Mechanical Engineering (MEEG)

Courses

**MEEG 2003. Statics. 3 Hours.**
Equilibrium and resultants of force systems in a plane and in space; analysis of structures, friction, centroids, moments of inertia, and virtual work method. Methods of analysis are emphasized. Corequisite: Drill component. Pre- or Corequisite: MATH 2574 or MATH 2574C. Prerequisite: PHYS 2054. (Typically offered: Fall, Spring and Summer)

**MEEG 2013. Dynamics. 3 Hours.**
Kinematics and kinetics of particle and of rigid bodies; work and energy; impulse and momentum, and special topics. Corequisite: Drill component. Prerequisite: MEEG 2003 and MATH 2574. (Typically offered: Fall, Spring and Summer)

**MEEG 2101. Computer-aided Design. 1 Hour.**
The concept and application of solid-modeling, based on SolidWorks Computer-Aided Design (CAD) software suite, are introduced in this course. They include sketches, parts modeling, assembly of parts, and drawing documentation. Prerequisite: GNEG 1121 or GNEG 1121H or GNEG 1103. (Typically offered: Fall and Spring)

**MEEG 2103. Introduction to Machine Analysis. 3 Hours.**
Introduction to kinematics and kinetics of mechanisms, static and dynamic forces, gears and cam design and analysis. Recitation three hours per week and drill one hour per week. Corequisite: Drill component. Pre- or Corequisite: MEEG 2013. Prerequisite: PHYS 2054 and MEEG 2101. (Typically offered: Spring and Summer)

**MEEG 2303. Introduction to Materials. 3 Hours.**
A study of chemical, physical, and electrical properties of materials using fundamental atomistic approach. The materials of interest are: metals, polymers, ceramics, and composites. The interactive relationship between structure, properties, and processing of materials will be emphasized. For various engineering applications. Corequisite: Drill component. Prerequisite: MATH 2554, PHYS 2054 and CHEM 1103. (Typically offered: Fall and Spring)

**MEEG 2403. Thermodynamics. 3 Hours.**
A study of the 1st and 2nd laws of thermodynamics. Availability of energy, properties of liquids, gases, and vapors; nonflow and flow processes. Recitation 3 hours, drill 2 hours per week. Corequisite: Drill component. Prerequisite: PHYS 2054 and MATH 2554. (Typically offered: Spring and Summer)

**MEEG 2703. Computer Methods in Mechanical Engineering. 3 Hours.**
Use of computers and programming for solving engineering problems. Basic numerical methods including errors, equation solution, matrices, optimization, regression, integration, and differential equations. Corequisite: Drill component. Pre- or Corequisite: MATH 2584. (Typically offered: Spring and Summer)

**MEEG 3013. Mechanics of Materials. 3 Hours.**
Stress and deformation of members in tension, compression, torsion, and bending, and the design of these members. Columns, statically indeterminate beams, and simple connections. Corequisite: Drill component. Prerequisite: MEEG 2003. (Typically offered: Fall, Spring and Summer)

**MEEG 3013H. Honors Mechanics of Materials. 3 Hours.**
Stress and deformation of members in tension, compression, torsion, and bending, and the design of these members. Columns, statically indeterminate beams, and simple connections. Corequisite: Drill component. Prerequisite: MEEG 2003 and honors standing. (Typically offered: Fall, Spring and Summer)

This course is equivalent to MEEG 3013.

**MEEG 3113. Fundamentals of Vibrations. 3 Hours.**
Time and frequency domain mathematical techniques for linear system vibrations are reviewed. Undamped system and viscously damped systems are analyzed. Equations of motion of single and multiple degrees-of-freedom systems are studied. Vibration of multi-degree-of-freedom systems are analyzed using modal analysis and modal summation methods. Eigenvalue problems as related vibrations are studied. Corequisite: Drill component. Prerequisite: MEEG 2103, MATH 2584 or MATH 2584C, MEEG 2703, and MEEG 2013. (Typically offered: Fall and Spring)

**MEEG 3202L. Mechanical Engineering Laboratory I. 2 Hours.**
Introduction to measurement, uncertainty, data acquisition, and instrumentation with an emphasis in materials and manufacturing. Corequisite: Drill component. Pre- or Corequisite: MEEG 3013 and ELEG 3903. Prerequisite: MEEG 2303 and PHYS 2074. (Typically offered: Fall and Spring)

