MEC

Mechanical Engineering

MEC 500: Modeling and Control of Manufacturing Systems

Introduction to manufacturing system modeling and analysis. Fundamental principles of production systems. Analytical and simulation approach to production system performance analysis, continuous improvement, and design. Topics include mathematical modeling of production systems, production lines with various statistic distribution models of machine reliability, improvement analysis and real-time decision making. Includes both the relevant fundamental concepts and the extensive practical knowledge base on which manufacturing research, development, and design depend. The students are expected to complete a project, in which they will interpret real-life manufacturing plant operation in the light of course principles and suggest improvement solutions.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 501: Convective Heat Transfer and Heat Exchange

Differential and integral formulation. Exact and approximate solutions. Topics include parallel and boundary layer flows, similarity solutions, external and internal flows, laminar and turbulent convection, and forced and free convection.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 502: Conduction and Radiation Heat Transfer

Heat conduction and conservation laws; formulation of conduction equations in differential and integral forms; analytical solution techniques including Laplace transforms and separation of variables; scaling analysis; black body radiation, Kirchoff's law, analysis of heat conduction problems; analysis of radiative exchange between surfaces and radiative transport through absorbing, emitting, and scattering media.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 506: Energy Management in Commercial Buildings

Topics include basic heating, ventilating, and air-conditioning (HVAC) system design and selection for commercial buildings (includes both low-rise and high-rise buildings); selection of central plant components and equipment; calculation of space heating and cooling load; computer techniques for estimating annual energy consumption; design tools for reducing energy consumption; ASHRAE codes; building controls; BACnet.

Prerequisite: B.S. in mechanical engineering or related fields
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 507: Mathematical Methods in Engineering Analysis I

An introduction to the use of mathematical analysis techniques for the solution of engineering analysis problems and the simulation of engineering systems. Both continuous and discrete methods are covered. Initial and boundary value problems for ordinary and partial differential equations are treated.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 508: Mathematical Methods in Engineering Analysis II

A continuation of the material covered in MEC 507. Introduction to and application of numerical analysis techniques used in engineering such as finite elements and fast Fourier transforms. Determination of response characteristics of dynamic systems. Combinatoric methods and techniques for optimization of engineering design and systems/process analysis problems.

Prerequisite: MEC 507
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 509: Transport Phenomena

Introduction to differential and integral formulation of mass, momentum, and energy transport in fluids and solids. Topics include viscosity, laminar flow, turbulent flows, conduction, convection, heat transfer coefficients, radiation, boundary layers, diffusion, and applications to energy technology.

Offered
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 510: Object-Oriented Programming for Scientists and Engineers

Practical introduction to C++ and object-oriented programming for a first programming course for scientists and engineers. Covers basics of application software development such as problem decomposition, structure charts, object modeling, class diagrams, incremental code building, and testing at a beginner's level. Features the concepts of abstract data types (ADT), encapsulation, inheritance, composition, polymorphism, operator and function overloading besides studying UML (Unified Modeling Language) as a graphical representational design technique. The course follows the evolution of programming ideas from the use of a single function to the use of structural charts and functions to modularize and finally to the use of object-oriented programming.

Prerequisite: B.S. in science or engineering
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 511: Mechanics of Perfect Fluids

Lagrangian and Eulerian frames. Dynamical equations of momentum and energy transfer. Two-dimensional dynamics of incompressible and barotropic perfect fluids and of the compressible perfect gas. Conformal mapping applied to two-dimensional fluid dynamics. Jets and cavities. Surface waves, internal waves. Perfect shear flows.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 512: Mechanics of Viscous Fluids

The role of viscosity in the dynamics of fluid flow. The Navier-Stokes equations, low Reynolds number behavior including lubrication theory, percolation through porous media, and flow due to moving bodies. High Reynolds number behavior including steady, unsteady, and detached boundary layers, jets, free shear layers, and wakes. Phenomenological theories of turbulent shear flows are introduced.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 514: Advanced Fluid Mechanics: Introduction to Turbulence

Introductory concepts and statistical descriptions: kinematics of random velocity fields; equations of motion; experimental techniques: isotropic turbulence, closure problem; transport processes.

