

# Mechanical Engineering (ME)

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## Courses

### ME A203 Machine Design I 3 Credits

Covers the use of solid modeling software to produce three-dimensional parts and assemblies, and two-dimensional engineering drawings. Introduces the concept of parametric modeling as a means to capture and maintain design intent. Covers fabrication techniques used to make machine elements, including an introduction to tolerances and stack-up analysis. Introduces the use of the finite element method to perform stress analysis.

**Prerequisites:** ES A106 with a minimum grade of C or (ENGR A105A with a minimum grade of C and ENGR A105B with a minimum grade of C).

### ME A280 Solid Modeling for Engineers 3 Credits

Introduces the use of solid modeling in engineering. Covers the process of creating solid parts, assemblies and fabrication-ready drawings in addition to kinematics linkages. Rapid prototyping technologies such as three-dimensional printing will be used as laboratory exercises.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering.

**Prerequisites:** ES A106 with a minimum grade of C or (ENGR A105A with a minimum grade of C and ENGR A105B with a minimum grade of C).

### ME A303 Machine Design II 3 Credits

Covers the analysis and design of mechanisms using graphical kinematics. Provides an intermediate examination of manufacturing techniques used for large-scale production of machine components. Introduces the geometric dimensioning and tolerancing (GD&T) system standardized by ASME Y14.5. Teaches analytical and numerical techniques for the analysis of beams, pressure vessels, and welded joints, including the estimation of loads and application of failure criteria. Introduces principles of fracture mechanics to facilitate the prediction of brittle failure.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering.

**Prerequisites:** ES A210 with a minimum grade of C and ES A261 with a minimum grade of C and ES A331 with a minimum grade of C or concurrent enrollment and ME A203 with a minimum grade of C and ME A334 with a minimum grade of C or concurrent enrollment.

### ME A306 Dynamics of Systems 3 Credits

Modeling of mechanical, electrical, fluid and thermal elements and systems. Study of free and forced response by the Laplace transform, transfer function and state space models. Time domain and frequency domain responses. Coupled systems, system analogy, sensing and actuation principles.

**Crosslisted With:** EE A306

**Prerequisites:** (EE A203 with a minimum grade of C or concurrent enrollment or ES A309 with a minimum grade of C or concurrent enrollment) and ES A210 with a minimum grade of C and MATH A302 with a minimum grade of C.

### ME A308 Instrumentation and Measurement 3 Credits

Principles of measurement, instrumentation, Laplace transform, Fourier series, transfer function, steady-state response, calibration, and errors. Signal filtering and amplification, data acquisition, recording, and processing. Methods and devices for measuring strain, force, torque, displacement, velocity, acceleration, pressure, fluid flow properties, and temperature.

**Crosslisted With:** EE A308.

**Prerequisites:** MATH A302 with a minimum grade of C and (EE A306 with a minimum grade of C or ME A306 with a minimum grade of C or EE A353 with a minimum grade of C).

### ME A313 Mechanical Engineering Thermodynamics 3 Credits

Continuation of ES A346 (or ES F346), with topics that include power and refrigeration cycles (Rankine, Brayton, Otto, and Diesel), compressible flow (isentropic, shock waves, and flow in ducts with friction), combustion, and gas vapor mixtures.

**Prerequisites:** ES A346 with a minimum grade of C.

### ME A334 Materials Science 3 Credits

Study and investigate the processing, structures, properties and performance of materials including metals, ceramics, polymers, and composites. Covers materials design and selection for engineering applications.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering

**Prerequisites:** CHEM A105 with a minimum grade of C and ME A334L with a minimum grade of C or concurrent enrollment and PHYS A212 with a minimum grade of C.

### ME A334L Materials Science Laboratory 1 Credit

Provides laboratory instruction and experience in the structures, processing, properties, and performance of materials.

**Prerequisites:** ME A334 with a minimum grade of C or concurrent enrollment and (WRTG A211 with a minimum grade of C or WRTG A212 with a minimum grade of C or WRTG A213 with a minimum grade of C or WRTG A214 with a minimum grade of C or WRTG A2W with a minimum grade of C).

### ME A341L Fluid Mechanics Lab 1 Credit

Provides supplemental explanation and practical exercises applying physical properties and behavior of fluids for mechanical engineering majors, including hydrostatics, fluid forces, pipe flow, fluid machinery, and flow through a wind tunnel.

