MECHANICAL ENGINEERING (ME)

100 Level Courses

ME 151: Practicum in Engineering. 2 credits.
This course provides students with experiences in algorithmic thinking, visualization and communications. An essential component of this course is preparation of students for the National Academy of Engineering Grand Challenge Scholars Program. Offered by Mechanical Engineering. Limited to two attempts.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale.

200 Level Courses

ME 211: Statics. 3 credits.
An initial course in applied vector mechanics with emphasis on static equilibrium. Topics include forces, moments, couples, equivalent force-couple systems, centroids, distributed forces, and Coulomb friction. The application of the free body diagram in the analysis of static equilibrium of frames, machines and trusses is stressed. Offered by Mechanical Engineering. Limited to two attempts.

Registration Restrictions:
Required Prerequisites: PHYS 160C and 161C.
C Requires minimum grade of C.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale.

ME 212: Solid Mechanics. 3 credits.
A first course in mechanics of deformable bodies with emphasis on the engineering approach to the responses of these bodies to various types of loadings. Topics include stress-strain relationships, stress-strain analysis, stress and strain transformation (Mohr's circle), load-deflection, bending, torsion, buckling, and thermal effects. Offered by Mechanical Engineering. Limited to two attempts.

Recommended Corequisite: MATH 214.

Registration Restrictions:
Required Prerequisite: ME 211C.
C Requires minimum grade of C.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale.

ME 221: Thermodynamics. 3 credits.
A basic thermodynamics course in which the first and second laws of thermodynamics are studied primarily from the classical macroscopic viewpoint and applied to both closed and open systems. Working substances include perfect gases, real gases and vapors in addition to solids and liquids. Offered by Mechanical Engineering. Limited to two attempts.

Registration Restrictions:
Required Prerequisite: MATH 113C.
C Requires minimum grade of C.

Students with a class of Freshman may not enroll.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale.

ME 231: Dynamics. 3 credits.
A course in classical vector dynamics. Topics include vector algebra and calculus, kinematics and kinetics of particles and rigid bodies, as well as energy and momentum methods. Extensive problem solving involving particle and rigid body motion is required. Offered by Mechanical Engineering. Limited to two attempts.

Recommended Corequisite: MATH 214.

Registration Restrictions:
Required Prerequisite: ME 211C.
C Requires minimum grade of C.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale.

300 Level Courses

ME 311: Mechanical Experimentation I. 1 credit.
Experimental measurements in solid mechanics and materials science. Involves technical report writing. Offered by Mechanical Engineering. Limited to two attempts.

Recommended Corequisite: ME 313.

Registration Restrictions:
Required Prerequisite: ME 211C.
C Requires minimum grade of C.

Enrollment is limited to students with a major in Mechanical Engineering.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale.

ME 313: Material Science. 3 credits.
An introductory course in physical and mechanical properties of engineering design materials, ceramics and plastics, their structures, use in engineering applications and failure phenomena. Offered by Mechanical Engineering. Limited to two attempts.

Registration Restrictions:
Required Prerequisites: CHEM 211C or 251C or (CHEM 271C and 272C) and ME 212C.
Mechanical Engineering (ME)

**ME 321:** Mechanical Experimentation II. 1 credit.
Experimental measurements in fluid mechanics and heat transfer. Involves technical report writing. Offered by Mechanical Engineering. Limited to two attempts.

**Recommended Corequisite:** ME 323.

**Registration Restrictions:**
**Required Prerequisite:** ME 322C.
C Requires minimum grade of C.

Enrollment is limited to students with a major in Mechanical Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**ME 322:** Fluid Mechanics. 3 credits.
An introductory course in fluid dynamics stressing both the integral and differential forms of the conservation laws of fluid flow. Engineering applications are made to hydrostatics and to ideal and real fluid flows. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**
**Required Prerequisites:** ME 221C and 231C.
C Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Laboratory