Prerequisite: MEC 512
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 516: Energy Technologies Laboratory

Experiments in the areas of infrared imaging, heat pumps, batteries/power electronics, solar thermal, thermal conductivity, and insulation. The focus is on system efficiencies, system integration, and design for residential markets. The fundamentals of the relevant technologies will be presented and utilized in the laboratory sessions. Student groups are assigned laboratory projects focused on applying various energy technologies to solve engineering problems.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 517: Energy Technologies Laboratory II

Experiments in the areas of thermoelectric power, fuel cells, photovoltaics, wind turbines, hydrogen storage, hydrogen generation, and power electronics in addition to related project work. The focus is on system efficiencies, system integration, and design for residential markets. Student groups are assigned laboratory projects to build experience applying various energy technologies to solve problems.

Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 518: Energy Harvesting

MEC 518 Energy Harvesting is designed to systematically disseminate recent advances in various energy harvesting technologies in the last decade. The topic will include mechanical vibrations, piezoelectric materials, electromagnetic transducers, thermoelectric materials, electromechanical system design, power electronics, and control, as well as the applications of energy harvesting to vehicles, transportations, civil structures, and ocean waves.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 520: Smart Materials for Sensing and Actuation

An introduction to the properties, characterization, manufacturing, and applications of various smart materials and structures. This course will cover sensors, actuators, and energy devices based on smart materials, including piezoelectric materials, electroactive polymers, magnetostrictive materials, magnetorheological fluids, and shape memory polymers. The goal is to expose students to fundamentals of smart materials and structures needed for the design and applications in engineering applications.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 521: Thermodynamics

This course begins with a review of the fundamental concepts and laws of classical thermodynamics. Then the thermostatic theory of equilibrium states and phase transitions is treated, followed by the thermodynamic theory of processes of simple systems and composite systems, including heat engines. Special topics may include istatisical thermodynamics, irreversible thermodynamics, radiation and photovoltaic energy conversion,, biological thermodynamic processes, and other topics of current interest.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 522: Building Energy Dynamics and Technology

Building is treated as a time-dependent energy system, with its interactive components coupled through energy and mass flows under an environment defined in terms of sunlight, ambient air and wind and with its equipment which assist in meeting building-dwellers comfort requirements. Major components discussed are thermal mass (both interior mass and envelope mass) and their thermal capacities, building envelopes and their heat transfer resistances, room air including its circulation and heat exchange with thermal mass, and the transparent part of the envelope the glazing or windows and the solar system passing through it during the day and the heat loss during the night time. Major equipment include lighting, air circulation system, cooling and heating equipment, solar thermal panels and solar PV panels, and other equipment including integrated electric and control units. Of the comfort requirements only temperature-and-humidity and illumination are studied with the objective of creating, through a system-understanding of the building, buildings that in the short run meet these requirements involving minimal use of energy and in the long run are benchmarked against the environmentally regenerative capabilities of wilderness.

Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 523: Internal Combustion Engines

Combustion fundamentals. Carnot cycle; reversible internal combustion engine cycle; introduction to practical internal combustion. engine cycles. Internal combustion piston engines; engine combustion and emission processes; engine operating characteristics. Gas turbine engines. Composite engines: turbocharging piston engines; gas generator engines; turbocompounding engines. Method of exhaust heat recovery for improvement of thermal efficiency. Method of intercooling-supercharging for thermal efficiency improvement.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 524: Computational Methods for Fluid Mechanics and Heat Transfer

Introduction of finite difference, finite volume, and finite element methods for incompressible flows and heat transfer. Topics include explicit and implicit schemes, accuracy, stability and convergence, derived and primitive-variables formulation, orthogonal and non-orthogonal coordinate systems. Selected computer assignments from heat conduction, incompressible flows, forced and free convection.

Prerequisite: MEC 507
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 525: Product Design Concept Development and Optimization

This graduate course will concentrate on the design concept development of the product development cycle, from the creative phase of solution development to preliminary concept evaluation and selection. The course will then cover methods for mathematical modeling, computer simulation and optimization. The concept development component of the course will also cover intellectual property and patent issues. The course will not concentrate on the development of any particular class of products, but the focus will be mainly on mechanical and electromechanical devices and systems. As part of the course, each participant will select an appropriate project to practice the application of the material covered in the course and prepare a final report.