**Prerequisites:** ES A341 with a minimum grade of C or concurrent enrollment and (WRTG A211 with a minimum grade of C or WRTG A212 with a minimum grade of C or WRTG A213 with a minimum grade of C or WRTG A214 with a minimum grade of C or WRTG A2W with a minimum grade of C).

### ME A403 Machine Design III 3 Credits

Introduces methods for analyzing damage evolution in components subjected to cyclic loading conditions. Teaches analytical and numerical techniques for the analysis of non-permanent joints, shafts, bearings, gears, clutches, brakes, couplings, springs, belts, and chains. Provides an overview of the typical applications and design considerations associated with the aforementioned machine elements.

**Prerequisites:** ES A331 with a minimum grade of C and MATH A302 with a minimum grade of C and ME A303 with a minimum grade of C and ME A334 with a minimum grade of C.

**ME A408 Mechanical Vibrations 3 Credits**

Modeling of vibratory mechanical systems with single and multiple degrees of freedom. Study of free and forced vibrations with or without damping by lumped-parameter methods and finite element analysis. Vibrations of rotor systems and vibration monitoring.

**Special Note:** Not available for credit to students who have completed ME A608.

**May Be Stacked With:** ME A608

**Prerequisites:** (EE A306 with a minimum grade of C or ME A306 with a minimum grade of C) and ES A331 with a minimum grade of C.

**ME A414 Thermal System Design 3 Credits**

Introduces the design of power and space conditioning systems, energy conversion, heating, ventilating, air conditioning, refrigeration (HVAC&R), and steady-state simulation of thermal systems.

**Prerequisites:** ES A341 with a minimum grade of C and ES A346 with a minimum grade of C.

**ME A414L Thermal System Design Lab 1 Credit**

Provides supplemental explanation and practical exercises applying heat and mass transfer concepts to engineering problems including steady state and transient conduction. Provides supplemental explanation and practical exercises applying thermal system design and heating, ventilation and air conditioning (HVAC) concepts including refrigeration systems, psychrometric applications, air handling unit designs, pipe and pump designs, and fan and air distribution designs.

**Prerequisites:** ME A414 with a minimum grade of C or concurrent enrollment and ME A441 with a minimum grade of C or concurrent enrollment and (WRTG A211 with a minimum grade of C or WRTG A212 with a minimum grade of C or WRTG A213 with a minimum grade of C or WRTG A214 with a minimum grade of C or WRTG A2W with a minimum grade of C).

**ME A415 Composite Materials 3 Credits**

Presents the mechanics and manufacturing of composite materials and their applications. Considers the analysis, design, processing/fabrication, repair, and evaluation of composite materials and structures.

**Special Note:** Not available for credit to students who have completed ME A615.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering

**May Be Stacked With:** ME A615

**Prerequisites:** ES A331 with a minimum grade of C and MATH A302 with a minimum grade of C.

**ME A420 Automotive Engineering 3 Credits**

Introduces the design and manufacturability of automotive systems including the vehicle powerplant, drivetrain, suspension and frame.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering

**Prerequisites:** (EE A306 with a minimum grade of C or ME A306 with a minimum grade of C) and ES A331 with a minimum grade of C and ME A303 with a minimum grade of C.

**ME A421 Engineering Finite Element Analysis 3 Credits**

Covers the mathematical formulation of the finite element analysis (FEA) method; elemental matrices, nodal loads, assembly, and solution of finite element problems; static, modal, and dynamic solid-mechanics FEA problems; heat transfer, fluid mechanics, and electromagnetic FEA problems; and FEA software: preprocessing, processing, and postprocessing.

**Special Note:** Not available for credit to students who have completed ME A621. Recommended for students to take MATH A314.

**May Be Stacked With:** ME A621

**Prerequisites:** ES A210 with a minimum grade of C and ES A331 with a minimum grade of C and ES A341 with a minimum grade of C and ES A346 with a minimum grade of C.

**ME A432 Analytical Dynamics 3 Credits**

Kinematics and kinetics of rigid bodies, introduction to analytical mechanics, Lagrange's equations and Hamiltonian mechanics. Applications to engineering problems.

