits: 9.
Restriction: Restricted to graduate standing majors in the College of Engineering, Design and Computing
Typically Offered: Fall, Spring.

MECH 5228 - Special Topics (3 Credits)
Restriction: Restricted to CEDC graduate students. Repeatable. Max hours: 9 Credits.
Grading Basis: Letter Grade
Repeatable. Max Credits: 9.
Restriction: Restricted to graduate standing majors in the College of Engineering, Design and Computing
Typically Offered: Fall, Spring, Summer.

MECH 5238 - Special Topics (1-3 Credits)
Restriction: Graduate standing or permission of the instructor required. Repeatable. Max hours: 9 Credits.
Grading Basis: Letter Grade
Repeatable. Max Credits: 9.
Restriction: Restricted to graduate students

MECH 5840 - Independent Study (1-3 Credits)
Available only through approval of the graduate advisor. Subjects arranged to fit needs of the particular student. Restriction: Graduate standing or permission of the instructor required. Repeatable. Max hours: 6 Credits.
Grading Basis: Letter Grade with IP
Repeatable. Max Credits: 6.
Restriction: Restricted to graduate students

MECH 5939 - Internship (1-3 Credits)
Students gain engineering design experience involving application of specific technical concepts and skills in a supervised industrial environment. (Must have approval from MECH faculty.) Max hours: 3 Credits.
Grading Basis: Letter Grade

MECH 5950 - Master's Thesis (3 Credits)
Restriction: Graduate standing or permission of the instructor required. Repeatable. Term offered: Fall, Spring, Summer. Max hours: 6 Credits.
Grading Basis: Letter Grade with IP
Repeatable. Max Credits: 6.
Restriction: Restricted to graduate students
Additional Information: Report as Full Time.
Typically Offered: Fall, Spring, Summer.

MECH 5960 - Master's Report (3 Credits)
Master of Science in Engineering report. Students seeking the Master of Science in Engineering, and who do not choose to do a thesis, must complete an individual project of an investigative and creative nature under the supervision of a member of the graduate faculty. Restriction: Graduate standing or permission of the instructor required. Repeatable. Max hours: 6 Credits.
Grading Basis: Letter Grade with IP
Repeatable. Max Credits: 6.
Restriction: Restricted to graduate students
Additional Information: Report as Full Time.

MECH 5970 - Graduate Problem Course (3 Credits)
The graduate problem course is for the solution of specific problems in MECH specialty areas. Each student is assigned a set of problems of some difficulty requiring the use of the literature of the various areas covered. Prereq: 15 hours of graduate level courses in MECH. Max Hours: 3 Credits.
Grading Basis: Letter Grade

MECH 6184 - Advanced Fluid Mechanics (3 Credits)
This course provides a description of the advanced concepts for understanding the physics of fluid motion under different regimes. Topics include kinematics, stresses, equation of motion, vorticity transport, low Reynolds number flow, irrotational flow, interfacial flow, acoustics&waves, hydrodynamic stability & transition, turbulent flow. Prereq: MECH 5141. Restriction: Restricted to students with graduate standing, or permission of instructor. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MECH 5141. Restriction: Restricted to students with graduate standing.

MECH 8990 - Doctoral Dissertation (1-10 Credits)
Restriction: Graduate standing or permission of the instructor required. Repeatable. Max hours: 10 Credits.
Grading Basis: Letter Grade with IP
Repeatable. Max Credits: 10.
Restriction: Restricted to graduate students
Additional Information: Report as Full Time.
Typically Offered: Fall, Spring.