Prerequisites: Undergraduate electrical or mechanical engineering and/or science training.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 526: Modern Power Cycles

First and second law design and analysis of modern power cycles including Rankin Steam Cycles, Bryton Gas Turbine cycles, Combined Cycles, Cogeneration, Central Heat and Power Generation (CHP), Tri-generation and current advances in thermal power systems design and analysis. Cycle efficiency and factors effecting performance and plant efficiency. Thermodynamic analysis of proposed as well as existing thermal energy systems.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

MEC 527: Introduction to Building Energy Modeling

Designing high performance buildings requires the application of building energy modeling (BEM) that uses computer-based software to simulate thermal processes in buildings. In applying building energy modeling, this course emphasizes the importance of formulating the problem in terms of assumptions: The two alternative assumptions are the static building load assumption and the dynamic building process assumption. The resistor-capacitor (RC model is introduced. With a 3D building model developed in Autodesk Revit, energy analysis is carried out with a series of software. Popular whole-building energy simulation programs, such as EnergyPlus and TRNSYS, are then explained briefly.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 529: Introduction to Robotics: Theory and Applications

Topics: robot components and mechanatronic aspects of robotics (sensors, actuators, and effectors, system integration); rotation, translation, rigid-body transform; robotics foundations in kinematics and inverse kinematics, dynamics, serial and parallel manipulators and their duality, introduction to mobile robots and LEGO Robotics, control theories, motion planning, trajectory generation, grasping and manipulation, robotic programming language, industrial robotics, manufacturing automation, and societal impacts. Include hands-on projects.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 530: Applied Stress Analysis

Advanced mechanics of solids and structures. Elastic boundary value problems are analyzed with various solution techniques including finite element method. Major topics are stress and strain, FEM formulations, material behavious, 2D elastic problems, stress function and fracture. Detailed studies of structural components are carried out with FEM with emphasis on optimal mesh design and proper interpretations of computed results.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 532: Vibration and Control

Fundamentals of vibrations and control of vibrations of structures and dynamic systems. Topics include one dof systems and responses, frequency response, multiple dof systems and responses, relevant classical control theory, modern state-space feedback control theory, application of control methodology in systems with dynamics and vibration, eigenvalue problems and modal analysis, vibration analysis of various continuous systems.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 536: Mechanics of Solids

A unified introduction to the fundamental principles, equations, and notation used in finite deformation of solids, with emphasis on the physical aspects of the subject. Cartesian tensor representation of stress, principal values, finite strain, and deformation. Conservation of mass, momentum, and energy. Formulation of stress-strain relations in elasticity, and compatibility relations. The use of general orthogonal coordinate systems in the equations governing solids. Principles of virtual displacement and virtual work.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 537: Combustion Research Laboratory

Experimental methods for testing and development of internal combustion engines. Methods for measuring engine performance and emissions. Review of combustion chemistry and thermodynamics. Engine cycle quantities measurements. Students will apply these methods to reciprocating engines and gas turbines.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 539: Introduction to Finite Element Methods

(formerly Finite Element Methods in Structural Analyses)

Theory of finite element methods and their application to structural analysis problems. Matrix operations, force and displacement methods. Derivation of matrices for bars, beams, shear panels, membranes, plates, and solids. Use of these elements to model actual structural problems. Weighted residual techniques and extension of the finite element method into other areas such as heat flow and fluid flow. Laboratory sessions introduce use of the computer in solving finite element problems. Programs for the solution of force and displacement method problems are configured. A computer project consisting of the solution and evaluation of a structural problem is required.
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 540: Mechanics of Engineering Structures

An introduction to variational principles of mechanics and the development of approximation methods for the solution of structural mechanics problems. Linear and nonlinear theories of beams and thin plates are developed along with their framework for numerical solutions. An introduction of the general theory of structural stability is presented along with its application to the buckling and initial postbuckling behavior of beams and plates.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 541: Elasticity

Formulation of boundary value problems. Compatibility equations and reciprocal theorem. Torsion of noncircular cross-sections. Fundamental solutions for two- and three-dimensional domains. Potential function formulations. Use of integral transforms and complex variable approaches. Formulation and solution of problems in thermoelasticity.

Prerequisite: MEC 536
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 543: Plasticity

Stress and deformation of solids: yield criteria and flow rules for plasticity deforming solids; the notion of a stable inelastic material; static and dynamic analysis of plastic bodies under mechanical and thermal loading; use of load bounding theorems and the calculation of collapse loads of structures; the theory of the slip-line field.