**Special Note:** Not available for credit to students who have completed ME A632.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering.

**May Be Stacked With:** ME A632

**Prerequisites:** ES A210 with a minimum grade of C and MATH A302 with a minimum grade of C.

**ME A434 Materials Selection for Design 3 Credits**

Evaluates materials selection early in the design process and the associated design degrees of freedom. Covers procedures to select optimum material(s) under multiple constraints resulting from functional, reliability, safety, cost and environmental issues.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering

**Prerequisites:** ES A331 with a minimum grade of C and ME A334 with a minimum grade of C.

**ME A438 Design of Mechanical Engineering Systems 3 Credits**

Capstone course in which mechanical engineering students design a mechanical engineering component or system starting with the initial design specification to the implementation and testing. Students apply knowledge and skills learned in their undergraduate curriculum.

**Registration Restrictions:** Student must be in senior year of BSME degree program or obtain faculty permission. Completion of GER Tier 1 (basic college-level skills) courses.

**Prerequisites:** ME A403 with a minimum grade of C or concurrent enrollment.

**Attributes:** UAA Integrative Capstone GER.

**ME A441 Heat and Mass Transfer 3 Credits**

Application of heat and mass transfer concepts to engineering problems including steady state and transient conduction, numerical analysis of heat transfer problems, laminar and turbulent free and forced convection, and black body and real surface radiation.

**Prerequisites:** ES A341 with a minimum grade of C and ES A346 with a minimum grade of C and MATH A302 with a minimum grade of C.

**ME A441L Heat and Mass Transfer Lab 1 Credit**

Provides supplemental explanation and practical exercises applying heat and mass transfer concepts to engineering problems including steady state and transient conduction, numerical analysis of heat transfer problems, laminar and turbulent free and forced convection, and black body and real surface radiation.

**Prerequisites:** ME A441 with a minimum grade of C or concurrent enrollment.

**ME A442 Advanced Fluid Mechanics 3 Credits**

Covers advanced topics in fluid mechanics, including derivation of flow equations, ideal fluid flows, incompressible viscous flows and compressible inviscid flows.

**Special Note:** Not available for credit to students who have completed ME A642.

**May Be Stacked With:** ME A642

**Prerequisites:** ES A341 with a minimum grade of C and MATH A302 with a minimum grade of C.

**ME A451 Aerodynamics 3 Credits**

Covers fundamentals of aerodynamics including boundary layer theories, aerodynamics of lifting flow over airfoils, wings of finite span and airfoil theory in subsonic, transonic, and supersonic flows.

**Special Note:** Not available for credit to students who have completed ME A651.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering

**May Be Stacked With:** ME A651

**Prerequisites:** ES A341 with a minimum grade of C and ES A346 with a minimum grade of C and MATH A302 with a minimum grade of C.

**ME A452 Introduction to Astrodynamics 3 Credits**

Provides basic gravitation and orbital theory principles for spacecraft mission design. Includes maneuvers and mission profiles, orbit perturbations, trajectories, and selecting optimal orbit, rendezvous, and transfers to accomplish the ultimate goals of the mission. Reviews particle dynamics, classical orbital elements, fundamental transformation matrices, ground tracks, Hohmann transfer, and coplanar rendezvous.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering

**Prerequisites:** EE A306 with a minimum grade of C or ME A306 with a minimum grade of C.

**ME A454 Manufacturing Design 3 Credits**

Covers the capabilities and limitations of different manufacturing processes in terms of their feasibility, capital needs, economic considerations, and environmental impact. Analyzes the steps in processing a part and taking into account the geometrical complexity, process capabilities, surface finish, and tolerances for assembly. Design parts for machining, molding, casting, and sheet metal operations. Introduces methods for applied design for manufacturing and assembly.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering

**Prerequisites:** ES A331 with a minimum grade of C and ME A203 with a minimum grade of C and ME A334 with a minimum grade of C.

**ME A455 HVAC Systems Optimization 3 Credits**

Design of heating, ventilation, and air-conditioning (HVAC) systems with emphasis on economic considerations and optimization. Concepts of thermodynamics, fluid mechanics and heat transfer will be integrated under a design framework. A semester long project is conducted to design a thermal system, perform system simulations, and to optimize the design based on economic and technical considerations.

