MECHANICAL ENGINEERING

Department of Mechanical Engineering

Chairperson: Paul I. Ro
Graduate Program Director: Stephen T. McClain

- Mechanical Engineering, M.S.M.E. (https://catalog.baylor.edu/graduate-school/curriculum-departments-institutes-instruction/school-engineering-computer-science/mechanical-engineering/mechanical-engineering-msme/)
- Mechanical Engineering, Ph.D. (https://catalog.baylor.edu/graduate-school/curriculum-departments-institutes-instruction/school-engineering-computer-science/mechanical-engineering/mechanical-engineering-phd/)

Mechanical Engineering (ME)

ME 4330 Introduction to Robotics (3)
See ELC 4330 for course information.

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 4377 Solar Energy (3)
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 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.

ME 5199 Non-Thesis Degree Completion (1)
To fulfill requirements for non-thesis master's students who need to complete final degree requirements other than coursework during their last semester. This may include such things as a comprehensive examination, oral examination, or foreign language requirement. Students are required to be registered during the semester they graduate.

ME 5302 Engineering Analysis (3)
See ELC 5302 for course information.

ME 5322 Computer-Aided Engineering and Design (3)
Design and analysis of engineering components and systems using interactive computer programs with inclusion of computer simulation.

ME 5323 Introduction to Finite Element Methods (3)
Introductory course on the theory and techniques of finite element analysis for numerical solutions of partial differential equations beginning from energy concepts and foundational constitutive equations. Numerical implementations and solutions are demonstrated by user-created code using modern computer technologies.

ME 5324 Advanced Dynamics (3)
Pre-requisite(s): Graduate standing in Engineering
An advanced study of the mechanical dynamics of systems involving multiple, interconnected rigid bodies. Topics include mathematical expressions of body kinematics, various methods to derive dynamic equations of motion, three-dimensional inertial properties, and dynamic motion constraints.

ME 5325 Advanced Finite Element Methods (3)
Pre-requisite(s): ME 3321 (or equivalent), 4324 (or equivalent), and 4345 (or equivalent)
Advanced analysis of the finite element theory with emphasis on non-linear applications for thermal and fluidic applications. Course will formulate the finite element form from several classes of constitutive equations, discuss solution methods, and construct and implement algorithms for solving the finite element form.

ME 5333 Introduction to Combustion (3)
Understand and apply fundamentals for 1) combustion of gas, solid and liquid fuels; 2) combustion equilibrium and calculation of equilibrium compositions and flame temperature; 3) characterization of flame types; 4) quenching, flammability, ignition, and stabilization of flames; 5) soot formation; and 6) detonations and deflagrations.

ME 5335 Composite Materials (3)
Pre-requisite(s): ME 3322 or equivalent
Introduction to composite materials, micromechanics of fiber reinforced composites, lamina mechanics, mechanical behavior of composite laminates, hygrothermal effects, and failure models.

ME 5336 Thermal Systems Design (3)
Pre-requisite(s): A grade of C or better in ME 3321; and a grade of C or better in or concurrent enrollment in ME 4345
Design, analysis, and simulation 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. Estimation and optimization of initial and operational costs.

ME 5338 Experimental Methods in Heat Transfer and Fluid Flow (3)
Pre-requisite(s): ME 4335 or consent of instructor
Consideration of experimental methods including experiment planning and design, error and uncertainty analysis, temperature measurement (in fluids and solids), flow rate measurement, flow visualization, and advanced data analysis; selected experiments conducted.

ME 5339 Tribology (3)
Topics include the nature of rough surfaces, contact mechanics between noncomformal and nominally-flat surfaces, nature of friction, lubricants and lubrication theory, and surface damage and fatigue. Computational analyses of surfaces and lubricant flow are performed using Python.

ME 5340 Intermediate Fluid Mechanics (3)
Pre-requisite(s): ME 3321
Introduction to vectors and tensors, deformation and stress in fluids, kinematics of fluid flows, conservation laws, Navier-Stokes equations, energy equation, introduction to computational fluid dynamics (CFD), introduction to vorticity dynamics and selected topics in compressible fluid flow.