Prerequisite: MEC 541
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 549: Robot Dynamics and Control

This course will cover the fundamentals of dynamic modeling and control techniques for robots, focusing mainly on robot manipulators. The dynamic modeling part includes Lagrange formulation, Newton Euler formulation, properties of the dynamic equations, and trajectory planning with dynamic constraints, and the control part includes nonlinear systems, state-space representation, Lyapunov stability theorems, feedback linearization, linear controller design, position control, motion control, inverse dynamics control, robust control, adaptive control, force control, impedance control, hybrid motion force control, and implementation of controllers. Prerequisite: MEC 529

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 550: Mechatronics

An introduction to the design, modeling, analysis and control of mechatronic systems (smart systems comprising mechanical, electrical, and software components). Fundamentals of the basic components needed for the design and control of mechatronic systems, including sensors, actuators, data acquisition systems, microprocessors, programmable logic controllers, and I/O systems, are covered. Hands-on experience in designing and building practical mechatronic systems are provided through integrated lab activities.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 552: Mechanics of Composite Materials

The course is concerned with the analysis of layered composite materials subject to mechanical loads. Cartesian tensor calculus is used. Homogeneous anisotropic media are studied first. The effect of layering is then analyzed. Applications to plates and shell are studied and analytical methods of solution are given. Numerical analysis of composite solids is also considered using finite difference and finite element methods.

Prerequisite: MEC 536

Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 556: Introduction to Engineering Mechanics of Composites

Introduction to the engineering mechanics of fiber reinforced composites. Brief history of the development of fiber composites, their properties, advantages, limitations and applications. Overview of the different types of composites but with focus on long fiber reinforced composites; particularly, lamina and laminate concepts characteristics and configurations. Topics covered include: elastic properties of unidirectional lamina, strength of unidirectional lamina, elastic behavior of multidirectional laminates and stress and failure of multidirectional laminates. Design methodologies and considerations for structural composite materials. The students are expected to complete a project, in which they will design a real-life structural part out of composite materials using course principles.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 557: Introduction to Fiber Composites Fabrication and Characterization

Overview of fiber reinforced composites, applications and mechanical properties. Introduction to fiber composites fabrication methods as well as experimental characterization methods used in acquiring their relevant mechanical properties. Fabrication topics include: Impregnation of fibers; Prepregs; Stacking; Curing; Vacuum bagging; Autoclave technology; Out-of-autoclave manufacturing processes; Molding; Processing; Cutting and Joining. Topics in mechanical characterization include: Experimental methods; Characterization of the elastic properties and failure strengths of unidirectional lamina; Characterization of the elastic properties and failure strengths of multidirectional laminates. Course is divided into in-class lectures and laboratory sessions. The students are expected to complete a project, in which they will design, fabricate and test a real-life structural part made out of composite materials using course principles.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 559: Mobile Robotics and Autonomous Vehicles

This course will cover the fundamentals of planning, state estimation, and control techniques for mobile robots and autonomous vehicles. Key topics include: Kinematics of wheeled mobile robots; State estimation, Localization, and Mapping; Simultaneous Localization and Mapping Algorithms (SLAM) Algorithms; Path planning, Obstacle Avoidance, and Non-holonomic Control; Mobile robot programming and control architecture.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 560: Advanced Control Systems

Analytical methods applied to the design of multivariable linear control systems. Introduction to linear system theory: linearization, solution of linear matrix differential equations, stability, controllability, observability, transformations to canonical forms. Formulation of control objectives. Deterministic state observer. Full-state feedback control based on pole assignment and linear quadratic optimization theory. Linear systems with stochastic inputs and measurement noise. The response of linear systems to random input; stochastic state estimator (Kalman filter); separation principle of stochastic control and estimation; system robustness.

Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 564: Fundamentals of Aerodynamics

Kinematics and dynamics of incompressible irrotational flow; stream function and the potential functions; Euler and Bernoulli equations. This-foil theory; lift and moment for symmetric and cambered airfoils. Finite-wing theory; induced drag. Compressible flow, small disturbance theory; thin wings at subsonic and supersonic speeds.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 565: Aerospace Propulsion

Fundamentals of propulsion; performance parameters, thermodynamic cycles. Introduction to combustion and combustors. Performance and cycle analysis of various flight propulsion systems: turbojets, turbofans, turboprops, ramjets, scramjets, rockets, propellers. Design of supersonic inlet nozzles, component matching and map.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 567: Kinematic Analysis and Synthesis of Robotic Mechanisms

Introduction, mechanism structure, basic concepts of mechanisms, canonical representation of motion. Kinematic analysis, algebraic method, vector-loop method, complex number method, spherical and spatial polygon method, matrix method, dual-number quaternion method, screw coordinate method, line coordinate method, motor algebra method, type synthesis, number synthesis, coupler curves, curvature theory path generation, finite displacement theory, rigid body guidance, function generation, computer-aided mechanisms analysis and synthesis.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 568: Advanced Dynamics

