

# MECHANICAL ENGINEERING (ME)

## ME 2320 Statics (3)

Pre-requisite(s): A grade of C or better in MTH 1321; a grade of B or better in EGR 1302; a grade of C or better or concurrent enrollment in PHY 1420  
Study of forces, moments, free-body diagrams, friction, equilibrium, first and second moments of lines, centers of pressure, mass and gravity, and moments of inertia.

## ME 2321 Dynamics (3)

Pre-requisite(s): A grade of C or better in ME 2320, PHY 1420 and MTH 1322

Kinematics and kinetics of particles and rigid bodies including Newton's Second Law, work-energy methods, impulse-momentum, and central and oblique impact.

## ME 2345 Thermodynamics (3)

Pre-requisite(s): A grade of C or better in MTH 1322; a grade of B or better in EGR 1302

Thermodynamic properties, heat and work, first and second laws, processes, ideal and non-ideal cycles.

## ME 3122 Materials and Manufacturing Processes Lab (1)

Pre-requisite(s): A grade of C or better in both ME 3320 and ME 3420 and a grade of C or better or concurrent enrollment in ME 3322

Laboratory experiments in strength of materials, property of materials, and manufacturing processes. Application of statistics and probability to material properties and manufacturing.

## ME 3145 Thermal/Fluids Laboratory (1)

Pre-requisite(s): A grade of C or better in ME 3420 and a grade of C or better or concurrent enrollment in ME 3321

Laboratory measurements of devices and systems in thermodynamics and fluid mechanics. Physics and operation of temperature, pressure, and flowrate measurement devices, and application of measurement concepts to analyzing the performance of pumps, pipe networks, airfoils, and thermodynamic cycles.

## ME 3320 Strength of Materials (3)

Pre-requisite(s): A grade of C or better in ME 2320 and MTH 2321  
Introduction of stress and strain, stress transformations, analysis of stresses, strain, and deflections in axial members, beams, and torsional shafts. Analysis of pressure vessels.

## ME 3321 Fluid Mechanics (3)

Pre-requisite(s): A grade of C or better in ME 2345 and MTH 3325  
Introductory concepts of fluid motions, fluid statics, control volume forms of basic principles, and applications basic principles of fluid mechanics to problems in viscous and compressible flow.

## ME 3322 Mechanical Engineering Materials and Manufacturing Processes (3)

Pre-requisite(s): A grade of C or better in CHE 1301 and ME 3320  
Properties of the principal families of materials used in mechanical engineering design with an introduction to the manufacturing processes used to convert these materials into finished products.

## ME 3323 Machine Design (3)

Pre-requisite(s): A grade of C or better or concurrent enrollment in ME 3322

The fundamentals of machine elements in mechanical design. Includes the analysis of components under static and fatigue loadings, and the analysis, properties, and selection of machine elements such as shafts, gears, belts, chains, brakes, clutches, bearings, screw drives, and fasteners.

## ME 3345 Thermodynamics II (3)

Pre-requisite(s): A grade of C or better in ME 2345

Second law analysis, gas power cycles, vapor power cycles, refrigeration cycles, property relations, gas mixtures, gas-vapor mixtures, combustion, design of cycles. (3-0)

## ME 3420 Instrumentation and Measurements (4)

Pre-requisite(s): A grade of C or better in ELC 2320 or ELC 2330 and a grade of C or better in ME 2345 and STA 3381

Introductory mechanical engineering laboratory experience: measurement system concepts, statistical and uncertainty analyses, survey of measurement devices, experimental design and planning.

## ME 4305 Sustainable Engineering (3)

Pre-requisite(s): A grade of C or better in EGR 3380

This is an introduction to the context, concepts, and practice of sustainable engineering, and the importance of sustainable systems in the modern world. Topics will include an overview of resources and sustainability, technological systems, complexity, industrial ecology, green design principles, and life cycle assessment.

## ME 4320 Computer-Aided Structural Analysis (3)

Pre-requisite(s): A grade of C or better in ME 3320

Structural analysis using the matrix stiffness method with applications to 2-dimensional and 3-dimensional beams, trusses and plates.

## ME 4322 Computer-Aided Engineering and Design (3)

Pre-requisite(s): A grade of C or better in EGR 3380

Design and analysis of engineering components and systems using interactive computer programs with emphasis on computer simulation.

## ME 4323 Mechanical Vibrations (3)

Pre-requisite(s): A grade of C or better in ME 2321, ME 3320 and MTH 3325

The theory and analysis of vibrating systems including single and multi-degrees of freedom, free and forced, vibrations, with and without damping.