**MEEG 3212L. Mechanical Engineering Laboratory II. 2 Hours.**
Design and implementation of measurements, fabrication processes, data acquisition, and data analysis with emphasis in mechanical and fluid systems. Corequisite: Drill component. Prerequisite: MEEG 3202L, MEEG 3503 and MEEG 3113. (Typically offered: Fall and Spring)

**MEEG 3223. Introduction to Mechatronics. 3 Hours.**
This course is an introduction to design and control the mechatronic system, which requires integration of the mechanical and electrical knowledge within a unified framework. The topics covered in this course include basic electronics, diodes, transistors, power amplifiers, digital logic, operation amplifier, motor design, encoder, and programming in Arduino. Corequisite: Lab component. Prerequisite: MEEG 3202L. (Typically offered: Spring)

**MEEG 3503. Mechanics of Fluids. 3 Hours.**
A study of fluids including fluid properties, pressure, and flow fields utilizing conservation of mass, energy, and momentum principles. Prerequisite: MEEG 2403 or CHEG 2313. Pre- or Corequisite: MATH 2584. (Typically offered: Fall and Summer)

**MEEG 4003. Intermediate Dynamics. 3 Hours.**
Review of central-force motion of spacecraft, use of rotating reference frames, Coriolis acceleration. Kinematics of rigid bodies in 3-D space: velocities and accelerations in different moving reference frames, addition theorem of angular accelerations. Kinetics of rigid bodies in 3-D space: eigenvalues and eigenvectors of inertia matrices, momentum and kinetic energy of a rigid body in 3-D motion, Euler's equations of motion; precession, nutation, and spin of a gyroscope; forced steady precession, torque free steady precession, space cone, and body cone. Prerequisite: MEEG 2013. (Typically offered: Irregular)

**MEEG 4023. Composite Materials: Analysis and Design. 3 Hours.**
A study of fibrous composite materials with emphasis on mechanical behavior, synthesis, and application. Topics include macro- and micromechanical analysis lamina, lamina theory, failure analysis in design, and manufacturing techniques. Prerequisite: MEEG 3013. (Typically offered: Irregular)

**MEEG 4103. Machine Element Design. 3 Hours.**
This course introduces the static failure theories and fatigue failure theories, and how each of the theories can be applied in practical engineering problems in supporting the selection and design of machine elements. This course also introduces key design concepts, design principles, design process, and design guidelines for four commonly-used machine elements: spring, gear, bearing and shaft. Pre- or Corequisite: MEEG 3113. Prerequisite: MEEG 3013. (Typically offered: Fall, Spring and Summer)
MEEG 4103H. Honors Machine Element Design. 3 Hours.
This course introduces the static failure theories and fatigue failure theories, and how each of the theories can be applied in practical engineering problems in supporting the selection and design of machine elements. This course also introduces key design concepts, design principles, design process, and design guidelines for four commonly-used machine elements: spring, gear, bearing and shaft. Advanced project required of honors students. Advanced project required. (Typically offered: Fall, Spring and Summer)
This course is equivalent to MEEG 4103.

MEEG 4123. Finite Element Methods I. 3 Hours.
Introduction to the use of the finite element method in mechanical engineering analysis and design. Use of commercial software to solve thermal and mechanical problems. Pre- or Corequisite: MEEG 3013 and MEEG 4413. (Typically offered: Fall and Spring)

MEEG 4143. Design for Safety. 3 Hours.
This course provides an overview of safety engineering and a framework from which the students can evaluate and develop mechanical and thermal systems from a safety perspective. Pre- or Corequisite: MEEG 4413. Prerequisite: MEEG 3013. (Typically offered: Fall and Spring)

MEEG 4153. Fundamentals of Mechanical Design. 3 Hours.
This class is designed to provide engineering students with a head start in industry as design engineers or working in an engineering related function. The course covers machine design and analysis experiences as related to working in industry and performing consulting work. Major topics include the design process, design procedures, fasteners, general design and numerous consulting experiences. A concept design exercise and two special design projects will be assigned to the students as homework. Prerequisite: MEEG 4103. Prerequisite: MEEG 4103. (Typically offered: Irregular)