**Grading:**
This course is graded on the Undergraduate Regular scale.

**ME 323:** Heat Transfer. 3 credits.
Study of thermal radiation, steady and transient conduction, laminar and turbulent convection, internal and external flow, boundary layers and empirical correlations. Applications address fins, nuclear reactor cooling, heat exchangers and interactive computing. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**
**Required Prerequisite:** ME 322C.
C Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**ME 331:** Mechatronics. 3 credits.
Study of electromechanical systems, utilizing the fundamentals of circuit theory to design, build, and control mechanical devices. Topics include electrical devices, sensors, microcontrollers, data acquisition, instrumentation and interfaces. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**
**Required Prerequisite:** ECE 330C.
C Requires minimum grade of C.

Enrollment is limited to students with a major in Mechanical Engineering.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**ME 341:** Design of Mechanical Elements. 3 credits.
Fundamentals of mechanical design. Introduction to the fundamentals of static and fatigue failure theories, design of basic machine elements such as fasteners, bearings, gearing and shafts. Builds on the fundamentals of design introduced in earlier courses by introducing the concepts of customer requirements, specification development, reverse engineering, functional decomposition, and design for manufacturing. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**
**Required Prerequisite:** ME 212C.
C Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**ME 342:** Design of Thermal Systems. 3 credits.
A study of equipment which operates on principles of thermodynamics and fluid mechanics is used to reinforce analyses and design of gas and vapor power cycles, refrigeration and air conditioning, propulsion systems, combustion, energy conversion and compressible flow. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**
**Required Prerequisite:** ME 221C.
C Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.
**ME 351: Analytical Methods in Engineering.** 3 credits.  
Survey of advanced mathematics topics needed in the study of engineering. Topics include vector differential and integral calculus, matrix analysis, partial differential equations, complex variables, numerical methods, data analysis using statistics and probability theory. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**  
**Required Prerequisite:** (MATH 214$^C$).  
$^C$ Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.

Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Lecture

**Grading:**  
This course is graded on the Undergraduate Regular scale.

**ME 352: Entrepreneurship in Engineering.** 3 credits.  
Introduces students to the concept of entrepreneurship and how to translate technical skill sets to commercial success. Topics include creating a business plan, pitching ideas, risk mitigation, and selecting investment alternatives. Emerging technology related to Mechanical Engineering will be analyzed in this context. Offered by Mechanical Engineering. Limited to two attempts.

**Recommended Prerequisite:** Completion of at least 15 credits hours in major courses.

**Registration Restrictions:**  
Enrollment limited to students with a class of Junior, Senior Plus or Senior.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.

Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Lecture

**Grading:**  
This course is graded on the Undergraduate Regular scale.

**400 Level Courses**

**ME 414: Fatigue Analysis.** 3 credits.  
This course is an introduction to some of the main concepts of deformation processes leading to fracture; linear elastic fracture mechanics and fatigue crack propagation. Fatigue and fracture of a wide variety of materials including metals, composites, and biomaterials will be covered. Particular attention will be given to fatigue analysis of metals and composites used in aerospace structures, natural biomaterials such as bone and additively manufactured metals (metal 3D printing) and laminated materials. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**  
**Required Prerequisite:** ME 313$^C$.  
$^C$ Requires minimum grade of C.

Enrollment is limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.

**Schedule Type:** Lecture

**Grading:**  
This course is graded on the Undergraduate Regular scale.

**ME 415: Composite Materials.** 3 credits.  
This course will develop an understanding of the structural mechanics of composite materials and applications in aerospace, civil, and mechanical engineering. Students will identify fundamental relationships for predicting the mechanical response of multi layered materials and structures and micromechanical and macromechanical relationships for lamina and laminated materials. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**  
**Required Prerequisite:** ME 313$^C$.  
$^C$ Requires minimum grade of C.

Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.

**Schedule Type:** Lecture

**Grading:**  
This course is graded on the Undergraduate Regular scale.

**ME 431: Systems Dynamics.** 4 credits.  
A first course which deals with the mathematical modeling of dynamic systems and response analysis of these systems. Topics include state variable and transfer functions, mathematical analysis of systems response, and the use of computational tools for modeling, design, and simulation. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**  
**Required Prerequisites:** (ME 231$^C$) and (PHYS 260$^C$ or 261$^C$).  
$^C$ Requires minimum grade of C.