ME 5341 Intermediate Heat Transfer (3)
Pre-requisite(s): ME 4345 (or equivalent)
Study of conduction, convection, and radiation. Steady and transient one - and multi-dimensional heat transfer with emphasis on analytical methods, numerical techniques, and approximate solutions.

ME 5342 Inviscid Flows (3)
Pre-requisite(s): ME 5340 or concurrent enrollment
Introduction to the dynamics of inviscid, incompressible fluids; vector representation theorems; vorticity transport theorem; solution methods to steady and unsteady, two-dimensional, axisymetric and three-dimensional flows; computational methods for inviscid flows; and forces and moments on bodies in two-dimensional flows.

ME 5343 Computational Fluid Dynamics (3)
Pre-requisite(s): 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. Applications include supersonic compressible and subsonic incompressible flows. Turbulence modeling. Finite volume method. Completion of ME 3321 Fluid Mechanics or equivalent recommended.

ME 5344 Viscoelasticity (3)
The Theory of Viscoelasticity is fundamental in the study of time rate dependent materials, with specific emphasis on applications to engineering systems with plastics and materials with polymeric behavior.

ME 5346 Introduction to Aeronautics (3)
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 5347 Analysis and Design of Propulsion Systems (3)
Pre-requisite(s): ME 3321, 3345
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 5348 Wind Energy (3)
This course presents fundamentals about wind turbines, both commercial and residential. Included are topics in aerodynamics, structures, power generation, control economics, environments, noise, and design.

ME 5351 Intermediate Numerical Methods (3)
Pre-requisite(s): MTH 2311 and 3326 Introduction to engineering computational methods for design, from theory to algorithm to implementation
Topics will include: roots of equations, optimization, linear systems, integration and differentiation, curve-fitting, and systems of ordinary differential equations.

ME 5352 Theory of Elasticity (3)
Pre-requisite(s): ME 3320, 3321, and MTH 3326
The Theory of Elasticity is fundamental to the study of linear and non-linear solid mechanics. This course introduces the foundations of elasticity for a deformable body, including the concept of deformation and stress using tensor calculus.

ME 5353 Continuum Mechanics (3)
Pre-requisite(s): ME 3320 and Graduate standing
Introductory course into the mechanics of a continuous medium. Topics include the foundational concepts of stress, strain, and constitutive relationships presented in Cartesian tensor notation. Studies will focus on both solid and fluid mechanics.

ME 5354 Rocket Propulsion (3)
Pre-requisite(s): C or better in ME 2345; and C or better in ME 3346 or ME 3321
Introduction to performance analysis of liquid and solid chemical rockets systems. Efficiency and other derivations, along with Thrust and Flight profile development.

ME 5357 Cardiovascular Engineering and Instrumentation (3)
See BME 5357 for course information.

ME 5360 Renewable Energy Devices (3)
Educates graduate students from engineering disciplines in the design and applications of various renewable energy sources, materials, and devices. Introduces the basic concepts, principles, potentials, and limitations of several energy conversion and storage devices with a particular focus on solar cells, fuel cells, batteries, and supercapacitors.

ME 5362 Principles of Process Engineering (3)
Pre-requisite(s): Graduate standing in engineering
Overview of the principles of process engineering, where process engineering is broadly described as converting matter from raw materials to more valuable forms. The fundamental engineering principles applied to chemical, environmental, and biomolecular processes.

ME 5363 Advanced Concepts of Process Engineering (3)
Pre-requisite(s): ME 4362 or ME 5362
Provides a deeper examination of some process engineering topics initially covered in the “Principles of Process Engineering” course. Topics include reaction engineering, unit operations, chemical measurements, process data analysis, and flowsheeting of a process.

ME 5364 Introduction to Additive Manufacturing (3)
This course introduces various aspects of additive manufacturing, which has become prominent in industry over the past two decades. The course gives the students a basic understanding of additive manufacturing and its use in design, both for rapid prototyping and for functional manufacturing. The course highlights the advances that additive manufacturing makes upon traditional manufacturing techniques.