MEEG 4173. Model-Based Systems Design and Analysis. 3 Hours.
This course provides students with an introduction into the two main approaches to understanding and designing complex engineered systems. First, the course covers the unique technical challenge of systems engineering and design of systems. Second, the course covers concepts, methods and tools related to "model-based systems design." This covers formal modeling of the information content of complex systems. The third portion of the course will focus on modeling the complex behavior of the systems. This is often described as dynamical systems modeling. Students will utilize the methods and tools presented in class to model a complex engineered system of their choice (with instructor approval). The classes will alternate between presenting modeling methods to the students and students demonstrating their system to the class utilizing those methods. Students may not receive credit for both MEEG 4173 and MEEG 5173. Prerequisite: MEEG 4103 or Instructor consent. (Typically offered: Spring Even Years)

MEEG 4182. Creative Project Design I. 2 Hours.
Students will select a capstone design project, and each student group will prepare a formal written proposal on their project for presentation to a panel of judges. This group project will be carried to completion in MEEG 4192. Corequisite: MEEG 4483. Prerequisite: MEEG 4103 and MEEG 3212L. (Typically offered: Fall and Spring)

MEEG 4192. Creative Project Design II. 2 Hours.
Students choose their capstone project from a list of approved engineering problems. During the course of two semesters, students will learn and apply the design process along with project management skills to deliver the solution on time and on budget as a team. For the first semester (CP1) the team will focus on design of the best solution and development of a complete engineering package necessary to move forward. In the final semester (CP2) the team will implement and test the performance of their solution. Prerequisite: MEEG 4182. (Typically offered: Fall and Spring)

MEEG 4202L. Mechanical Engineering Laboratory III. 2 Hours.
Application of measurement techniques to mechanical engineering problems which emphasize mechanical and thermal systems. Corequisite: Drill component. Pre- or corequisite: MEEG 4483. Prerequisite: MEEG 3212L and MEEG 4103. (Typically offered: Fall, Spring and Summer)

MEEG 4213. Control of Mechanical Systems. 3 Hours.
Mathematical modeling for feedback control of dynamic mechanical systems with design techniques using Laplace transforms, state variables, root locus, frequency analysis, and criteria for performance and stability. Prerequisite: MEEG 3113. (Typically offered: Irregular)

MEEG 4233. Microprocessors in Mechanical Engineering I: Electromechanical Systems. 3 Hours.
Microcomputer architectural, programming, and interfacing. Smart product design (microprocessor-based design). Control of DC and stepper motors and interfacing to sensors. Applications to robotics and real-time control. Mobile robot project. Digital and analog electronics are reviewed where required. Prerequisite: ELEG 3903. (Typically offered: Irregular)

MEEG 4253. Introduction to Robotics. 3 Hours.
This course serves as an introduction to robotics. The course covers the historical development of robotics as a field, and as mechatronic systems, the importance of integrating sensors, actuators and end-effectors. Topics covered in this course will include but not limited to the following: mathematical modeling of robots, rigid motions and homogeneous transformation, forward/inverse kinematics, and velocity kinematics. Prerequisite: MEEG 2703, MEEG 3113 and instructor consent. (Typically offered: Fall)

MEEG 4303. Materials Laboratory. 3 Hours.
A study of properties, uses, testing, and heat treatment of basic engineering materials and related analytical techniques. Corequisite: Lab component. Prerequisite: MEEG 2303. (Typically offered: Irregular)

MEEG 4313. Introduction to Tribology. 3 Hours.
A study of science and technology of interacting surfaces in relative motion. Topics include solid surface characterization, contact between solid surfaces, adhesion, friction, wear, lubrication, micro/nanotribology, friction and wear screening test methods, and tribological components and applications. Prerequisite: MEEG 3013 and MEEG 3503 or graduate standing. (Typically offered: Irregular)

MEEG 4333. Hybrid Electric Vehicles. 3 Hours.
This course is intended to provide an introduction to basics of hybrid and pure electrical vehicles (mainly passenger cars), covering history, architecture, constituents, working mechanisms, and key technologies. The course focuses on fundamental concepts of different hybrid electrical vehicles (HEVs) and their technical features and highlights the successes of the state-of-the-art pure electrical vehicles (EVs). In addition, this course will introduce various battery technologies used for electrical vehicles, covering traditional batteries, lithium-ion batteries, and batteries beyond lithium-ions. It is appropriate for engineering and natural science students interested in obtaining basic knowledge of hybrid and pure electrical vehicles to prepare for a career in developing alternate energy sources. Prerequisite: ELEG 3903 or BENG 3113, and senior standing. (Typically offered: Spring)