**Special Note:** Not available for credit to students who have completed ME A655.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering

**May Be Stacked With:** ME A655

**Prerequisites:** ES A341 with a minimum grade of C and ES A346 with a minimum grade of C.

**ME A456 Renewable Energy Systems Engineering 3 Credits**

The study and design of renewable energy systems from a technical engineering standpoint. Solar, hydrokinetic, conventional hydroelectric, wind, geothermal, and biological energy systems will be examined. Additional topics include feasibility analysis and energy storage techniques.

**Special Note:** Not available for credit to students who have completed ME A656.

**May Be Stacked With:** ME A656

**Prerequisites:** ES A341 with a minimum grade of C and ES A346 with a minimum grade of C.

**ME A459 Fracture Mechanics 3 Credits**

Presents theoretical, experimental, and applied fracture of solids, structures, and machines, subcritical crack growth including fatigue, creep, and corrosion, embrittlement, safety, and life cycle design and analysis. Uses studies to illustrate the course topics.

**Special Note:** Not available for credit to students who have completed ME A659.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering

**May Be Stacked With:** ME A659

**Prerequisites:** ES A331 with a minimum grade of C.

**ME A460 Turbomachinery 3 Credits**

Introduces the application of energy, momentum and continuity equations to designing turbomachinery such as pumps, compressors and turbines.

**Special Note:** Not available for credit to students who have completed ME A660.

**Registration Restrictions:** Admission to the Bachelor of Science in Mechanical Engineering or instructor approval

**May Be Stacked With:** ME A660

**Prerequisites:** ES A341 with a minimum grade of C and (ES A341L with a minimum grade of C or ME A341L with a minimum grade of C) and ES A346 with a minimum grade of C.

**ME A471 Automatic Control 3 Credits**

Linear system representation by transfer functions, signal flow graphics and state equations. Feedback, time and frequency response of linear systems. Stability analysis by Routh-Hurwitz criterion and frequency domain methods. Specifications of higher order linear systems. System design and compensation.

**Crosslisted With:** EE A471.

**Prerequisites:** (EE A306 with a minimum grade of C or ME A306 with a minimum grade of C or EE A353 with a minimum grade of C) and ES A210 with a minimum grade of C and MATH A302 with a minimum grade of C.

**ME A608 Mechanical Vibrations 3 Credits**

Models vibratory mechanical systems with single and multiple degrees of freedom. Includes study of free and forced vibrations with or without damping by lumped-parameter methods and finite element analysis. Vibrations of rotor systems and vibration monitoring.

**Special Note:** Not available for credit to students who have completed ME A408.

**Registration Restrictions:** Graduate standing or instructor approval

**May Be Stacked With:** ME A408

**ME A610 Biomechanics 3 Credits**

Applies the principles of mechanics to biological systems with an emphasis on the human body. Both analytical mathematical modeling and experimental approaches are explored.

**Registration Restrictions:** Graduate standing or instructor permission

**ME A615 Composite Materials 3 Credits**

Presents the mechanics and manufacturing of composite materials and their applications. Considers the analysis, design, processing/fabrication, repair, and evaluation of composite materials and structures.

**Special Note:** Not available for credit to students who have completed ME A415.

**Registration Restrictions:** Graduate standing or instructor approval

**May Be Stacked With:** ME A415

**ME A621 Engineering Finite Element Analysis 3 Credits**

Covers the mathematical formulation of the finite element analysis (FEA) method; elemental matrices, nodal loads, assembly, and solution of finite element problems; static, modal and dynamic solid-mechanics FEA problems; heat transfer, fluid mechanics, and electromagnetic FEA problems; and FEA software: preprocessing, processing, and postprocessing.

**Special Note:** Not available for credit to students who have completed ME A421.

**Registration Restrictions:** Graduate standing or instructor approval

**May Be Stacked With:** ME A421

**ME A630 Advanced Mechanics of Materials 3 Credits**

Covers advanced topics in the mechanics of solids, including both equilibrium and energy approaches. Provides in-depth study of topics introduced in previous courses such as bending of beams, torsion, and plane stress and strain. Additionally covers 3-D stress and strain analysis, yield and failure criteria, and time-dependent deformations.