## ME 4324 Introduction to Finite Element Methods (3)

Co-requisite(s):

Pre-requisite(s): A grade of C or better in MTH 3325

Introduction to the basic theory and techniques of finite element analysis beginning from energy concepts and the foundational constitutive equations. Engineering applications will focus on one- and two-dimensional formulations for classical beams, frames, trusses and electrical network applications. Introduction to typical workflow of finite element analysis using modern computer technologies.

## ME 4325 Dynamic Systems (3)

Pre-requisite(s): A grade of C or better in ME 2321, MTH 2311, and MTH 3325 and a grade of C or better or concurrent enrollment in ME 4327

Theory, analysis and simulation of dynamic systems including application of Newton's Laws and conservation of energy to model single and multiple degree-of-freedom mechanical and other dynamic engineering systems. Solutions obtained using advanced engineering mathematics and computational software.

**ME 4327 Numerical Methods for Engineers (3)**

Pre-requisite(s): A grade of C or better in ME 2321, MTH 2311 and MTH 3325

Introduction to engineering computational methods for design, from theory to algorithm to implementation. The course will discuss the following numerical methods from the engineering design perspective: roots of equations, optimization, linear systems, integration and differentiation, curve-fitting, and systems of ordinary differential equations.

**ME 4330 Introduction to Robotics (3)**

Cross-listed as ELC 4330

See ELC 4330 for course information.

**ME 4335 Mechanical Engineering Laboratory (3)**

Pre-requisite(s): A grade of C or better in ME 3345, ME 4345, PWR 3300, and STA 3381

Measurement of fluid flow, heat transfer, power and other properties of mechanical equipment. Design of experiments, selection and use of data acquisition systems, data reporting and presentation.

**ME 4336 Thermal Systems Design (3)**

Pre-requisite(s): A grade of C or better in or concurrent enrollment in ME 4345

Design and analysis of thermal energy systems such as pipe networks, HVAC systems, and steam power plants. Specification of energy system components such as pumps, pipes, control valves, and heat exchangers.

**ME 4337 Introduction to Computational Fluid Dynamics (3)**

Pre-requisite(s): A grade of C or better in ME 3321

Study of numerical methods tailored to solve thermo-fluids governing equations. Classification of partial differential equation (PDE). Finite difference method. Basic concepts of discretization, consistency, and stability. Applications of numerical methods to selected model PDE. Numerical methods for inviscid flow, boundary-layer flow, and the Navier-Stokes equations. supersonic compressible and subsonic incompressible flows.

**ME 4339 Tribology (3)**

Pre-requisite(s): A grade of C or better in ME 3321

Experimental, analytical, and computational analysis of tribology, which is the study of friction, lubrication, wear, and fatigue between contacting and sliding surfaces. Topics include the nature of rough surfaces, contact mechanics between nonconformal and nominally-flat surfaces, nature of friction, lubricants and lubrication theory, and surface damage and fatigue. Computational analyses of surfaces and lubricant flow will be performed using Python.

**ME 4344 Composite Materials (3)**

Pre-requisite(s): A grade of C or better in ME 3322

Introduction to advanced fiber-reinforced composite materials for engineering design. Topics include applications, material properties, stress analysis techniques, failure theories, and design methodologies.

**ME 4345 Heat Transfer (3)**

Pre-requisite(s): A grade of C or better in ME 3321

Steady and unsteady heat conduction including numerical solutions, thermal boundary layer concepts and applications to free and forced convection. Thermal radiation concepts. Heat exchanger design.

**ME 4346 Introduction to Aeronautics (3)**

Pre-requisite(s): A grade of C or better in ME 2321 and a grade of C or better or concurrent enrollment in ME 2345

Introduces the applied science of atmospheric flight. The course teaches about airplanes and how they fly from a design and application perspective. Included are topics in fluid dynamics, airfoil and wing theory, aircraft performance, stability, and aircraft design.

**ME 4347 Analysis and Design of Propulsion Systems (3)**

Pre-requisite(s): A grade of C or better in ME 3321 and ME 2345

Introduction to compressible flow, including flows with simple area change, heat addition, friction, and shock waves. Analysis, parametric design, and performance of ramjets, turbojets, turbofans, and turboprops. Introduction to the operating principles of major engine components. Introduction to rockets.

**ME 4349 Aircraft Structural Analysis (3)**

Pre-requisite(s): A grade of C or better in ME 3320 and ME 3322

Introduction to aircraft structures, including semi-monocoque and thin-walled structures, and the analysis techniques for these specialized structures. Understand the basis for airworthiness certification, aircraft loads, and design considerations in aerospace structures. Topics include elasticity, torsion, bending and shear stresses in thin walled structures; shear flow, and shear center.