MEEG 4413. Heat Transfer. 3 Hours.
Basic thermal energy transport processes; conduction, convection, and radiation; and the mathematical analysis of systems involving these processes in both steady and time-dependent cases. Prerequisite: MEEG 3503. (Typically offered: Spring and Summer)

MEEG 4423. Power Generation. 3 Hours.
Study of design and operational aspects of steam, gas, and combined cycle power plants. Brief study of Nuclear and Alternative energy systems. Prerequisite: MEEG 3503. (Typically offered: Irregular)
MEEG 4433. Aerospace Propulsion. 3 Hours.
Principles, operation, and characteristics of gas turbine and rocket engines. Brief study of novel spacecraft propulsion systems. Prerequisite: MEEG 3503. (Typically offered: Irregular)

MEEG 4453. Industrial Waste and Energy Management. 3 Hours.
Applications of thermodynamics, heat transfer, fluid mechanics, and electric machinery to the analysis of waste streams and energy consumption for industrial facilities. Current techniques and technologies for waste minimization and energy conservation including energy-consuming systems and processes, utility rate analysis, economic analysis and auditing are taught. Prerequisite: MEEG 4413. (Typically offered: Irregular)

MEEG 4473. Indoor Environmental Control. 3 Hours.
Gives student a thorough understanding of the fundamental theory of air conditioning design for commercial buildings, including calculating heating and cooling loads along with the proper selection and sizing of air conditioning equipment. Prerequisite: MEEG 4413. (Typically offered: Fall and Summer)

MEEG 4483. Thermal Systems Analysis and Design. 3 Hours.
Analysis design and optimization of thermal systems and components with examples from such areas as power generation, refrigeration, and propulsion. Availability loss characteristics of energy systems and availability conservation methods. Prerequisite: MEEG 4413. (Typically offered: Fall and Summer)

MEEG 4483H. Honors Thermal Systems Analysis and Design. 3 Hours.
Analysis design and optimization of thermal systems and components with examples from such areas as power generation, refrigeration, and propulsion. Availability loss characteristics of energy systems and availability conservation methods. Additional topics, with an additional design project and a more rigorous approach to design projects for honors course. Advanced project required. Prerequisite: MEEG 4413 (Typically offered: Fall and Summer)

MEEG 4503. Introduction to Flight. 3 Hours.
The course will provide understanding in basic aerodynamics, airfoil design and characteristics, and flight control surfaces. Prerequisite: MATH 2584, MEEG 3503. (Typically offered: Fall)

MEEG 4503H. Honors Introduction to Flight. 3 Hours.
The course will provide understanding in basic aerodynamics, airfoil design and characteristics, and flight control surfaces. Prerequisite: MATH 2584 and MEEG 3503. (Typically offered: Fall)

MEEG 4523. Astronautics. 3 Hours.
Study of spacecraft design and operations. Prerequisite: MEEG 2013 and MEEG 2403 or consent of instructor. (Typically offered: Irregular)

MEEG 4633. Additive Manufacturing. 3 Hours.
This course provides an overview of developing opportunities and critical challenges of additive manufacturing (AM, also known as 3-D printing). It covers existing and emerging additive manufacturing processes in the context of product design, materials selection and processing, and industrial and consumer applications. Students will learn to take advantage of the new capabilities of additive manufacturing technologies (e.g., design freedom) for existing and new applications and the implementation of their designs in a laboratory through project-based learning. Students may not receive credit for both MEEG 4633 and MEEG 5633. Prerequisite: MEEG 2101, MEEG 2303, MEEG 3013, and MEEG 3503 or instructor consent. (Typically offered: Spring)

MEEG 4703. Mathematical Methods in Engineering. 3 Hours.
Determinants, matrices, inverse of a matrix, simultaneous equations, eigenvalues, eigenvectors, coordinate transformations for matrices, diagonalization, square roots of a matrix, cryptography, and method of least squares. Vector algebra and calculus, Green's theorem, Stokes' theorem, and Gauss' divergence theorem. Index notation, epsilon-delta identity, and Cartesian tensors. Curvilinear coordinates, base vectors, and covariant and contravariant tensors. Applications to mechanics. Prerequisite: MATH 2574. (Typically offered: Irregular)

MEEG 4903H. Honors Mechanical Engineering Research. 3 Hours.
Independent research for mechanical engineering honors students. Prerequisite: Honors standing and instructor consent. (Typically offered: Fall and Spring)

MEEG 491V. Special Topics in Mechanical Engineering. 1-6 Hour.
Consideration of current mechanical engineering topics not covered in other courses. (Typically offered: Fall, Spring and Summer) May be repeated for up to 6 hours of degree credit.

