

# MEC

## Mechanical Engineering

### MEC 100: Introduction to Mechanical Engineering

Introduction to the engineering experience in general and mechanical engineering in particular through lectures by faculty and invited speakers from industry, field trips, films and laboratory demonstrations. Lectures cover creative thinking and problem-solving, design team work, computer utilization, engineering ethics and legal issues, use of libraries and other sources of information, career opportunities in mechanical engineering and related fields, emerging technologies and the cross-disciplinary nature of engineering.

3 credits

### MEC 101: Freshman Design Innovation

This course presents an overview of the mechanical engineering profession, engineering ethics, basics of computation via correct usage of dimensions, units, and significant digits, and engineering documentation. Furthermore, this course introduces the students to the process of engineering design and provides a project-based design experience wherein the students design, build, and program a microcontroller driven autonomous mechatronic device. In doing so, they are provided an early exposure to the systematic approach to engineering problem solving that brings together fundamental concepts of forces, motions, energy, materials, manufacturing processes, and machines and mechanisms from mechanical engineering and basic electronics, sensing, actuation, and computer programming. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Pre- or co-requisites:* AMS 151 or MAT 125 or MAT 131 or MAT 141 or MPE level 4 or greater and PHY 125 or PHY 131 or PHY 141  
3 credits

### MEC 102: Engineering Computing and Problem Solving

Introduction to programming with MATLAB. Control structures, arrays and matrix operations, functions, object-oriented programming, interfacing MATLAB with other languages. Projects includes applications in solid mechanics, fluid mechanics, thermodynamics and heat transfer, control theory, and basic design concepts. Emphasizes the interpretation of previous analysis in terms of generating results, making quantitative comparisons, and assessing changes that

optimize or otherwise maximize the usefulness of the result.

*Prerequisite:* A grade of C or better in MEC 101 or CIV 101

2 credits

### MEC 104: Practical Science of Things

A practical introduction to the science and engineering of objects and phenomena in everyday life. The basic principles that underlie the operation common to modern devices such as rollercoasters, balloons, vacuum cleaners, airplanes, bicycles, thermostats, air conditioners and automobiles are developed by investigating how they work. The scientific method, engineering design methodology, safety, and environmental impacts are discussed in the context of these practical applications.

*Prerequisite:* Satisfaction of entry skill in mathematics requirement (Skill 1) or satisfactory completion of D.E.C. C or QPS

**DEC:** E

**SBC:** SNW, TECH

3 credits

### MEC 105: Everyday Science and Engineering

A practical introduction to the science and engineering of objects and phenomena in everyday life. The basic principles that underlie the operation common to modern devices such as xerographic copiers, tape recorders, computers, microwaves, lasers, CDs, plastics, nuclear weapons, and magnetic resonance imaging (MRI) are developed by investigating how they work. The scientific method, engineering design methodology, safety, and environmental impacts are discussed in the context of these practical applications.

*Prerequisite:* Satisfaction of entry skill in mathematics requirement (Skill 1) or satisfactory completion of D.E.C. C or QPS

**DEC:** E

**SBC:** SNW, TECH

3 credits

### MEC 203: Engineering Graphics and CAD

Introduces engineering graphics and its role in design process. Includes the principles of engineering drawing and sketching for mechanical design, the use of computer graphics and solid modeling in design representation of 3D objects, assembly and simulation as well as ASME standards on geometric dimensioning and tolerances. Includes hands-on experience in the use of

CAD software packages for engineering design. Engineering ethics.

3 credits

### MEC 214: Probability and Statistics for Mechanical Engineers

Foundations of probability and statistics as applied to mechanical measurements and experimentation. Basic statistical analysis of data and assessing likelihood of future events based on past history. Concept of random sampling. Uncertainty analysis and error propagation, using both analytical and graphical tools. Assessing dominant sources of error in measurements.

