

Mechanical Engineering (MEEG)

Courses

MEEG 20003. 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 26004. Prerequisite: PHYS 20304. (Typically offered: Fall, Spring and Summer)

MEEG 20103. 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 20003 and MATH 26004. (Typically offered: Fall, Spring and Summer)

MEEG 21003. Mechanical Design and Manufacturing. 3 Hours.

Principles and tools to support the design and manufacture of products within constraints of cost and schedule. Students will learn how to develop and evaluate mechanical product designs and specify appropriate manufacturing methods for mechanical parts. This course will provide students with a systematic process to develop a product from the point of customer needs through conceptual design and to developing a functional prototype and specification of component's material, shape, and manufacturing processes. Corequisite: MEEG 20103. Prerequisite: MEEG 21031. (Typically offered: Spring and Summer)

MEEG 21031. 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 11201 or GNEG 112H1 or GNEG 11003. (Typically offered: Fall and Spring)

MEEG 23003. 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 24004, PHYS 20304 and CHEM 14103. (Typically offered: Fall and Spring)

MEEG 24003. 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 20304 and MATH 25004. (Typically offered: Fall, Spring and Summer)

MEEG 27003. 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 25804. (Typically offered: Spring and Summer)

MEEG 30103. 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 20003. (Typically offered: Fall, Spring and Summer)

MEEG 301H3. 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 20003 and honors standing. (Typically offered: Fall, Spring and Summer)
This course is equivalent to MEEG 30103.

MEEG 31103. 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 21003, MATH 25804, MEEG 27003, and MEEG 20103. (Typically offered: Fall and Spring)

MEEG 32002. 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 30103 and ELEG 39003. Prerequisite: MEEG 23003 and PHYS 20404. (Typically offered: Fall and Spring)

MEEG 32102. 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 32002, MEEG 35003 and MEEG 31103. (Typically offered: Fall and Spring)

MEEG 32203. 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 32002. (Typically offered: Spring)

MEEG 35003. 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 24003 or CHEG 23103. Pre- or Corequisite: MATH 25804. (Typically offered: Fall and Summer)

MEEG 40003. 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 20103. (Typically offered: Irregular)

MEEG 40203. 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 30103. (Typically offered: Irregular)

MEEG 41003. 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 31103. Prerequisite: MEEG 30103. (Typically offered: Fall, Spring and Summer)

MEEG 410H3. 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 41003.

MEEG 41203. 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 30103 and MEEG 44103. (Typically offered: Irregular)

MEEG 41302. Professional Engineering Practices. 2 Hours.

Design proposal preparation, design codes, professional ethics, engineering economics, and the role of the engineer in society. Pre- or Corequisite: MEEG 41003 or MEEG 44803. (Typically offered: Fall and Spring)

MEEG 41403. 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 44103. Prerequisite: MEEG 30103. (Typically offered: Irregular)

MEEG 41503. 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. Prerequisite: MEEG 41003. (Typically offered: Fall)

MEEG 41703. 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 41703 and MEEG 51703. Prerequisite: MEEG 41003 or Instructor consent. (Typically offered: Spring Even Years)

MEEG 41802. 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 41902. Corequisite: MEEG 44803. Prerequisite: MEEG 41003 and MEEG 32102. (Typically offered: Fall and Spring)

MEEG 41902. 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 41802. (Typically offered: Fall and Spring)

MEEG 42002. 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 44803. Prerequisite: MEEG 32102 and MEEG 41003. (Typically offered: Fall, Spring and Summer)

MEEG 42103. 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 31103. (Typically offered: Irregular)

MEEG 42303. 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 39003. (Typically offered: Irregular)

MEEG 42503. 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 27003, MEEG 31103 and instructor consent. (Typically offered: Fall)

MEEG 43003. 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 23003. (Typically offered: Irregular)

MEEG 43103. 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 30103 and MEEG 35003 or graduate standing. (Typically offered: Irregular)

MEEG 43303. 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 39003 or BENG 31103, and senior standing. (Typically offered: Spring)

MEEG 44103. 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 35003. (Typically offered: Spring and Summer)

MEEG 44203. 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 35003. (Typically offered: Irregular)

MEEG 44303. Aerospace Propulsion. 3 Hours.

Principles, operation, and characteristics of gas turbine and rocket engines. Brief study of novel spacecraft propulsion systems. Prerequisite: MEEG 35003. (Typically offered: Irregular)

MEEG 44403. Machine Learning for Mechanical Engineers. 3 Hours.

This course covers an introduction to supervised and unsupervised learning algorithms for engineering applications, such as visualization-based physical quantity predictions, dynamic signal classification, and prediction, data-driven control of dynamical systems, surrogate modeling, and dimensionality reduction, among others. The lectures cover the fundamental concepts and examples of developing machine learning models using Python and MATLAB. This course includes four homework assignments to practice the application of different machine learning algorithms in specific mechanical engineering problems and a project assignment that gives the students the flexibility of selecting their topics to study using designated machine learning tools. Students are not allowed to take both MEEG 44403 and MEEG 54403 for credits. Prerequisite: MEEG 27003. (Typically offered: Fall)

MEEG 44503. 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 44103. (Typically offered: Irregular)

MEEG 44703. 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 44103. (Typically offered: Irregular)

MEEG 44803. 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 44103. (Typically offered: Fall and Summer)

MEEG 448H3. 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 /or more rigorous approach to design projects for honors course. Advanced project required. Prerequisite: MEEG 44103. (Typically offered: Fall and Summer)

This course is equivalent to MEEG 44803.

MEEG 45003. Introduction to Flight. 3 Hours.

The course will provide understanding in basic aerodynamics, airfoil design and characteristics, and flight control surfaces. Prerequisite: MATH 25804, MEEG 35003. (Typically offered: Fall)

MEEG 450H3. Honors Introduction to Flight. 3 Hours.