MEEG 492V. Individual Study in Mechanical Engineering. 1-3 Hour.
Individual study and research on a topic of mutually agreeable interest to the student and a faculty member. Prerequisite: Senior standing. (Typically offered: Fall, Spring and Summer)

MEEG 492VH. Honors Individual Study in Mechanical Engineering. 1-3 Hour.
Individual study and research on a topic of mutually agreeable interest to the student and a faculty member. Prerequisite: Senior standing. (Typically offered: Fall, Spring and Summer)

This course is equivalent to MEEG 492V.

MEEG 5033. Advanced Mechanics of Materials I. 3 Hours.
Combined stress, theories of failure, thick-walled cylinders, bending of unsymmetrical sections, torsion in noncircular section, plate stresses, and strain energy analysis. Prerequisite: MEEG 2013 and MEEG 3013. (Typically offered: Irregular)

MEEG 5153. Fundamentals of Mechanical Design. 3 Hours.
This class is designed to provide engineering students with a head start in industry as design engineers or working in an engineering related function. The course contents cover machine design and analysis experiences as related to working in industry and performing consulting work. Major topics include the design process, design procedures, fasteners, general design and numerous consulting experiences. A concept design exercise and two special design projects will be assigned to the students as homework. Graduate degree credit will not be given for both MEEG 4153 and MEEG 5153. Prerequisite: MEEG 4103. (Typically offered: Fall)

MEEG 5163. Advanced Product Design. 3 Hours.
This course provides an in-depth and comparative study on the theories of engineering design and equips students to understand and utilize the tools and methodologies founded on those theories. (Typically offered: Fall)

MEEG 5173. Model-Based Systems Design and Analysis. 3 Hours.
This course provides students with an introduction into the two main approaches to understanding and designing complex engineered systems. First, the course covers the unique technical challenge of systems engineering and design of systems. Second, the course covers concepts, methods and tools related to "model-based systems design." This covers formal modeling of the information content of complex systems. The third portion of the course will focus on modeling the complex behavior of the systems. This is often described as dynamical systems modeling. Students will utilize the methods and tools presented in class to model a complex engineered system of their choice (with instructor approval). The classes will alternate between presenting modeling methods to the students and students demonstrating their system to the class utilizing those methods. Students may not receive credit for both MEEG 4173 and MEEG 5173. Prerequisite: MEEG 4103 or Instructor consent. (Typically offered: Spring Even Years)
MEEG 5203. Robot Modeling and Simulation. 3 Hours.
This is a graduate level course in Robotics dealing with the behavioral study of robots. Topics covered in this course will include but not limited to the following: mathematical modeling of robots, rigid motions and homogeneous transformation, forward/inverse kinematics of robots, velocity kinematics, path and trajectory planning, robot dynamics, joint control, PD/PID control, and multivariable control. Advanced topics may include passivity-based motion control, geometric nonlinear control, computer vision, vision-based control, and sensor fusion. Prerequisite: Graduate standing in MEEG or ELEG and consent of the instructor. (Typically offered: Spring)

MEEG 5253. Bio-Mems. 3 Hours.
Topics include the fundamental principles of microfluidics, Navier-Stokes Equation, bio/abio interfacing technology, bio/abio hybrid integration of microfabrication technology, and various biomedical and biological problems that can be addressed with microfabrication technology and the engineering challenges associated with it. Lecture 3 hours per week. Prerequisite: MEEG 3503 or CVEG 3213 or CHEG 2133. (Typically offered: Spring)

This course is cross-listed with BENG 5253.