*Prerequisites:* MAT 126 or 131 or 141 or AMS 151

*Corequisites:* MAT 127 or 132 or 142 or 171 or AMS 161

1 credit

### MEC 220: Practical Electronics Mechanical Engineers

This is a lecture and laboratory course that will overview basic electronics from a practical level (versus a theoretical approach) to provide mechanical engineering students with the fundamentals to do basic electronics work needed for laboratories, subsequent courses and their professional careers.

*Prerequisites:* PHY127, PHY132, or PHY142  
3 credits

### MEC 225: Fundamentals of Machining Practices

Hands-on experience in the fundamentals of machining including metrology tools and devices, saw, sheet metal working, drilling, reaming, tapping, turning, boring, milling, and welding. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Pre- or Co-requisite:* MEC 203

*Prerequisite:* MEC major or permission of instructor

1 credit

### MEC 260: Engineering Statics

A review of vector algebra. Concept of force. Equilibrium of particles. Moments about points and lines, couples and equivalent force systems. Equilibrium of rigid bodies. Analysis of simple structures such as trusses, frames, and beams. Centroids, centers of gravity, and moments of inertia. Dry friction with applications to wedges, screws, and belts. Method of virtual work, potential energy, and stability.

*Prerequisite:* PHY 131 or 141 or 125

*Corequisite:* AMS 261 or MAT 203

3 credits

### MEC 262: Engineering Dynamics

Vectorial kinematics of particles in space, orthogonal coordinate systems. Relative and constrained motions of particles. Dynamics of particles and the systems of particles, equations of motion, energy and momentum methods. Collisions. Two- and three-dimensional kinematics and dynamics of rigid bodies. Moving frames and relative motion. Free, forced, and damped vibrations of particles and rigid bodies.

*Prerequisite:* A grade of "C" or better in MEC 260

3 credits

### MEC 280: Pollution and Human Health

An examination of major environmental pollution problems such electromagnetic radiation, ozone layer depletion, and global warming, with a specific focus on the resulting effects on human health. Assessment of health risks in relation to the formulation of environmental and workplace regulations is also considered.

*Prerequisite:* one D.E.C. E or SNW course

**DEC:** H

**SBC:** STAS

3 credits

### MEC 300: Technical Communication in Mechanical Engineering

Aims to ensure proficiency in the types of communication necessary for success in the engineering profession. Provides students with the ability to apply their knowledge of correct written and spoken English to the diverse modes of communication encountered and used by engineers in the professional workplace.

*Prerequisites:* WRT 102; MEC Major; U3 or U4

*Corequisite:* MEC 317

1 credit, S/U grading

### MEC 301: Thermodynamics

Variables that describe the thermodynamic state of a system or control volume, including absolute temperature, internal energy, enthalpy, and entropy are introduced, and basic principles governing the transformations of energy, especially heat and work, are developed. Underlying principles are used to analyze and solve problems related to thermodynamic systems and to determine the changes in properties of the systems and surroundings implied by changes in inputs, configuration, or constraints.

*Prerequisites:* AMS 261 or MAT 203; PHY 125 or 131 or 141; CHE 131; MEC Major

3 credits

### MEC 305: Heat and Mass Transfer

The fundamental laws of momentum, heat and mass transfer, and the corresponding transport coefficients. Principles of steady-state and transient heat conduction in solids are investigated. Laminar and turbulent boundary layer flows are treated, as well as thermal radiation, and radiation heat transfer between surfaces. Applications to heat transfer equipment are covered throughout the course.

*Prerequisites:* MEC 301 and 364; MEC 102, or ESG 111, or ESE 124, or CSE 114 or 130 or BME 120

3 credits

### MEC 310: Introduction to Machine Design

Application of graphical and analytical methods to the analysis and synthesis of mechanism. Covers concepts of degrees of freedom, graphical and analytical linkage synthesis, position, velocity, acceleration, and force analysis of linkage mechanisms. Introduces principles behind the operation of various machine elements such as gears and gear trains, cams, flywheels and their design, and analysis techniques.