Newtonian and Lagrangian mechanics of rigid bodies; kinematics, inertia tensor, principle of momentum, principle of virtual work, potential and kinetic energy, equations of motion, extraction of information from the equations of motion, and application to engineering problems.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 569: Aerial Robotics

This hands-on course covers a broad range of topics related to aerial-robotics. There is a comparative analysis of the most common types of flying vehicles. A few of the most common control strategies such as cascaded control, dubins path, and flocking algorithms are covered as well. Lastly, we look at the latest work in both the scientific literature and industry. In particular, this course covers multicopters, fixed-wings, flapping-wings, aerial swarms, perching, collision resilience, search & rescue, and flight testing. There are two hands-on projects, the first consists of searching a space for a safe landing point with a crazyflie quadcopter, and the second is navigation of a narrow passage with a fixed-wing robot. At the end of the class, the students will be able to critically evaluate existing aerial robotic systems, conceive new systems, and implement functional prototype vehicles.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

MEC 570: Introduction to Engineering Tribology

Focus is on the fundamentals of tribology, the science of surfaces in relative motion, with an introduction to friction, lubrication, and wear. The basics of tribology science: engineering surfaces, contact mechanics, lubrication theory, wear processes and modeling, wear properties of materials, and tribology test methods will be covered. Analysis of tribological aspects of machine components and bearings. Industrial case studies will be presented to place the topics in context to industry and society.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 571: Analysis and Design of Robotic Manipulators

Introduction to robot manipulators from the mechanical viewpoint, emphasizing fundamentals of various mechanisms and design considerations. Kinematics on 2D and 3D manipulators; statics and dynamics; motion planning; control fundamentals; algorithms development; computer-graphics simulation of manipulators; current applications.

Prerequisite: Permission of instructor
Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 572: Computer-Aided Design of Shapes and Motions

This class would focus on presenting a unifying treatment for the design of geometric shapes, such as curves and surfaces as well as motions of entities, such as lines, planes, and rigid bodies. It will be shown that in the language of projective geometry, one can design curves, surface, and motions utilizing same algorithms and similar data structures. In the process, the students will learn the theory of NURBS (Non- Uniform Rational B-splines), which is the standard representation in existing CAD/CAM system, and extend it to the space of rigid body displacements for the design of motions. Students will implement shape and motion design algorithms in graphical computer programs.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 575: Introduction to Micro Electro-Mechanical Systems (MEMS)

An introduction to the fundamental knowledge and experience in the design and manufacture of microsystems. Emphasis will be placed on the methodologies for design, fabrication, and packaging of microsystems. An overview on fabrication and manufacturing technologies for producing microsystems will also be covered. Interdisciplinary nature of MEMS will be emphasized via various engineering principles ranging from mechanical and electrical to materials and chemical engineering. Introduction of the working principles of micro actuators, sensors, and transducers.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 579: Optical Measurement

Introduction to optical measurement and its applications to the fields of solid mechanics, design and manufacturing, and thermal and fluid systems. Topics include fundamentals of optics, lasers, and detectors, dimensional and surface metrology, machine vision, measurement of temperature, concentration, and density, and optical techniques for stress analysis and nondestructive testing.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 585: Total Quality Management

Concepts of TQM and quality improvement methods to attain world-class performance in business operations. Topics include policy deployment, process improvement methodology, daily work management, quality story methodology, six sigma, poka-yoke, ISO, Deming and Baldridge Awards criteria.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 596: Projects in Mechanical Engineering

Conducted jointly by graduate students and one or more members of the faculty.

1-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 597: Graduate Research and Study in Manufacturing

Independent research or project in the area of manufacturing processes or systems.

1-6 credits, Letter graded (A, A-, B+, etc.)

MEC 599: Research

Fall, Spring, and Summer, 1-12 credits, S/U grading
May be repeated for credit.