Enrollment limited to students with a major, minor, or concentration in Mechanical Engineering.

Students with the terminated from VSE major attribute may **not** enroll.

**Schedule Type:** Lecture

**Grading:**  
This course is graded on the Undergraduate Regular scale.

**ME 432: Control Engineering.** 4 credits.  
Introduces fundamentals of feedback and modern control theory. Topics include analysis of mechanical and thermal systems by root locus and frequency response techniques. Use of sensors and transducers in control systems, data acquisition and analysis. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**  
**Required Prerequisites:** ME 351$^C$ and (ECE 285$^C$ or 330$^C$).  
$^C$ Requires minimum grade of C.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.
Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Laboratory, Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**ME 443: Mechanical Design I.** 3 credits.
The first course in a two-semester capstone design sequence. Topics include the engineering design process, project management, codes and standards, engineering ethics, and computer-aided design. Students form design teams, select a capstone design project and progress through the proposal and preliminary design stages of the project. The capstone design project continues in ME 444. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**
**Required Prerequisites:** ME 212\(^\text{C}\), 313\(^\text{C}\) and 323\(^\text{C}\) and (ME 341\(^\text{C}\) or 342\(^\text{C}\)) and ME 351\(^\text{C}\).
\(^\text{C}\) Requires minimum grade of C.

Enrollment is limited to students with a major in Mechanical Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**ME 444: Mechanical Design II.** 3 credits.
The second of the two-semester capstone design sequence. Topics will include concept selection, detail design, prototyping and evaluation of their major design projects. Formal presentations and reports are prepared to review and document the designs. Offered by Mechanical Engineering. Limited to two attempts.

**Mason Core:** Capstone

**Specialized Designation:** Writing Intensive in Major

**Registration Restrictions:**
**Required Prerequisite:** (ME 443\(^\text{C}\)).
\(^\text{C}\) Requires minimum grade of C.

Enrollment is limited to students with a major in Mechanical Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**ME 445: Finite Element Analysis.** 3 credits.
This course will develop an understanding of how finite element analysis (FEA) can be applied to mechanics and thermal fluids problems. Students will apply the mathematics of FEA to solve engineering problems and utilize software packages to aid in analysis. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**
**Required Prerequisite:** ME 351\(^\text{C}\).
\(^\text{C}\) Requires minimum grade of C.

Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major, minor or concentration in Mechanical Engineering.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**ME 446: Energetics.** 3 credits.
This course will develop an understanding of the basic science of energetic systems. Basic properties of explosives, propellants, and pyrotechnics will be discussed; as well as basics systems and safety engineering using energetic materials. Application of energetic materials in different industries (i.e. automotive air bags as well as oil/gas industries) will be discussed. Offered by Mechanical Engineering. Limited to two attempts.

**Recommended Prerequisite:** ME 313

**Registration Restrictions:**
Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major, minor or concentration in Mechanical Engineering.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**ME 453: Developing the Societal Engineer.** 2 credits.
A course which highlights, through speakers, discussions and workshops, the professional responsibility of a being mechanical engineer. Additional topics that will be covered include ethical issues, current events and trends in the profession. Engineering case studies will be explored. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**
**Required Prerequisite:** ME 443\(^\text{C}\).
\(^\text{C}\) Requires minimum grade of C.

Enrollment is limited to students with a major in Mechanical Engineering.

Students with the terminated from VSE major attribute may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Undergraduate Regular scale.

**ME 454: Project Mgmt for Engineers.** 3 credits.
Introduction to the fundamentals of project management. Students will understand the proposal process, apply decision-making and analysis tools to select a winning proposal, perform network scheduling techniques to identify the critical path for a project, and understand and apply the interpersonal skills to lead and manage highly effective project teams. Offered by Mechanical Engineering. Limited to two attempts.