The course will provide understanding in basic aerodynamics, airfoil design and characteristics, and flight control surfaces. Prerequisite: MATH 25804 and MEEG 35003. (Typically offered: Fall)

This course is equivalent to MEEG 45003.

MEEG 45203. Astronautics. 3 Hours.

Study of spacecraft design and operations. Prerequisite: MEEG 20103 and MEEG 24003 or consent of instructor. (Typically offered: Irregular)

MEEG 45403. Aerospace Systems Engineering and Safety. 3 Hours.

Systems engineering fundamentals and application to the aerospace industry. Application of key concepts of systems design, including customer needs assessment and communication of solutions. Discussion of aerospace systems and vehicles. Systems safety and hazard analysis, including risk assessment and accident modeling methods. Analysis of notable aerospace accidents, their causes, and lessons learned. Prerequisite: MEEG 21003 and Senior Status. (Typically offered: Spring)

MEEG 46303. 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 46303 and MEEG 56303. Prerequisite: MEEG 21031, MEEG 23003, MEEG 30103, and MEEG 35003 or instructor consent. (Typically offered: Spring)

MEEG 47003. 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 26004. (Typically offered: Irregular)

MEEG 490H3. 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 4910V. 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 4920V. 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 492HV. 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 4920V.

MEEG 50303. 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 20103 and MEEG 30103. (Typically offered: Irregular)

MEEG 51503. 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 41503 and MEEG 51503. Prerequisite: MEEG 41003. (Typically offered: Fall)

MEEG 51603. 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 51703. 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 41703 and MEEG 51703. Prerequisite: MEEG 41003 or Instructor consent. (Typically offered: Spring Even Years)

MEEG 52003. 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 52503. 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 35003 or CVEG 32103 or CHEG 21303. (Typically offered: Spring)

This course is cross-listed with BENG 52503.

MEEG 52603. 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 52803. 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 52703 or instructor consent. (Typically offered: Fall Even Years)

MEEG 53303. 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 53303 and MEEG 43103. Prerequisite: Graduate standing. (Typically offered: Irregular)

MEEG 53403. 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 53503. 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 14103 and MEEG 23003. (Typically offered: Fall)

MEEG 54003. 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 54403. Machine Learning for Mechanical Engineers. 3 Hours.

This course covers an introduction to supervised and unsupervised learning algorithms for engineering applications, such as visualization-based physical quantity predictions, dynamic signal classification, and prediction, data-driven control of dynamical systems, surrogate modeling, and dimensionality reduction, among others. The lectures cover the fundamental concepts and examples of developing machine learning models using Python and MATLAB. This course includes four homework assignments to practice the application of different machine learning algorithms in specific mechanical engineering problems and a project assignment that gives the students the flexibility of selecting their topics to study using designated machine learning tools. Students are not allowed to take both MEEG 44403 and MEEG 54403 for credits. Prerequisite: MEEG 27003 or equivalent and Graduate student standing. (Typically offered: Fall)

MEEG 54503. Advanced Heat Transfer. 3 Hours.

More in-depth study of topics covered in MEEG 44103, Heat Transfer, and coverage of some additional topics. Prerequisite: MEEG 44103 or equivalent. (Typically offered: Fall)

MEEG 54703. Radiation Heat Transfer. 3 Hours.

Spectral analysis, radiant exchange in gray and non-gray enclosures, gas radiation, and multi-mode heat transfer. Prerequisite: MEEG 54503 or equivalent. (Typically offered: Summer Even Years)

MEEG 54803. 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 44803 and MEEG 54803. Prerequisite: MEEG 44103. (Typically offered: Fall and Summer)

MEEG 55003. 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 35003 and MATH 25804. (Typically offered: Spring)

MEEG 55103. 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 45003 and MEEG 55103. Prerequisite: MATH 25804, MEEG 35003. (Typically offered: Fall)

MEEG 55203. Astronautics. 3 Hours.

Study of spacecraft design and operations. Graduate degree credit will not be given for both MEEG 45203 and MEEG 55203. Prerequisite: MEEG 20103 and MEEG 24003 or consent of instructor. (Typically offered: Irregular)

MEEG 55303. 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 35003. (Typically offered: Spring)

MEEG 55403. Aerospace Systems Engineering and Safety. 3 Hours.

Systems engineering fundamentals and application to the aerospace industry. Application of key concepts of systems design, including customer needs assessment and communication of solutions. Discussion of aerospace systems and vehicles. Systems safety and hazard analysis, including risk assessment and accident modeling methods. Analysis of notable aerospace accidents, their causes, and lessons learned. Prerequisite: MEEG 21003 and Graduate Standing. (Typically offered: Spring)

MEEG 56303. 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 46303 and MEEG 56303. Prerequisite: MEEG 21031, MEEG 23003, MEEG 30103, and MEEG 35003 or instructor consent. (Typically offered: Spring)

MEEG 57303. 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 58303. 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 44303 and MEEG 58303. Prerequisite: MEEG 35003. (Typically offered: Irregular)

MEEG 58503. Industrial Waste and Energy Management. 3 Hours.

This course is 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 44103 or consent of instructor. (Typically offered: Irregular)

MEEG 58703. 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 44103 or consent of instructor. (Typically offered: Irregular)

MEEG 5910V. 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 5920V. 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 59503. 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 59503, CVEG 59503.

MEEG 59603. 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 59503, or BMEG 59503, or CVEG 59503 or equivalent, or instructor consent. (Typically offered: Fall and Spring)

MEEG 6000V. 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 68000. 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 7000V. Doctoral Dissertation. 1-18 Hour.

Doctoral Dissertation. Prerequisite: Candidacy. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.