MECHNICAL SCIENCE AND ENGINEERING

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- Bachelor of Science in Mechanical Engineering (http://
catalog.illinois.edu/undergraduate/engineer/departments/mech-
engin/bs-mechanical-engineering)
- Bachelor of Science in Engineering Mechanics (http://
catalog.illinois.edu/undergraduate/engineer/departments/mech-
engin/engin-mech)

ME Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/
DEFAULT/ME)

Mechanical Engineering Courses

ME 170 Computer-Aided Design credit: 3 Hours.
Geometry and topology of engineered components; creation of
engineering models and their presentation in standard 2D blueprint
form and as 3D wire-frame and shaded solids; meshed topologies
for engineering analysis and tool-path generation for component
manufacture; ISO and ANSI standards for coordinate dimensioning
and tolerancing; geometric dimensioning and tolerancing. Use of solid-
modeling software for creating associative models at the component and
assembly levels with automatic blueprint creation, interference checking,
and linked bill of materials. Credit is not given for both ME 170 and GE
101.

ME 199 Undergraduate Open Seminar credit: 1 to 5 Hours.
May be repeated.

ME 270 Design for Manufacturability credit: 3 Hours.
Introduction to DFM methodologies and tools; material selection
(new and traditional materials); designing for primary manufacturing
processes (cutting fundamentals, casting, forming, and shaping);
designing with plastics (snap-fits, integral hinges, etc.); design for
assembly (DFA); geometric dimensioning and tolerancing (GD&T).
Prerequisite: ME 170. ME and EM majors only.

ME 297 Introductory Independent Study credit: 1 to 3 Hours.
Independent study and/or individual projects related to mechanical
engineering. Approved for Letter and S/U grading. May be repeated to
a maximum of 6 credit hours for letter grade; no limit for S/U grade mode.
Prerequisite: Consent of Instructor.

ME 300 Thermodynamics credit: 3 Hours.
Classical thermodynamics through the second law; system and control-
volume analyses of thermodynamic processes; irreversibility and
availability; relations for ideal gas mixtures. Prerequisite: MATH 241.

ME 310 Fundamentals of Fluid Dynamics credit: 4 Hours.
Fundamentals of fluid mechanics with coverage of theory and
applications of incompressible viscous and inviscid flows, and
compressible high speed flows. Credit is not given for both ME 310 and
TAM 335. Prerequisite: MATH 285; credit or concurrent registration in
ME 300.

ME 320 Heat Transfer credit: 4 Hours.
Principles and application of heat transfer by conduction, convection, and
thermal radiation. Prerequisite: ME 310 or TAM 335.

ME 330 Engineering Materials credit: 4 Hours.
Structures of polymers, metals, and ceramics as the basis for their
mechanical behavior. Manipulation of structure through such processes
as heat treatment and solidification. Mechanisms of material failure
in service (yielding, fracture, fatigue, creep, corrosion, and wear) and
simple design techniques to avoid these failures. Strategies for materials
selection in design. Credit is not given for both ME 330 and either
CEE 300 or MSE 280. Prerequisite: CHEM 102 and TAM 251.

ME 340 Dynamics of Mechanical Systems credit: 3.5 Hours.
Dynamic modeling of mechanical components and systems; time-domain
and frequency-domain analyses of linear time-invariant systems; multi-
degree-of-freedom systems; linearization of nonlinear systems. Credit
is not given for both ME 340 and either GE 320 or AE 353. Prerequisite:
MATH 285 and TAM 212; credit or concurrent registration in ECE 205,
ECE 206, and MATH 415.

ME 351 Analysis of Mfg Processes credit: 3 Hours.
Mechanistic and empirical modeling of manufacturing processes
including metal cutting theory, casting analysis, forging analysis,
sheet metal forming, plastics molding, welding and mechanical joining
assembly analysis. Also, hands-on exposure to manufacturing processes,
CAD/CAM software (MasterCam), 5 axis machining (ShopBot), Wire EDM
machining, statistical process control (SPC), and geometric dimensioning
tolerancing (GD&T) metrology principles using CMM. Prerequisite:
ME 270.

ME 360 Signal Processing credit: 3.5 Hours.
Basic electromechanical techniques used in modern instrumentation
and control systems. Use of transducers and actuators. Signal conditioning,
grounding, and shielding. Analog and digital signal processing and
feedback control methods with emphasis on frequency domain
techniques. Frequency response of continuous and discrete systems.
Credit is not given for both ME 360 and ABE 425. Prerequisite: ME 340.