ME 5365 Properties and Processing of Electronic Materials (3)
Study of the design and applications of conventional and advanced electronic materials ranging from typical Si and electroceramics to complex oxides and conducting polymers. Fundamental issues controlling their properties, processing, and reliability are addressed. In addition, a variety of thin film deposition techniques such as dc/rf magnetron sputtering, thermal/e-beam evaporation, and chemical vapor deposition are covered.

ME 5366 Metal Additive Manufacturing (3)
Pre-requisite(s): ME 5364
Metal additive manufacturing (AM) printing technologies, devices, capabilities, materials, and applications. Trade-offs between various metal AM processes and technologies, along with the various software tools, processes, and techniques enabling customization. Includes hands-on experience encompassing processing-structure-property-performance relations.

ME 5380 Microscopy Techniques for Materials Science (3)
Pre-requisite(s): ME 3322
Introduction to the basic principles of structural, chemical and property characterization techniques. The course is grounded in modern X-ray diffraction and electron microscopy techniques for characterization of the chemical and structural properties of a material. The course introduces the fundamental theoretical framework for diffraction, spectrometry and imaging methods.

ME 5381 Advanced Mechanics of Materials (3)
Pre-requisite(s): ME 3320 and ME 3322
Analysis of stresses and strains at a point, stress-strain relationships, stresses due to various loading conditions, and theories of failure. Includes energy methods, shear center, unsymmetrical bending, curved beams, torsion in closed and open cell cross-sections, principles of plastic analysis, and buckling analysis.

ME 5382 Mechanical Behavior of Polymers and Polymeric Composites (3)
Pre-requisite(s): ME 3320 or equivalent and ME 3322 or equivalent
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, thermoplastics, and semi-crystalline plastics; relating processing to mechanical properties; and predicting stiffness and strength from properties of fibers and polymeric matrices.

ME 5383 Deformation and Fracture in Metals (3)
Pre-requisite(s): ME 3320 or equivalent and ME 3322 or equivalent
This course introduces students to advanced theories of deformation and fracture that limit lifetimes in service of components and structures made of metals and alloys. Fracture mechanics are introduced as a tool in the life prediction of components that develop cracks before catastrophic failure. Plastic collapse, creep, fatigue, and environmental stress cracking are covered. Failure analysis methodology and tools are introduced and illustrated.

ME 5384 Fracture Mechanics (3)
Pre-requisite(s): ME 3320
Basic elements of fracture mechanics, including elastic and elastic-plastic crack tip stress and strain fields, and fracture toughness. Methods for prediction of crack growth under static and fatigue loading using stress intensity factor, J integral and energy release rate, and their applications to materials assessment.

ME 5385 Failure Analysis: Theory and Practice (3)
Pre-requisite(s): ME 3322
Introduction to basic failure theories and their application to the analysis of component and system failure in service; methodology of systematic failure analysis of actual service failures; introduction to tools used in failure analysis; case studies used extensively for teaching and assignments.

ME 5396 Special Topics in Engineering (3)
Pre-requisite(s): Approval of department chair
Study of special topics in mechanical engineering. This course may be repeated for a total of six times with different topics.

ME 5397 Special Topics in Engineering (3)
See EGR 5397 for course information.

ME 5V99 Master's Thesis (1-6)
Students completing a master's program with a thesis must complete six hours of ME 5V99.

ME 6396 Advanced Topics in Engineeering (3)
Study of advanced topics in engineering. This course may be repeated for a total of four times.

ME 6V97 Engineering Research (1-12)
Pre-requisite(s): Consent of student's supervisory graduate committee and admission to doctoral candidacy
Doctoral students may enroll in up to 12 semester hours of engineering research hours prior to taking the preliminary exam and being accepted into candidacy for the doctoral degree. These engineering research hours will count toward the degree.

ME 6V99 Dissertation (1-6)
Required of all doctoral candidates. In no case will fewer than 12 semester hours be accepted for a dissertation. Students may not enroll for doctoral research hours until they have been officially accepted into candidacy for the doctoral degree. After initial enrollment, students must register for at least one semester hour of doctoral research every term thereafter (summer term excluded).