MEEG 5263. Introduction to Micro Electro Mechanical Systems. 3 Hours.
A study of mechanics and devices on the micro scale. Course topics will include: introduction to micro scales, fundamentals of microfabrication, surface and bulk micromachining, device packaging, device reliability, examples of micro sensors and actuators. Recitation three hours per week. (Typically offered: Fall)

MEEG 5283. Microelectronics Reliability. 3 Hours.
In this course, students will learn about common failure modes experienced in electronic packaging and devices, with special attention on mechanical and thermally driven failure mechanisms. Additionally, students will gain familiarity with accelerated testing methods and the associated governing standards associated with electronics reliability qualifications used in identifying and certifying electronics for various applications. Prerequisite: ELEG 5273 or instructor consent. (Typically offered: Fall Even Years)

MEEG 5333. Introduction to Tribology. 3 Hours.
A study of science and technology of interacting surfaces in relative motion. Topics include solid surface characterization, contact between solid surfaces, adhesion, friction, wear, lubrication, micro/nanotribology, friction and wear screening test methods, and tribological components and applications. Students may not earn credit for both MEEG 5333 and MEEG 4313. Prerequisite: Graduate standing. (Typically offered: Irregular)

MEEG 5343. Computational Material Science. 3 Hours.
This course provides students with an overview of different modeling techniques in material science. Applications will be presented on a broad range of modeling techniques including atomistic simulation methods, Monte Carlo techniques, molecular mechanics, and molecular dynamics. Prerequisite: Graduate standing. (Typically offered: Irregular)

MEEG 5353. Lithium-ion Batteries and Beyond: Materials, Characterization, and Performance. 3 Hours.
This course is intended to provide students an overview of various battery systems and help students establish the concepts of primary and secondary batteries. The course materials will focus on lithium-ion batteries (LIBs), covering their electrochemical mechanisms, components, materials synthesis, materials characterization, and performance evaluations. Prerequisite: CHEM 1103 and MEEG 2303. (Typically offered: Fall)

MEEG 5403. Advanced Thermodynamics. 3 Hours.
An in-depth review of classical thermodynamics, including availability analysis, combustion, and equilibrium, with an introduction to quantum mechanics and statistical thermodynamics. Prerequisite: Graduate standing in Engineering or consent of instructor. (Typically offered: Spring)

MEEG 5453. Advanced Heat Transfer. 3 Hours.
More in-depth study of topics covered in MEEG 4413, Heat Transfer, and coverage of some additional topics. Prerequisite: MEEG 4413 or equivalent. (Typically offered: Fall)

MEEG 5473. Radiation Heat Transfer. 3 Hours.
Spectral analysis, radiant exchange in gray and non-gray enclosures, gas radiation, and multi-mode heat transfer. Prerequisite: MEEG 5453 or equivalent. (Typically offered: Summer Even Years)

MEEG 5483. Thermal Systems Analysis and Design. 3 Hours.
Analysis design and optimization of thermal systems and components with examples from such areas as power generation, refrigeration, and propulsion. Availability loss characteristics of energy systems and availability conservation methods. Graduate degree credit will not be given for both MEEG 4483 and MEEG 5483. Prerequisite: MEEG 4413. (Typically offered: Fall and Summer)

MEEG 5503. Advanced Fluid Dynamics I. 3 Hours.
A basic survey of the characteristics of fluid flow under a variety of conditions with examples. Begins with a derivation of the Navier-Stokes equations and an evaluation of the dimensionless groups found from these equations. Topics to be covered include viscous laminar and turbulent boundary layers, jets and wakes, Stokes flow, inviscid flows with and without free surfaces and turbulence. Prerequisite: MEEG 3503 and MATH 2584. (Typically offered: Spring)

MEEG 5513. Introduction to Flight. 3 Hours.
The course will provide understanding in basic aerodynamics, airfoil design and characteristics, and flight control surfaces. Graduate degree credit will not be given for both MEEG 4503 and MEEG 5513. Prerequisite: MATH 2584, MEEG 3503. (Typically offered: Fall)

MEEG 5523. Astronautics. 3 Hours.
Study of spacecraft design and operations. Graduate degree credit will not be give for both MEEG 4523 and MEEG 5523. Prerequisite: MEEG 2013 and MEEG 2403 or consent of instructor. (Typically offered: Irregular)

MEEG 5553. Fundamentals of Aerodynamics. 3 Hours.
A study of external-flow fluid mechanics applied to Aerodynamics. Topics include integral and differential forms of the basic fluid equations (continuity, momentum, and energy), potential flow, and supersonic flow. Prerequisite: MEEG 3503. (Typically offered: Spring)

MEEG 5633. Additive Manufacturing. 3 Hours.
This course provides an overview of developing opportunities and critical challenges of additive manufacturing (AM, also known as 3-D printing). It covers existing and emerging additive manufacturing processes in the context of product design, materials selection and processing, and industrial and consumer applications. Students may not receive credit for both MEEG 4633 and MEEG 5633. Prerequisite: MEEG 2101, MEEG 2303, MEEG 3013, and MEEG 3503 or instructor consent. (Typically offered: Spring)