ME 370 Mechanical Design I credit: 3 Hours.
Kinematics and dynamics of machinery, including analytical kinematics,
force analysis, cam design and balancing. Application of elementary
mechanics of solids to analyze and size machine components for stress
and deflection. Finite-element analysis with emphasis on beam and plate
models. Prerequisite: ME 170, TAM 212, and TAM 251.

ME 371 Mechanical Design II credit: 3 Hours.
Design and analysis of machinery for load-bearing and power
transmission. Consideration of material failure modes, including yielding,
fracture, fatigue, and creep. Design and selection of machine elements:
bolts, springs, rolling-element bearings, fluid-film lubrication, and power
transmissions, including gears and friction drives. Prerequisite: ME 330
and ME 370.

ME 390 Seminar credit: 0 Hours.
Lectures by faculty and invited authorities, concerning the ethics and
practices of mechanical engineering/engineering mechanics, as well
as its relationship to other fields of engineering, to economics, and to
society. Offered fall term only. Approved for S/U grading only.

ME 400 Energy Conversion Systems credit: 3 or 4 Hours.
Processes and systems for energy conversion, including power and
refrigeration cycles, air conditioning, thermoelectrics and fuel cells; ideal-
gas mixtures and psychrometrics. 3 undergraduate hours. 4 graduate
hours. Prerequisite: ME 300.

Information listed in this catalog is current as of 09/2017
**ME 401** Refrigeration and Cryogenics  credit: 3 or 4 Hours.  
Theory of operation and design of equipment for production of low temperatures, from below ambient to near absolute zero; industrial, consumer, aerospace, medical, and research applications.  
3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: ME 300, ME 310, and ME 320.

**ME 402** Design of Thermal Systems  credit: 3 or 4 Hours.  
Selection of components in fluid- and energy-processing systems to meet system-performance requirements; computer-aided design; system simulation; optimization techniques; investment economics and statistical combinations of operating conditions.  
3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: Credit or concurrent registration in ME 320.

**ME 403** Internal Combustion Engines  credit: 3 Hours.  
Theory and analysis of reciprocating internal-combustion engines; fuels, carburetion, combustion, exhaust emissions, detonation, fuel injection, and factors affecting performance; laboratory work on variables that affect performance.  
3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: Credit or concurrent registration in ME 400 or ABE 466.

**ME 404** Intermediate Thermodynamics  credit: 4 Hours.  
Classical thermodynamics, including the Tds equations and the Maxwell relations; development of thermodynamic property relations, behavior of real gases, thermodynamics of mixtures, phase equilibrium and chemical reactions and equilibrium with an emphasis on combustion reactions; statistical thermodynamics including the effect of molecular and atomic structure, statistical concepts and distributions, calculation of thermodynamic properties of gas-phase atoms and molecules, kinetic theory of gases, and vibrations in crystals and the electron gas in metals; selected applications. 4 undergraduate hours. 4 graduate hours. Credit is not given for both ME 404 and any of PHYS 427, CHEM 442, or CHEM 444. Prerequisite: ME 300.

**ME 410** Intermediate Gas Dynamics  credit: 4 Hours.  
Solution of internal compressible-flow problems by one-dimensional techniques, both steady and unsteady; flows with smooth and abrupt area change, with friction, with heat addition, and with mass addition; flows with weak and strong waves, multiple confined streams, and shock waves. 4 undergraduate hours. 4 graduate hours. Prerequisite: ME 300 and ME 310; or one of AE 311, TAM 335.

**ME 411** Viscous Flow & Heat Transfer  credit: 4 Hours.  
Same as AE 412. See AE 412.

**ME 412** Numerical Thermo-Fluid Mechs  credit: 2 to 4 Hours.  
Numerical techniques for solving the equations governing conduction and convective heat transfer in steady and unsteady fluid flows: finite-difference and finite-volume techniques, basic algorithms, and applications to real-world fluid-flow and heat-transfer problems. Same as CSE 412. 2 or 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: ME 310 and ME 320.

**ME 420** Intermediate Heat Transfer  credit: 4 Hours.  
Conduction heat transfer, radiation heat transfer, mass transfer, phase change, heat exchangers; numerical methods. 4 undergraduate hours. 4 graduate hours. Prerequisite: ME 310 and ME 320.