**Registration Restrictions:**
Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major, minor or concentration in Mechanical Engineering.

Students with the terminated from VSE major attribute may not enroll.
ME 471: Introduction to Astronautics. 3 credits.
Astronautics is the study of space and its uses. This course will introduce the student to multiple aspects of space and space sciences, such as orbital mechanics, satellite subsystems, space systems engineering, launch, and re-entry. Offered by Mechanical Engineering. Limited to two attempts.

Registration Restrictions:
Required Prerequisite: ME 231 C.  
C Requires minimum grade of C.

Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Lecture
Grading:
This course is graded on the Undergraduate Regular scale.

ME 472: Spacecraft Subsystems. 3 credits.
Spacecraft are complex systems of systems made up of many separate subsystems. In this course we shall study the various types of subsystems, learn their functions and major components, and understand the interaction between them to make a functional spacecraft. Offered by Mechanical Engineering. Limited to two attempts.

Recommended Corequisite: ME 471

Registration Restrictions:
Required Prerequisite: ME 231 C.  
C Requires minimum grade of C.

Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.

Schedule Type: Lecture
Grading:
This course is graded on the Undergraduate Regular scale.

ME 497: Applied Engineering Abroad. 3 credits.
Introduces students to applications of engineering processes outside USA. The students will gain hands-on project management, critical thinking, intercultural and career skills by exploring engineering aspects such as auto assembly, airliner manufacturing, metropolitan infrastructure, and bridge designs. By visiting technology museums, students will learn to appreciate the rich history of the country’s technology and manufacturing. Offered by Mechanical Engineering. Limited to two attempts. Equivalent to CEIE 497, SYST 497.

Mason Core: Global Understanding

Registration Restrictions:
Enrollment limited to students with a class of Junior, Senior Plus or Senior.

Students with the terminated from VSE major attribute may not enroll.

Schedule Type: Internship
Grading:
This course is graded on the Undergraduate Regular scale.

ME 498: Independent Study in Mechanical Engineering. 0-3 credits.
Directed self-study of topics of special interest. Offered by Mechanical Engineering. May be repeated within the term for a maximum 6 credits.

Schedule Type: Independent Study
Grading:
This course is graded on the Undergraduate Regular scale.

ME 499: Special Topics in Mechanical Engineering. 0-4 credits.
Topics of special interest to undergraduates. Notes: May be repeated for credit when topic is different. Offered by Mechanical Engineering. May be repeated within the term for a maximum 12 credits.

Registration Restrictions:
Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major, minor, or concentration in Mechanical Engineering.

Schedule Type: Lecture
Grading:
This course is graded on the Undergraduate Regular scale.

500 Level Courses

ME 521: Energy Transfer. 3 credits.
Study of thermal fluid sciences related to energy systems. Provides foundations in thermodynamics, mass transfer, fluid mechanics, and heat transfer in steady systems. Covers modelling and analysis of engineering devices such as pumps, heat exchangers, turbines, and airfoils which constitute energy systems. Offered by Mechanical Engineering. May not be repeated for credit.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may not enroll.

Enrollment limited to students in the College of Science, Schar School of Policy and Gov or Volgenau School of Engineering colleges.

Schedule Type: Lecture
Grading:
This course is graded on the Graduate Regular scale.

ME 531: Energy Transmission. 3 credits.
Introduces analysis of local and national electrical grids used for power transmission and develops understanding of economic constraints on energy systems. Students will model energy transmission systems with dynamic loads ensuring energy security and optimal performance. Advanced topics such as forecasting for renewable energy integration, smart grid implementation, and utilization of emerging energy storage
technology are covered. Offered by Mechanical Engineering. May not be repeated for credit.

**Registration Restrictions:**
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may not enroll.

Enrollment limited to students in the College of Science, Schar School of Policy and Gov or Volgenau School of Engineering colleges.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Graduate Regular scale.