**ME 4350 Aircraft Flight Dynamics and Control (3)**

Pre-requisite(s): C or better in ME 4346 and ME 4325

Development of aircraft equations of motion. Examination of aircraft dynamic modes based on both limited and full degree of freedom models utilizing analytical and numerical methods. Aircraft design considerations. Determination and evaluation of aircraft flying qualities. Application of control system theory to the design of aircraft stability augmentation systems and autopilots.

**ME 4356 Introduction to Space Flight (3)**

An interdisciplinary introduction to the basics, concepts, methods, and applications of space flight. Topics include fundamental principles, history, space environment, orbital mechanics, launch vehicles, propulsion systems, spacecraft (e.g., satellites, probes, space stations), applications (Earth observation, astronomy, interplanetary exploration, commercial utilization), international space efforts, regulations, and future activities.

**ME 4357 Cardiovascular Engineering and Instrumentation (3)**

Cross-listed as BME 4357, EGR 4357, ELC 4357

See BME 4357 for course information.

**ME 4360 Renewable Energy Devices (3)**

Cross-listed as EGR 4360

Pre-requisite(s): A grade of C or better in ELC 2320 or ELC 2330

Introduction to the basic concepts, principles, potential, and limitations of several energy conversion and storage devices with a focus on solar cells, fuel cells, batteries, inverters, wind power, and hydropower with real world examples. Design and/or application of various renewable energy sources, materials, and devices.

**ME 4364 Introduction to Additive Manufacturing (3)**

Co-requisite(s):

Pre-requisite(s): A grade of C or better or concurrent enrollment in ME 3322

This course introduces various aspects of additive manufacturing, which has become prominent in industry over the past two decades. The aim of this course is to give the students a basic understanding of additive manufacturing and its use in design, both for rapid prototyping and for functional manufacturing. Specifically, this course will highlight the advances that additive manufacturing makes upon traditional manufacturing techniques.

**ME 4377 Solar Energy (3)**

Cross-listed as ELC 4377

See ELC 4377 for course information.

**ME 4382 Selection of Materials and Manufacturing Processes in Design (3)**

Pre-requisite(s): A grade of C or better in ME 3320, ME 3322, and ME 3323

Systematic approach for selection of materials and manufacturing process in design that balances performance requirements with cost of materials and manufacturing. Material properties, manufacturing processes and types of materials. Advanced computer software and case studies are used to illustrate application of principles.

**ME 4384 Engineering with Plastics (3)**

Pre-requisite(s): A grade of C or better in ME 3322

Introduction to engineering plastics, including manufacturing process and mechanical properties, elastic and viscoelastic behavior of polymers and polymeric composites, predicting long-term behavior from short-term tests using time-temperature-superposition, relating chemical structure to mechanical properties for thermosets and amorphous or semi-crystalline thermoplastics, environmental stress cracking in polymers, relating processing to mechanical properties, introduction to injection molding, extrusion, thermoforming, compression molding, and blow molding.

**ME 4385 Failure Analysis and Product Liability (3)**

Pre-requisite(s): A grade of C or better in ME 3322

How components and systems fail; how to determine the probable cause of specific failures; practical skills to do failure analyses; product liability as it applies to product failures and litigation. Class time and homework assignment will use principally a case studies approach.

**ME 4386 Properties and Processing of Electronic Materials (3)**

Pre-requisite(s): A grade of C or better in ME 3322

Modern microelectronic technologies utilize the electrical, magnetic and optical properties of materials to develop new devices for a wide variety of cutting edge applications. A strong foundation in materials physics and chemistry helps engineers/scientists to understand these properties. The course will highlight: 1) structure-property relationships and 2) materials used for various electronic and optoelectronic device applications.

**ME 4388 Corrosion and Sustainable Metallurgy (3)**

Pre-requisite(s): A grade of C or better in ME 3322

Introduction to the eight forms of corrosion. Sustainable engineering concepts, with an emphasis on metallic materials. Alternative metallic designs. Course will culminate in a sustainable materials design project.

**ME 4396 Special Topics in Mechanical Engineering (3)**

Pre-requisite(s): Consent of Department Chair

Study of advanced topics in mechanical engineering. This course may be repeated once under a different topic.

**ME 4V97 Special Projects in Mechanical Engineering (1-6)**

Pre-requisite(s): Consent of department chair

Advanced topics and/or special project activities in Mechanical Engineering.