**Registration Restrictions:** Graduate standing and instructor permission.

**Crosslisted With:** CE A630.

**ME A632 Analytical Dynamics 3 Credits**

Topics include kinematics and kinetics of rigid bodies, introduction to analytical mechanics, Lagrange's equations and Hamiltonian mechanics. Students will engage with applications to engineering problems.

**Special Note:** Not available for credit to students who have completed ME A432. Additional work is required at the graduate level.

**Registration Restrictions:** Graduate standing or instructor approval

**May Be Stacked With:** ME A432

**ME A642 Advanced Fluid Mechanics 3 Credits**

Covers advanced topics in fluid mechanics, including derivation of flow equations, ideal fluid flows, incompressible viscous flows and compressible inviscid flows.

**Special Note:** Not available for credit to students who have completed ME A442.

**Registration Restrictions:** Graduate standing or instructor approval

**May Be Stacked With:** ME A442

**ME A651 Aerodynamics 3 Credits**

Covers fundamentals of aerodynamics including boundary layer theories, aerodynamics of lifting flow over airfoils, wings of finite span and airfoil theory in subsonic, transonic, and supersonic flows. Includes a literature review and research on selected aerodynamics topics.

**Special Note:** Not available for credit to students who have completed ME A451.

**Registration Restrictions:** Graduate standing or instructor approval

**May Be Stacked With:** ME A451

**ME A655 HVAC Systems Optimization 3 Credits**

Covers design of heating, ventilation, and air-conditioning (HVAC) systems with emphasis on economic considerations and optimization. Concepts of thermodynamics, fluid mechanics and heat transfer will be integrated under a design framework. A semester long project is conducted to design a thermal system, perform system simulations, and to optimize the design based on economic and technical considerations.

**Special Note:** Not available for credit to students who have completed ME A455.

**Registration Restrictions:** Graduate standing or instructor approval

**May Be Stacked With:** ME A455

**ME A656 Renewable Energy Systems Engineering 3 Credits**

The study and design of renewable energy systems from a technical engineering standpoint. Solar, hydrokinetic, conventional hydroelectric, wind, geothermal, and biological energy systems will be examined. Additional topics include feasibility analysis and energy storage techniques.

**Special Note:** Not available for credit to students who have completed ME A456. ME A656 includes additional reviews of articles and a written report.

**Registration Restrictions:** Graduate standing or instructor approval

**May Be Stacked With:** ME A456

**ME A659 Fracture Mechanics 3 Credits**

Presents theoretical, experimental, and applied fracture of solids, structures, and machines, subcritical crack growth including fatigue, creep, and corrosion, embrittlement, safety, and life cycle design and analysis. Case studies are used to illustrate the course topics.

**Special Note:** Not available for credit to students who have completed ME A459. Additional work is required at the graduate level.

**Registration Restrictions:** Graduate standing or instructor approval

**May Be Stacked With:** ME A459

**ME A660 Turbomachinery 3 Credits**

Introduces the application of energy, momentum and continuity equations to designing turbomachinery, such as pumps, compressors and turbines.

**Special Note:** Not available for credit to students who have completed ME A460.

**Registration Restrictions:** Graduate standing or instructor approval

**May Be Stacked With:** ME A460

**ME A664 Corrosion Processes and Engineering 3 Credits**

Covers corrosion processes and mechanisms. Topics include the concepts, materials, and mechanisms of corrosion with application to engineering design for corrosion prevention.

**Registration Restrictions:** Graduate standing or instructor approval

**Prerequisites:** ME A334 with a minimum grade of C.

**ME A672 Advanced Linear Systems 3 Credits**

Presents a state space linear algebra approach to multiple input, multiple output systems. Concepts of controllability and observability motivate design techniques for optimal open loop and closed loop systems.

Analysis and design of optimal feedback control systems and design of observers and estimators are presented.

**Special Note:** Not available for credit to students who have completed EE A472.

**Registration Restrictions:** Graduate standing or instructor permission

**May Be Stacked With:** EE A472

**ME A686 Project 3 Credits**

Project arranged among the advisor, graduate advisory committee and student to solve a practical engineering problem.

**Registration Restrictions:** Graduate standing and instructor permission

**ME A699 Thesis 1-6 Credits**

Individual study of an advanced engineering problem resulting in a thesis.

**Registration Restrictions:** Graduate standing and instructor permission