**ME 541: Power Generation.** 3 credits.
Study of traditional and advanced power generation technology. Builds upon conservation principles of mass, energy, and momentum to analyze, model and optimize energy systems based on physical principles. Specific attention will be paid to site specific conditions for generation. Advanced cycles will be covered which utilize fossil fuel, renewable, and nuclear energy. Offered by Mechanical Engineering. May not be repeated for credit.

**Recommended Prerequisite:** ME 521.

**Registration Restrictions:**
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may not enroll.

Enrollment limited to students in the College of Science, Schar School of Policy and Gov or Volgenau School of Engineering colleges.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Graduate Regular scale.

**ME 620: Mechanical Engineering Decision Making.** 3 credits.
Fundamentals of decision making with applications to mechanical engineering product and systems design, system reliability, and system operation and maintenance; product/system evaluation and optimization; design and systems theory; and social choice theory. This course takes the view that engineers are decision makers and presents the fundamentals of good decision making in the context of mechanical engineering. Offered by Mechanical Engineering. May not be repeated for credit.

**Registration Restrictions:**
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Graduate Regular scale.

**ME 621: Foundations of Fluid Mechanics.** 3 credits.
Derivation of the fundamental equations of fluid mechanics, including the Navier-Stokes equations, conservation of mass, and the vorticity transport equations. Vector and Cartesian tensor notation are used throughout. Equations of motion are applied to incompressible viscous and inviscid flows. Some aspects of turbulence are discussed. Offered by Mechanical Engineering. May not be repeated for credit.

**Registration Restrictions:**
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Graduate Regular scale.

**ME 698: Research Study in Selected Mechanical Engineering Topics.** 3 credits.
This is a research based course that allows graduate students to work on a special research topic. Offered by Mechanical Engineering. May be repeated within the degree for a maximum 6 credits.

**Recommended Prerequisite:** Graduate Student Standing and Permission of the Instructor
**ME 699: Advanced Special Topics in Mechanical Engineering.** 3 credits.
Advanced topics in mechanical engineering will be taught in this course. Offered by Mechanical Engineering. May be repeated within the degree for a maximum 6 credits.

**Registration Restrictions:** Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non-Degree or Senior Plus.

**Recommended Prerequisite:** Permission of the Instructor

**Schedule Type:** Independent Study

**Grading:**
This course is graded on the Graduate Regular scale.

**ME 714: Fracture Mechanics.** 3 credits.
Investigation of linear elastic and elastic-plastic fracture mechanics. Topics include: theory of elasticity and plasticity, energy and stress approach to fracture mechanics, methods to determine the stress intensity factor, fracture mechanics testing, fatigue crack growth. Develop a basic understanding of how crack-like defects impact performance in structures and learn how to select materials to ensure damage tolerance. Offered by Mechanical Engineering. May not be repeated for credit.

**Recommended Prerequisite:** Introductory graduate level course in advanced strength of materials or theory of elasticity, or consent of the instructor.

**Registration Restrictions:**
Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Graduate Regular scale.

**ME 715: Impact Dynamics.** 3 credits.
Includes advanced dynamics of impact, impact biomechanics, as well as vehicle crashworthiness standards and accident data analysis. Students will learn about FMVSS and NCAP crash tests. FARS and NASS real world accident databases, and methods to analyze crash and accident data. Offered by Mechanical Engineering. May not be repeated for credit.

**Recommended Prerequisite:** ME 231, ME 212 or equivalent courses.

**Registration Restrictions:**
Enrollment is limited to Graduate or Non-Degree level students.

**ME 721: Advanced Fluid Mechanics.** 3 credits.
The course is intended to provide engineering students with the opportunity to apply theoretical ideas developed in ME 621 to specific problems in inviscid and viscous flows, including turbulence. We will be exclusively concerned with incompressible flows. Although this is not a CFD course, a full understanding of theoretical aspects of fluid mechanics is a prerequisite for understanding and using CFD-simulations. Models used in CFD such as k-epsilon, Reynolds-averaged Navier-Stokes (RANS), Large-eddy (LES), and Direct (DNS) will be discussed. Specially designed projects are intended to enable students to apply what they have learned to different flow situations. Offered by Mechanical Engineering. May not be repeated for credit.