*Prerequisites:* MEC 102 or CSE 114 or 130 or ESG 111 or BME 120; C or better in MEC 262 (or BME 260 for BME majors)

*Pre- or Corequisite:* MEC 203 (ESG 316 for ESG majors)

3 credits

### MEC 316: Mechanical Engineering Lab I: Sensors and Instrumentation

The spatial and temporal resolution of modern instrumentation and sensors that are particular to mechanical engineering. Concepts of static and dynamic response as well as probability, statistics, and the statistical analysis of data are discussed. Includes basic circuit components. Laboratory safety. Students learn to operate instruments for measuring temperature, pressure, flow velocity, displacement, angle, acceleration, and strain. Design project. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Prerequisites:* MEC major; C or better in MEC 363; AMS 361 or MAT 303; PHY 134

*Corequisites:* MEC 214; MEC 220 or ESE 271; MEC 301 and MEC 364

**SBC:** TECH

2 credits

### MEC 317: Mechanical Engineering Laboratory II

Hands-on experience in solid and fluid mechanics and heat transfer. Emphasis is on the understanding of fundamental principles as well as familiarity with modern experimentation. Lectures at the beginning of the course provide background information and theories of experimentation. Student groups perform four experiments each in solid mechanics and in fluid mechanics and heat transfer. Report writing is an integral part of the course, with emphasis on design of experiment, interpretation and presentation of data, error analysis, and conclusions. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Prerequisites:* MEC 316 and 364

*Corequisite:* MEC 305 and MEC 300

**SBC:** TECH

2 credits

### MEC 320: Numerical Methods in Engineering Design and Analysis

This course emphasizes the implementation of numerical methods for computer-aided solutions to the problems that arise in engineering design and analysis. Methods include interpolation, extrapolation, curve fitting, and integration and techniques solving non-linear equations, systems of linear equations, and differential equations. Optimization in engineering design is covered from the formulation of design specifications and criteria, to analyzable models, through to numerical implementation.

*Prerequisites:* MEC 102 or CSE 114 or CSE 130 or 130 or ESG 111 or ESE 124 or BME 120; AMS 261 or MAT 203; AMS 361 or MAT 303

3 credits

### MEC 325: Manufacturing Processes

The relationship between product design and manufacturing. Materials properties and influence. Introduces traditional and nontraditional manufacturing processes and their capabilities and limitations. Measurement inspection, reliability, and quality engineering. Economic impact of modern process engineering. Hands-on experience in various manufacturing machines and processes.

*Pre- or Corequisite:* MEC 225

3 credits

### MEC 363: Mechanics of Solids

Stress and deformation of engineering structures and the influence of the mechanical behavior of materials. Concepts of stress

and strain, constitutive relations, analysis of statically indeterminate systems, study of simple bars and beams, and stability conditions. Emphasis on force equilibrium, elastic response of materials, geometric compatibility, Mohr's circle, stresses and deflections in beams, and torsion and buckling of rods. Design for bending, shear, and combined states of stress.

*Prerequisite: A grade of "C" or better in MEC 260 or BME 260*

3 credits

### **MEC 364: Introduction to Fluid Mechanics**

Fundamental properties of fluids and their conservation laws with applications to the design and evaluation of flows of engineering interest. Topics include hydrostatics, surface tension, dimensional analysis and dynamic similitude, Euler's equation, rotating coordinate systems, boundary layers, lubrication, drag on immersed bodies, open channel and pipe flows, and turbomachinery.

*Prerequisite: PHY 126 or PHY 131; MEC 262; MEC or CIV Major*

3 credits

### **MEC 393: Engineering Fluid Mechanics**

The application of the principles of fluid mechanics to important areas of engineering practice such as turbomachinery, hydraulics, and wave propagation. Prepares students for advanced coursework in fluid dynamics. Extends the study of viscous effects, compressibility, and inertia begun in MEC 364.