**ME 430** Failure of Engrg Materials  credit: 3 or 4 Hours.  
Material anisotropy and elasto-plastic properties at the crystal level; microstructural basis for fatigue, fracture, and creep in metals, polymers, and ceramics; failure mechanisms and toughening in composites; structure and behavior of metal-matrix composites, ceramic-matrix composites, and polymer composites. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: ME 330.
ME 470  Senior Design Project  credit: 3 Hours.
Solution of a real-world design problem: development, evaluation, and recommendation of alternative solutions subject to realistic constraints that include most of the following considerations: economics, environment, sustainability, manufacturability, ethics, health and safety, society, and politics. 3 undergraduate hours. No graduate credit. Departmental approval required. Prerequisite: Concurrent enrollment in no more than two required ME courses; completion of all required courses. This course satisfies the General Education Criteria for: Advanced Composition

ME 471  Finite Element Analysis  credit: 3 or 4 Hours.
The finite element method and its application to engineering problems: truss and frame structures, heat conduction, and linear elasticity; use of application software; overview of advanced topics such as structural dynamics, fluid flow, and nonlinear structural analysis. Same as AE 420 and CSE 451. 3 or 4 undergraduate hours. 3 or 4 graduate hours. Credit is not given for both ME 471 and CEE 470. Prerequisite: CS 101 and ME 370.

ME 472  Introduction to Tribology  credit: 3 or 4 Hours.
Friction, wear, and lubrication; engineering surfaces; surface properties and surface topography; Hertzian contacts and contact of rough surfaces; friction of surfaces in contact; wear and surface failures; boundary lubrication; fluid properties; hydrodynamic lubrication; elastohydrodynamic lubrication; bearing selection; introductory micro- and nanotribology. 3 undergraduate hours. 3 or 4 graduate hours.

ME 481  Whole-Body Musculoskel Biomech  credit: 3 or 4 Hours.
Exploration of the human musculoskeletal system with an emphasis on the whole-body or organism level, modeling and analysis techniques for examining human movement, such as rigid-body modeling techniques, forward and inverse dynamics, and Lagrangian mechanics; examination of current topics, such as orthopedic biomechanics, prosthetics and orthotics, postural control, and locomotion; use of computerized motion-capture equipment and software to examine, simulate, and analyze human movement. Same as BIOE 481. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: TAM 212 and TAM 251.

ME 482  Musculoskel Tissue Mechanics  credit: 3 Hours.
Composition-structure-function relationships for musculoskeletal tissues, including bone, tendon, ligament, cartilage, and muscle; hierarchical structure of tissues from the macro- to nano-scales; relation of composition to mechanical properties of health and diseased tissue; experimental methods used to obtain mechanical properties. Same as BIOE 482. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: TAM 212 and TAM 251.

ME 483  Mechanobiology  credit: 4 Hours.
Integrative approach to mechanobiology; mechanics of cell adhesion; cytoskeletal structure and mechanics; mechanotransduction; mechanics of cell proliferation, apoptosis, cancer cells, and stem cells; aging; critical issues facing the mechanobiological sciences. 4 undergraduate hours. 4 graduate hours. Prerequisite: CHEM 103 and TAM 251.

ME 485  MEMS Devices & Systems  credit: 3 Hours.
Same as ECE 485. See ECE 485.

ME 487  MEMS-NEMS Theory & Fabrication  credit: 4 Hours.
Physical and chemical theory, design, and hands-on fabrication of micro- and nano-electromechanical systems (MEMS and NEMS); cleanroom fabrication theory, including general cleanroom safety, lithography, additive and subtractive processes, bulk and surface micromachining, deep reactive ion etching (DRIE), lithographic Galvanoformung Abformung (LIGA), packaging, scaling, actuators, and micro-nanofluids; fabrication of two take-home devices, such as piezoresistive sensors and microfluidic logic chips, that demonstrate advanced fabrication processing. 4 undergraduate hours. 4 graduate hours. Prerequisite: PHYS 212.

ME 496  Honors Project  credit: 1 to 4 Hours.
Special project or reading course for James Scholars in engineering. 1 to 4 undergraduate hours. No graduate credit. May be repeated. Prerequisite: Consent of instructor.

ME 497  Independent Study  credit: 1 to 4 Hours.
Independent study of advanced problems related to mechanical engineering. 1 to 4 undergraduate hours. 1 to 4 graduate hours. May be repeated. Prerequisite: Consent of instructor.

ME 498  Special Topics  credit: 0 to 4 Hours.
Subject offerings of new and developing areas of knowledge in mechanical engineering intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. 0 to 4 undergraduate hours. 0 to 4 graduate hours. May be repeated in the same or separate terms if topics vary to a maximum of 9 hours.

TAM Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/TAM)

Theoretical and Appl Mechanics Courses

TAM 195  Mechanics in the Modern World  credit: 1 Hour.
Freshman introduction to engineering mechanics and its role in modern engineering analysis and design. Project activity.