**Recommended Prerequisite:** ME 621.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Graduate Regular scale.

**ME 722: Introduction to Turbulence.** 3 credits.
Introduces beginning graduate students to the theory of turbulence. The theory of homogeneous-isotropic turbulence is introduced, followed by a discussion of sheared and wall-bounded turbulence. Some aspects of coherent structures in turbulence will be introduced as well as models used in computing turbulence. Specially designed projects are intended to enable students to apply what they have learned to different flow situations. Offered by Mechanical Engineering. May not be repeated for credit.

**Recommended Prerequisite:** ME 621.

**Schedule Type:** Lecture

**Grading:**
This course is graded on the Graduate Regular scale.

**ME 723: Compressible Flow.** 3 credits.
This course is intended to provide engineering students with the opportunity to study the fluid mechanics of a compressible gas. Topics of interest include one-dimensional gas flows, flow of gas in convergent-
divergent ducts, choked flows, high speed flows, physical acoustics, and shock waves. Offered by Mechanical Engineering. May not be repeated for credit.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale.

ME 724: Viscoelastic Flow. 3 credits.
Many flows in nature behave very differently than air or water. Such flows may possess elasticity, or may have complex viscosities. Examples include blood, corn starch solutions, and solutions of high molecular weight polymers. This course will introduce the students to the theoretical methods that are needed to model the behavior of such viscoelastic fluids. Offered by Mechanical Engineering. May not be repeated for credit.

Recommended Prerequisite: ME 621

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale.

ME 728: Foundations of Heat Transfer. 3 credits.
This course provides an introduction to the mechanisms of heat transfer. The course first covers the fundamentals of conduction, natural and forced convection, radiation, and phase-change heat transfer. Modeling of thermal systems, such as thermosyphons or heat exchangers, will be emphasized. The semester concludes with important and emerging application areas, including heat transfer in biological systems, sustainable power generation, and nanoscale heat transfer. Grades are determined by performance on homework, journal article review, final project, and take-home midterm and final examinations. Offered by Mechanical Engineering. May not be repeated for credit.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale.

ME 740: Introduction to Continuum Mechanics. 3 credits.
This course covers tensor analysis, state of stress, material and spatial descriptions of motion of a continuous medium, kinematics of deformation, general principles of solid mechanics, fluid mechanics and thermomechanics and balance principles: mass, momentum, and energy. Constitutive equations of large-deformation elasticity, and an introduction to inelasticity are also covered. Offered by Mechanical Engineering. May not be repeated for credit.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale.

ME 741: Theory of Elasticity. 3 credits.
This course is intended to introduce graduate students to the field of linear elasticity. The governing equations of linear elasticity are developed before solving the problems of plane elasticity. The course also covers boundary value problems and the Airy stress function method associated with plane elasticity. Specialized topics may include: three-dimensional problems, energy and numerical methods. Offered by Mechanical Engineering. May not be repeated for credit.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale.

ME 745: Mechanics and Properties of Materials. 3 credits.
This course is intended to introduce graduate students to the field of solid mechanics. The theories of elastic stress and strain are covered before moving on to inelastic behavior. Torsion and bending of solid and thin-walled bars are covered. Specialized topics include: buckling, fatigue and fracture mechanics. Offered by Mechanical Engineering. May not be repeated for credit.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

**ME 750: Nanomaterials Enabled Renewable Energy**. 3 credits.
This course is intended to introduce beginning graduate students to the advanced nanomaterials, as well as their applications in renewable energy, i.e. photovoltaics and energy storage devices. Students will investigate how nano-materials can be used to harness renewable energy. Offered by Mechanical Engineering. May not be repeated for credit.

**Registration Restrictions**: Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type**: Lecture

**Grading**: This course is graded on the Graduate Regular scale.

**ME 751: Advanced Materials for Water Treatment**. 3 credits.
This course is intended to introduce graduate students to the specific advanced materials which play an important role in the water treatment. In particular, the course will focus on water desalination and water purification. Offered by Mechanical Engineering. May not be repeated for credit.