*Prerequisite: MEC 364*

3 credits

### **MEC 398: Thermodynamics II**

Psychrometrics and psychrometric charts. Thermodynamic considerations for the design and performance of cooling towers, humidifiers, and dehumidifiers. Reacting mixtures, combustion, and chemical equilibrium. Thermodynamics of fluid flow, simple compression, and expansion processes. Analysis and design of gas and vapor power cycles. Cycles with reheat, intercooling, and cogeneration plants. Refrigeration cycles.

*Prerequisites: MEC 301 and 364*

3 credits

### **MEC 402: Mechanical Vibrations**

Modeling, analysis and design for mechanical vibrations. Fundamentals of free vibration, harmonically excited vibration and vibration under general forcing conditions are considered for one degree, two degree and

multidegree of freedom systems; continuous systems; vibration design strategies including isolation and absorbers.

*Prerequisites: MEC 262 and 363*

3 credits

### **MEC 410: Design of Machine Elements**

Application of analytical methods, material science, and mechanics to problems in design and analysis of machine components. Includes the design of mechanical components such as bearings, gears, shafting, springs, fasteners, belts, clutches, and brakes, and takes into consideration factors such as manufacturability and reliability. Design projects with open-ended and interactive problems are assigned to integrate several machine elements in a system.

*Prerequisites: MEC 310 and 363*

3 credits

### **MEC 411: Control System Analysis and Design**

Analysis and design of feedback control systems. Topics include system modeling; transfer function; block diagram and signal-flow graph; sensors, actuators, and control circuit design; control system characteristics and performance; stability analysis; root locus method; Bode diagram; PID and lead-lag compensator design.

*Prerequisites: MEC 262; MEC 316; AMS 361 or MAT 303*

4 credits

### **MEC 422: Thermal System Design**

Device design and system design. Quantitative data for system design including operating characteristics of compressors, turbines, heat exchangers, piping systems, internal combustion engines, and other component equipment. Component matching and system simulation. Optimization including thermoeconomic evaluation and energy analysis. Case studies: refrigeration and air conditioning systems, combined cycles, steam-injected gas turbines.

*Prerequisite: MEC 305*

3 credits

### **MEC 423: Internal Combustion Engines**

Introduction to internal combustion engines and their operation. Analytical approach to the engineering problem and performance analysis of internal combustion engines. Topics include thermodynamics fundamentals; fuel-air cycle analysis; engine combustion; emission formation and control strategies. Includes both the relevant fundamental concepts and the extensive practical knowledge base on which

engine research, development, and design depend. Not for credit in addition to MEC 523.

*Prerequisite: MEC 305*

3 credits

### **MEC 440: Mechanical Engineering Design I**

Part I of the two-semester capstone design project sequence. Senior students select a project with multiple realistic constraints, develop the necessary technical background, and write a proposal, progress reports, and a preliminary design report. Includes an oral presentation on the development and progress of the project. Not counted as a technical elective. The final grade will be assigned at the end of the two course sequence MEC 440-MEC 441. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Prerequisites: MEC 225 or 125, MEC 310, 320, and 325; MEC major; U4 standing*

*Corequisites: MEC 300, 317, 410 and 411*

3 credits

### **MEC 441: Mechanical Engineering Design II**

Part II of the two-semester capstone design project sequence. Students complete the project design, incorporating engineering standards, build and test a prototype, write a mid-term report and a final design report, and give an oral presentation. Not counted as a technical elective. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Prerequisite: MEC 440*

3 credits

### **MEC 442: Introduction to Experimental Stress Analysis**

The concepts of three-dimensional stress and strain, their transformation laws, and their mutual relationships are discussed in detail. Results from theory of elasticity as pertinent to experimental stress analysis are also presented. Experimental techniques studied include two-dimensional photoelasticity, resistance strain gauge, moire method, brittle coating, and analog methods. The application of different techniques to the measurement of stress and strain in models as well as actual structures is demonstrated. Students form small groups and each group is assigned different laboratory projects to gain experience in various experimental stress analysis methods. Previously offered as MEC 342.