TAM 199  Undergraduate Open Seminar  credit: 1 to 5 Hours.
May be repeated.

TAM 201  Mechanics for Technol & Mgmt  credit: 3 Hours.
Engineering mechanics (statics, dynamics, solid mechanics, and fluid mechanics) and the role that mechanics plays in engineering analysis and design. For Technology and Management majors only.

TAM 210  Introduction to Statics  credit: 2 Hours.
Forces, moments, couples; resultants of force systems; equilibrium analysis and free-body diagrams; analysis of forces acting on members of trusses, frames, etc.; shear-force and bending-moment distributions; Coulomb friction; centroids and center of mass; applications of statics in design. Credit is not given for both TAM 210 and TAM 211. Prerequisite: PHYS 211; credit or concurrent registration in MATH 241.

TAM 211  Statics  credit: 3 Hours.
Forces, moments, and couples; resultants of force systems; equilibrium analysis and free-body diagrams; analysis of forces acting on members of trusses, frames, etc.; shear-force and bending-moment distributions; Coulomb friction; centroids, center of mass, moment of inertia, polar moment of inertia, and product of inertia; virtual work; hydrostatic pressure; applications of statics in design. Credit is not given for both TAM 211 and TAM 210. Prerequisite: PHYS 211; credit or concurrent registration in MATH 241.
TAM 212  Introductory Dynamics  credit: 3 Hours.
Kinematics and dynamics of the three-dimensional motion of particles; kinematics and dynamics of the plane motion of rigid bodies; methods of work energy and impulse momentum; moving reference frames. Prerequisite: TAM 210 or TAM 211.

TAM 251  Introductory Solid Mechanics  credit: 3 Hours.
Relationship between internal stresses and deformations produced by external forces acting on deformable bodies, and design principles based on mechanics of solids: normal stresses, shear stresses, and deformations produced by tensile, compressive, torsional, and bending loading of members; beam deflections; elastic energy and impact; multi-dimensional stress states; buckling of columns. Prerequisite: TAM 210 or TAM 211.

TAM 252  Solid Mechanics Design  credit: 1 Hour.
Design problems and projects intended to accompany TAM 251. Prerequisite: Credit or concurrent registration in TAM 251.

TAM 297  Introductory Independent Study  credit: 1 to 3 Hours.
Independent study and/or individual projects related to engineering mechanics. Approved for Letter and S/U grading. May be repeated to a maximum of 6 credit hours for letter grade; no limit for S/U grade mode. Prerequisite: Consent of Instructor.

TAM 302  Engineering Design Principles  credit: 3 Hours.
Examples of mechanical design problems that occur in engineering practice and the procedures and issues involved in solving them; technical aspects and societal ramifications of the design process; intellectual property, ethics, and contemporary issues; probability and statistics; computational mechanics; case studies; student discussion of design-related issues at different levels; design project reports and presentations; student teams.

TAM 324  Behavior of Materials  credit: 4 Hours.
Same as CEE 300. See CEE 300.

TAM 335  Introductory Fluid Mechanics  credit: 4 Hours.
Fluid statics; continuity, momentum, and energy principles via control volumes; ideal and real fluid flow; introduction to the Navier-Stokes equation; similitude; laminar and turbulent boundary layers; closed-conduit flow, open-channel flow, and turbomachinery. Prerequisite: TAM 212.

TAM 412  Intermediate Dynamics  credit: 4 Hours.
Lagrangian mechanics of dynamical systems with an emphasis on vibrations; constraints and generalized coordinates; motion in accelerating frames; conservation laws and invariance of the Lagrangian; particle motion in one dimension, the two-body problem, and central-force motion; free and forced vibration of linearized single-degree-of-freedom and multi-degree-of-freedom discrete systems; weakly nonlinear vibrations; parametric resonance; introduction to Hamiltonian dynamics; rigid-body motions. 4 undergraduate hours. 4 graduate hours. Credit is not given for both TAM 412 and AE 352. Prerequisite: MATH 225 or MATH 415; MATH 285; TAM 212.

TAM 413  Fund of Engr Acoustics  credit: 3 or 4 Hours.
Same as ECE 473. See ECE 473.

TAM 416  Intro to Nonlinear Dyn & Vib  credit: 4 Hours.
Single- and multi-degree-of-freedom oscillators; asymptotic methods; forced, internal and combination resonances; time-discrete dynamical systems (maps); complex dynamics; parametric vibrations and resonances; introduction to nonlinear localization and nonlinear targeted energy transfer; nonlinear vibrations of elastic continua; application in mechanics and engineering. 4 undergraduate hours. 4 graduate hours. Prerequisites: MATH 285 OR MATH 441; MATH 415; TAM 212.