**Registration Restrictions**: Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type**: Lecture

**Grading**: This course is graded on the Graduate Regular scale.

**ME 753: Tribology**. 3 credits.
Tribology is the study and application of the friction, lubrication and wear principles in engineering and design. This course covers the contact of surfaces, mechanics of friction, surface failures/wear, boundary lubrication, fluid properties, thin/thick film (elastohydrodynamic/hydrodynamic) lubrication, and an introduction to emerging tribology (micro/nanotribology and biotribology). Tribology is an interdisciplinary area, and most importantly still has many unknowns. Offered by Mechanical Engineering. May not be repeated for credit.

**Registration Restrictions**: Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type**: Lecture

**Grading**: This course is graded on the Graduate Regular scale.

**ME 754: Introduction to Nano-Materials**. 3 credits.
Introduction to the properties of nanomaterials, nanotechnology and their applications in energy, environmental, biology, and medicine. General discussion of nanotechnology, from multidisciplinary fundamental research to consumer products, suitable for all levels and specializations. This course provides an opportunity for students to learn the superior properties of nanomaterials, the evolving nanotechnology which lies at the interfaces of chemistry, physics and biology, and their broader impact nowadays. Offered by Mechanical Engineering. May not be repeated for credit.

**Registration Restrictions**: Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type**: Lecture

**Grading**: This course is graded on the Graduate Regular scale.

**ME 755: Optofluidics**. 3 credits.
Optofluidics is an emerging field which seeks to understand fluids and optics at micro and nanoscale. This course provides an overview of the fundamental physics of optics and fluid mechanics (e.g. the Maxwell equations and the Navier-Stokes equations) and discusses how they interact at small scales to create many new applications. Offered by Mechanical Engineering. May not be repeated for credit.

**Registration Restrictions**: Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type**: Lecture

**Grading**: This course is graded on the Graduate Regular scale.

**ME 762: Biosensors**. 3 credits.
The objective of this course is to introduce the fundamentals and applications of biosensors including concepts of biosensors, physics and mechanisms of sensing signal transduction, device fabrications/engineering principles, system integrations, chemistry and materials science of nanomaterials, biomolecules associated with detection strategies, and various applications. Offered by Mechanical Engineering. May not be repeated for credit.

**Registration Restrictions**: Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may not enroll.

**Schedule Type**: Lecture

**Grading**: This course is graded on the Graduate Regular scale.
900 Level Courses

ME 990: Dissertation Topic Presentation. 1 credit.
Students put together a professional presentation of a research proposal and present it for critique to fellow students and interested faculty. Notes: May be repeated with change of research topic, but credit toward doctoral degree is given once. Offered by Mechanical Engineering. May not be repeated for credit.

Recommended Prerequisite: Completion of all coursework for the PhD in Mechanical Engineering, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy or Graduate.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Research

Grading:
This course is graded on the Satisfactory/No Credit scale.

ME 998: Doctoral Dissertation Proposal. 1-12 credits.
Work on research proposal that forms basis for doctoral dissertation. Notes: No more than 24 credits of ME 998 and 999 may be applied to doctoral degree requirements. Offered by Mechanical Engineering. May be repeated within the degree for a maximum 12 credits.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy or Graduate.

Schedule Type: Dissertation

Grading:
This course is graded on the Satisfactory/No Credit scale.

ME 999: Doctoral Dissertation. 1-12 credits.
Admission to Doctoral candidacy. Students must submit the Doctoral proposal and have it approved prior to registering for this course. Students may not take ME 998 and 999 at the same time. NOTE: Students must contact the department to receive approval and CRN to register. Offered by Mechanical Engineering. May be repeated within the degree for a maximum 12 credits.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy or Graduate.

Students in a Non-Degree Undergraduate degree may not enroll.

Schedule Type: Dissertation

Grading:
This course is graded on the Satisfactory/No Credit scale.