MEC 630: Special Topics in Fluid Mechanics

TThe subject matter of each special topics course varies from semester to semester, depending on the interests of students and staff. Advanced topics and specialized topics will be discussed, particularly those of current interest.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 631: Special Topics in Heat Transfer

The subject matter of each special topics course varies from semester to semester, depending on the interests of students and staff. Advanced topics and specialized topics will be discussed, particularly those of current interest.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 633: Special Topics in Thermodynamics

The subject matter of each special topics course varies from semester to semester, depending on the interests of students and staff. Advanced topics and specialized topics will be discussed, particularly those of current interest.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 634: Advanced Topics in Kinematics and Dynamics of Machines

The subject matter of each special topics course varies from semester to semester, depending on the interests of students and staff. Advanced topics and specialized topics will be discussed, particularly those of current interest.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 635: Advanced Topics in Nonlinear Dynamic Systems

The subject matter of each special topics course varies from semester to semester, depending on the interests of students and staff. Advanced topics and specialized topics will be discussed, particularly those of current interest.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 636: Advanced Topics in Mechanical Vibration

The subject matter of each special topics course varies from semester to semester, depending on the interests of students and staff. Advanced topics and specialized topics will be discussed, particularly those of current interest.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 637: Special Topics in Precision Engineering

The subject matter of each special topics course varies from semester to semester, depending on the interests of students and staff. Advanced topics and specialized topics will be discussed, particularly those of current interest.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 641: Fracture Mechanics

The mechanics of brittle and ductile fracture in engineering materials are studied. Major subjects are linear elastic fracture, elastic-plastic fracture, and fatigue crack analysis. Topics also include stress intensity factor, energy release rate, J-integ.

Prerequisite: MEC 536,
Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 651: Advanced Finite Element Analysis

Finite element method for the analysis of continuous media. In-depth discussion of penalty method, integration techniques, and differential equation solvers. Computer implementation of finite element code in nonlinear elastic, elastic-plastic materials, and dynamic problems. Major topics are 2-D and 3D element formulations, stress update algorithms, Newton-Raphson iterative technique, and explicit/implicit time integration schemes.

Prerequisites: MEC 541, MEC 539
Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MEC 656: Aerospace Propulsion

Fundamentals of propulsion; performance parameters, thermodynamic cycles. Introduction to combustion and combustors. Performance and cycle analysis of various flight propulsion systems: turbojets, turbofans, ramjets, scramjets, rockets, propellers. Design of supersonic inlet nozzles, component matching and map.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 662: Advanced Vibration and Analysis

Principle and techniques of vibration analysis of structures and machines. Includes free and forced vibration responses of linear limped-parameter, multiple dof systems; model analysis of distributed, continuous systems; non-linear vibration analysis; random vibrations.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 691: Mechanical Engineering Seminar

This course is designed to expose students to cutting-edge research and development activities in mechanical engineering. Speakers are invited from both on and off campus. Fall and spring. 0 credits, S/U grading. May be repeated.

S/U grading
May be repeated for credit.

MEC 695: Mechanical Engineering Internship

Participation in off-campus engineering practice in private corporations, public agencies, or non-profit institutions as an intern. Students will be required to have a faculty adviser as well as a contact coordinator at the place of internship, to participate with them in regular consultations on the project, and to submit a final report to both and the Graduate Program Director. Credits from this course cannot be applied toward the MS and/or PhD degree. 1 credit, S/U grading. Offered Fall and Spring semesters

1 credit, S/U grading
May be repeated 3 times FOR credit.

MEC 696: Aerial Robotics

This hands-on course covers a broad range of topics related to aerial-robotics. There is a comparative analysis of the most common types of flying vehicles. A few of the most common control strategies such as cascaded control, dubins path, and flocking algorithms are covered as well. Lastly, we look at the latest work in both the scientific literature and industry. In particular, this course covers multicopters, fixedwings, flapping-wings, aerial swarms, perching, collision resilience, search & rescue, and flight testing. There are two hands-on projects, the first consists of searching a space for a safe landing point with a crazyflie quadcopter, and the second is navigation of a narrow passage with a fixed-wing robot. At the end of the class, the students will be able to critically evaluate existing aerial robotic systems, conceive new systems, and implement functional prototype vehicles.

3 credits, Letter graded (A, A-, B+, etc.)

MEC 696: Special Problems in Mechanical Engineering

Conducted jointly by graduate students and one or more members of the faculty.

1-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MEC 697: Practicum in Teaching I

Every TA must register for the course

Fall, Spring, S/U grading
May be repeated for credit.

MEC 698: Practicum in Teaching II

Practicum in teaching under faculty supervision

1-3 credits, S/U grading
May be repeated for credit.

MEC 699: Dissertation Research on Campus

Prerequisite: Advancement to candidacy (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.

Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

MEC 700: Dissertation Research off Campus - Domestic

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

MEC 701: Dissertation Research off Campus - International

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

MEC 800: Full Time Summer Research

May be repeated for credit.