TAM 424  Mechanics of Structural Metals  credit: 3 Hours.
Micromechanisms at the atomic, single-crystal, and polycrystal levels and their use in explaining the deformation and failure characteristics of metals; elastic deformation, dislocation mechanics, plastic deformation and strengthening mechanisms, fracture mechanics and fracture mechanisms, fatigue, and creep; design criteria; special topics. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 300 or ME 330.

TAM 427  Mechanics of Polymers  credit: 3 Hours.
Mechanical behavior of amorphous and semi-crystalline polymers; overview of polymer structure, properties, and processing; polymer linear viscoelasticity using Boltzmann superposition and mechanical models; measurement of viscoelastic properties; polymeric yield phenomena; fracture and craze formation; impact and fatigue. Same as AE 427 and MSE 454. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 300 or ME 330.

TAM 428  Mechanics of Composites  credit: 3 Hours.
Same as AE 428 and MSE 456. See MSE 456.

TAM 435  Intermediate Fluid Mechanics  credit: 4 Hours.
Analytical solution methods for problems involving ideal and real fluids: potential flow theory, boundary-layer theory; surface waves, vortex dynamics, and compressible flows. 4 undergraduate hours. 4 graduate hours. Prerequisite: One of AE 312, ME 310, TAM 335.

TAM 445  Continuum Mechanics  credit: 4 Hours.
Tensor algebra and analysis; kinematics of continua; mass, force, stress, and the general balance laws of continuum mechanics; introduction to constitutive equations. 4 undergraduate hours. 4 graduate hours. Prerequisite: TAM 251.

TAM 451  Intermediate Solid Mechanics  credit: 4 Hours.
Analysis of stress and strain (definitions, transformation of axes, equilibrium equations, and symmetry of the stress tensor); linear materials, Hooke’s law; strain energy, potential energy, energy principles and methods; two-dimensional problems in elasticity (torsion, axisymmetric problems); the finite-element method for two- and three-dimensional boundary-value problems in linear elasticity; plasticity (introduction, yield criteria, elastic-plastic behavior, and limit-load calculations); linear-elastic fracture mechanics (introduction, Griffith’s approach, stress intensity factor, and energy release rate). 4 undergraduate hours. 4 graduate hours. Prerequisite: TAM 251.

TAM 456  Experimental Stress Analysis  credit: 3 Hours.
Basic theories for measuring stresses and deformations in load-carrying engineering components; use of optical, electrical, and mechanical instrumentation; laboratory sessions on brittle coatings, electrical resistance strain gages, photoelasticity, and moire interferometry. 3 undergraduate hours. 3 graduate hours. Prerequisite: TAM 251.

TAM 461  Cellular Biomechanics  credit: 4 Hours.
Mechanics of biological cells and tissues: cell structure; mechanics of biomembranes; the cytoskeleton and cortex; dynamic cell processes; cell motility and control of cell shape and proliferation; experimental approaches and theoretical models. Same as BIOE 461. 4 undergraduate hours. 4 graduate hours. Prerequisite: TAM 251.

TAM 470  Computational Mechanics  credit: 3 or 4 Hours.
Modercomputational mechanics: mappings and iterative methods; stability; convergence; consistency; numerical and symbolic solutions of ordinary and partial differential equations; finite-difference methods; the finite-element method; spectral methods. Applications to problems in solid mechanics, fluid mechanics, and dynamics. Same as CSE 450. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 101 and MATH 285.

Information listed in this catalog is current as of 09/2017
TAM 497  Independent Study  credit: 1 to 4 Hours.
Individual studies in any area of theoretical and applied mechanics. 1 to 4 undergraduate hours. 1 to 4 graduate hours. May be repeated to a maximum of 12 hours, with a maximum of 8 hours in any one term. Prerequisite: consent of instructor.

TAM 498  Special Topics  credit: 1 to 4 Hours.
Subject offerings of new and developing areas of knowledge in theoretical and applied mechanics intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. 1 to 4 undergraduate hours. 1 to 4 graduate hours. May be repeated in the same or separate terms if topics vary to a maximum of 9 undergraduate hours or 12 graduate hours.

TAM 499  Senior Thesis  credit: 3 Hours.
Thesis investigation of special subjects in mechanics, including theoretical or experimental research. 3 undergraduate hours. No graduate credit. Prerequisite: Department and instructor approval required.