MEEG 5733. Advanced Numerical Methods. 3 Hours.
Numerical methods for the solution of linear and non-linear ordinary and partial differential equations; initial and boundary value problems; one-step and multi-step methods; predominantly finite difference but also finite element and control volume techniques; and computer applications. Graduate standing in Engineering or consent of instructor. (Typically offered: Irregular)

MEEG 5833. Aerospace Propulsion. 3 Hours.
Principles, operation, and characteristics of gas turbine and rocket engines. Brief study of novel spacecraft propulsion systems. Graduate degree credit will not be given for both MEEG 4433 and MEEG 5833. Prerequisite: MEEG 3503. (Typically offered: Irregular)
MEEG 5853. Industrial Waste and Energy Management. 3 Hours.
This course in a basic application of thermodynamics, heat transfer, fluid mechanics, and electric machinery to the analysis of energy consumption and waste streams in industrial manufacturing facilities. There is also application toward energy conservation in commercial buildings. Current techniques and technologies for energy conservation and waste minimization are covered, including energy-consuming systems and processes, utility rate analysis, economic analysis and auditing. This course may be of interest to engineers in industry, consulting, facilities, environmental sustainability, and others. Prerequisite: MEEG 4413 or consent of instructor. (Typically offered: Irregular)

MEEG 5873. Indoor Environmental Control. 3 Hours.
This course is a broad use of thermal-fluid concepts toward understanding and applying fundamental theories of heating, ventilating, and air conditioning (HVAC) design. Upon completion of the course, students will be able to apply current engineering techniques and methodologies to design HVAC systems, including heating and cooling loads, and proper selection and sizing of air conditioning equipment. Moreover, through this class, students will gain a physical understanding of HVAC systems and buildings, which is needed for today's HVAC designs. This course may be of interest to engineers in industry, consulting, facilities, and others. Prerequisite: MEEG 4413 or consent of instructor. (Typically offered: Irregular)

MEEG 591V. Special Topics in Mechanical Engineering. 1-6 Hour.
Consideration of current advanced mechanical engineering topics not covered in other courses. Prerequisite: Graduate standing. (Typically offered: Fall, Spring and Summer) May be repeated for up to 6 hours of degree credit.

MEEG 592V. Individual Study in Mechanical Engineering. 1-6 Hour.
Opportunity for individual study of advanced subjects related to a graduate mechanical engineering program to suit individual requirements. Prerequisite: Graduate standing. (Typically offered: Fall, Spring and Summer) May be repeated for up to 6 hours of degree credit.

MEEG 5953. Fundamentals of Fracture and Fatigue in Structures. 3 Hours.
The course will cover the concepts of linear-elastic, elastic-plastic and time-dependent Fracture Mechanics as applied to fracture in a variety of materials, structures, and operating conditions. The examples will include fracture in large components such as aircraft, bridges and pressure vessels and also in bones and in soft materials and human tissue. Prerequisite: Graduate standing in Civil, Mechanical or Biomedical Engineering or consent of the instructor. (Typically offered: Fall and Spring)
This course is cross-listed with BMEG 5953, CVEG 5953.

MEEG 5963. Advanced Fracture Mechanics and Structural Integrity. 3 Hours.
This course provides an in-depth treatment of advanced topics in fracture mechanics such as stress analysis of cracks under elastic-plastic loading, crack initiation and growth under elastic-plastic and time-dependent creep and creep-fatigue conditions. The course emphasizes fundamental underpinnings of nonlinear fracture mechanics and its use in material evaluation and life prediction methodology for structural components. Micro-mechanics of fracture and crack growth processes are also covered. Prerequisite: MEEG 5953, or BMEG 5953, or CVEG 5953 or equivalent, or instructor consent. (Typically offered: Fall and Spring)

MEEG 600V. Master's Thesis. 1-6 Hour.
Master's Thesis. Prerequisite: Graduate standing. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

MEEG 6800. Graduate Seminar. 0 Hours.
A periodic seminar devoted to mechanical engineering research topics. Course includes letter grades A, B, C, D, and F as well as CR. (Typically offered: Fall and Spring)

MEEG 700V. Doctoral Dissertation. 1-18 Hour.
Doctoral Dissertation. Prerequisite: Candidacy. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.