*Prerequisite: MEC 363*

3 credits

**MEC 450: 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 is provided through integrated lab activities.

*Prerequisites: MEC 310; 316; 411*

3 credits

**MEC 455: Applied Stress Analysis**

A study of linear elastic solids with emphasis on internal stress analysis. Simple boundary value problems at plane structures are analyzed with various solution techniques. Major topics are stress and strain tensors, linear elasticity, principle of virtual work, torsion, stress functions, stress concentration, elementary fracture, and plasticity.

*Prerequisite: MEC 363*

3 credits

**MEC 456: 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.

*Prerequisite: MEC 363*

3 credits

**MEC 457: Engineering 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.

*Prerequisite: MEC 363*

3 credits

**MEC 464: Fundamentals of Aerodynamics**

Kinematics and dynamics of incompressible irrotational flow; stream function and the potential function; Euler and Bernoulli equations. Thin-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.

*Prerequisites: MEC 305; MEC 310; MEC 364*

3 credits

**MEC 465: 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 and propellers. Design of supersonic inlet nozzles, component matching and map.

*Prerequisites: MEC 305; MEC 310; MEC 364*

3 credits

**MEC 470: Introduction to 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.

*Prerequisites: MEC 363 and 364*

3 credits

**MEC 475: Undergraduate Teaching Practicum**

Students assist the faculty in teaching by conducting recitation or laboratory sections that supplement a lecture course. The student receives regularly scheduled supervision from the faculty instructor. May be used as an open elective only and repeated once.

*Prerequisites: U4 standing; a minimum g.p.a. of 3.00 in all Stony Brook courses and the grade of B or better in the course in which the student is to assist; permission of department*

**SBC: EXP+**

3 credits

**MEC 488: Mechanical Engineering Internship**

Participation in off-campus engineering practice. Students are required to submit a proposal to the department at the time of registration and two term reports before the end of the semester. May be repeated up to a limit of 12 credits.

*Prerequisite: Permission of undergraduate program director*

**SBC: EXP+**

3-9 credits, S/U grading

**MEC 491: Topics in Mechanical Engineering**

Treatment of an area of mechanical engineering that expands upon the undergraduate curriculum. Topics may include advanced material in a specialty, development of a specialized experimental technique, or a specific area of design. Topics may vary from semester to semester. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated as the topic changes.

*Prerequisite: U3 or U4 standing in a B.E. degree major; permission of department (course prerequisites vary with topic)*

1-4 credits

**MEC 492: Topics in Mechanical Engineering**

Treatment of an area of mechanical engineering that expands upon the undergraduate curriculum. Topics may include advanced material in a specialty, development of a specialized experimental technique, or a specific area of design. Topics may vary from semester to semester. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated as the topic changes.

*Prerequisite: U3 or U4 standing in a B.E. degree major; permission of department (course prerequisites vary with topic)*

1-4 credits

**MEC 495: Professional Engineering Seminar**

Prepares the student to enter the workplace as a practicing engineer. Topics include professional ethics, professional activities, professional engineering licensing, patents,

seeking entry-level employment, and exposure to the engineering work environment. Aids in preparation for the EIT/FE exam. Includes speakers from a variety of disciplines, within the College and from industry.

*Prerequisites: CEAS major; U4 standing*

*1 credit, S/U grading*

**MEC 499: Research in Mechanical Engineering**

An independent research project under the supervision of a mechanical engineering faculty member. Permission to register requires the agreement of the faculty member to supervise the research and submission of a one-page research proposal. May be repeated but only six credits of research electives may be counted as technical electives.

*Prerequisite: Permission of department*

*0-3 credits*