MECHANICAL ENGINEERING

At the undergraduate level, the Department of Mechanical Engineering offers an ABET-accredited Bachelor of Science in Mechanical Engineering. Additional information is available in that program's section of this catalogue.

REGULATIONS

Students pursuing the Bachelor of Science in Mechanical Engineering are subject to the Academic Standards in CEMS outlined in this catalogue.

ADDITIONAL REGULATIONS

Students may apply no more than three credits graded D, D+ or D- in any engineering (BME, CE, EE, ENGR or ME) course toward the degree.

In order to earn the Bachelor of Science in Mechanical Engineering, students must achieve a minimum 2.00 GPA in all Engineering (BME, CE, EMGT, ENGR, EE, ME), Mathematics, Statistics, Physics, Chemistry and Computer Science coursework.

MAJORS

MECHANICAL ENGINEERING MAJORS


GRADUATE

See the online Graduate Catalogue ([http://catalogue.uvm.edu/graduate/](http://catalogue.uvm.edu/graduate/)) for more information.

Courses

ME 001. First-Year Design Experience. 0 or 2 Credits.
Project-based. Introduction to the engineering profession and design. Hands-on experiences that emphasize interdisciplinary teamwork, technical communications, and project design methodologies.

ME 003. Introduction to Robotics. 1 Credit.
Introduction to the fundamentals of mobile robotics and associated engineering concepts. Students build and program their own robots to execute specific tasks using sensor data acquisition and processing. The course culminates in a team robot competition.

ME 012. Dynamics. 3 Credits.
Kinematics and kinetics of particles and rigid bodies in two and three dimensions. Computer-aided analysis. Prerequisite: CE 001, MATH 121.

ME 014. Mechanics of Solids. 3 Credits.
Stress, strain, temperature relationships, torsion, bending stresses and deflections. Columns, joints, thin-walled cylinders. Combined stresses and Mohr’s circle. Prerequisites: CE 001 with a grade of C- or better. Cross-listed with: CE 100.

ME 040. Thermodynamics. 3 Credits.
Principles of engineering thermodynamics; applications of these principles to thermodynamic cycles. Prerequisites: MATH 022 or MATH 023, PHYS 031 or PHYS 051, CHEM 031.

ME 042. SU: Applied Thermodynamics. 3 Credits.
Analysis of isentropic processes, gas, vapor and combined power cycles; refrigeration/heat pump cycles; relationships for ideal and real gases; gas mixtures and psychrometric applications. Prerequisite: ME 040 with a C- minimum.

ME 081. Mech Engr Shop Experience. 0-1 Credits.
Introduction to the machine shop environment; shop safety; proper use of essential shop tools; machining techniques. Pre/co-requisite: Sophomore standing in Mechanical Engineering.

ME 083. Computational Mech Engr Lab. 1 Credit.
Introduction to finite element analysis, solid modeling, and stress-strain analysis with post-processing techniques. Prerequisite: CE 001. Co-requisite: ME 014 or CE 100.

ME 090. Internship. 1-3 Credits.
On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

ME 092. Independent Study. 1-18 Credits.

ME 095. Special Topics. 1-18 Credits.
See Schedule of Courses for specific titles. One to three hours with Instructor approval.

ME 101. Materials Engineering. 3 Credits.
Atomic structure, crystalline structure, mechanical properties and testing of materials, phase equilibria, processing of metals, polymers, and ceramics. Prerequisite: ME 014.

ME 111. System Dynamics. 3 Credits.

ME 123. Thermo-Fluid Lab. 0 or 2 Credits.
Engineering measurements, data analysis and theory of experimentation. Experiments with fluids and material testing machines and instrumentation for dynamic measurements. Co-requisite: ME 143.

ME 124. Materials and Mechanics Lab. 0 or 2 Credits.
ME 143. Fluid Mechanics. 3 Credits.
Fluid pressure distributions; integral control volume systems; differential relations for a fluid particle; dimensional similarity; viscous flow in ducts; boundary layer flows; inviscid incompressible flows. Prerequisites: ME 012, ME 014 or CE 100, ME 040, MATH 271.

ME 144. Heat Transfer. 3 Credits.
One- and two-dimensional steady and unsteady thermal conduction; natural and forced internal and external convection; thermal radiation; heat exchangers; boiling and condensation heat transfer. Prerequisite: ME 143.

ME 161. Modern Manufacturing Processes. 3 Credits.
Product development, product design, concurrent engineering, rapid prototyping, semiconductor manufacturing, metal and plastic products manufacturing, EDM, ECM, laser, ultrasonic and high energy forming methods, biotechnology. Prerequisite: Junior standing in Mechanical Engineering.

ME 162. Modern Manufacturing Systems. 3 Credits.
Overview of systems used in manufacturing and operations management methods, including: quality systems, material management, lean manufacturing, statistical process control, and sustainable operations. Prerequisites: Senior standing in Mechanical Engineering or Engineering Management.

ME 171. Design of Elements. 3 Credits.
Mechanical fatigue criteria, fatigue analysis and design of springs, bolted/welded joints, gearing, shafts, bearings, power transmission. Computer-aided design and analysis. Prerequisite: Junior standing; ME 014.

ME 185. Capstone Design I. 3 Credits.
Project-based course. Multidisciplinary teams apply their knowledge to design, analyze, build and test a functional prototype that meets client's requirements and solves unique problems. Teams follow engineering design and project management processes such as periodic reports, presentations, meetings, reviews and demonstrations using standard industry tools. Prerequisite: EE 120 or EE 171, and EE 184 or Instructor permission; or Senior standing in Mechanical or Biomedical Engineering. Cross-listed with: BME 187, EE 187.

ME 186. Capstone Design II. 0 or 3 Credits.
Project-based course. Multidisciplinary teams apply their knowledge to design, analyze, build and test a functional prototype that meets client's requirements and solves their problems. Teams follow engineering design and project management processes such as periodic reports, presentations, meetings, reviews and demonstrations using standard industry tools. Prerequisite: Senior standing.

ME 190. Internship. 1-18 Credits.
On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

ME 191. Senior Thesis. 3 Credits.
Investigation of a research or design project under supervision of assigned staff member culminating in acceptable thesis. Prerequisite: Senior standing; department permission.

ME 192. Independent Study. 1-18 Credits.
A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

ME 193. College Honors. 1-3 Credits.
Honors studies leading to thesis. Prerequisite: CEMS 101.

ME 194. College Honors. 1-6 Credits.

ME 195. Intermediate Special Topics. 1-18 Credits.
See Schedule of Courses for specific titles. Prerequisite: Senior standing in Civil or Mechanical Engineering.

ME 197. Teaching Assistantship. 1-3 Credits.
Undergraduate student service as a teaching assistant, usually in an introductory level course in the discipline, for which credit is awarded. Offered at department discretion.

ME 198. Undergraduate Research. 1-18 Credits.
Undergraduate student work on individual or small team research projects under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

ME 199. Cooperative Ed Experience. 12 Credits.
On-site, full-time, supervised work experience that satisfies the educational objectives defined by the Department of Mechanical Engineering co-op program. Prerequisite: Sophomore standing.

ME 201. Biomaterials Engineering. 3 Credits.
A materials science and engineering approach is used to explore the structure-function relationships of natural and bio-inspired materials for various engineering applications. The emphasis is on mechanical design and function. The medical applications of biomaterials will be discussed. Prerequisite: ME 101.

ME 203. Machinery Analysis & Synthesis. 3 Credits.
Kinematic and kinetic analysis of two- and three-dimensional machines; kinematic synthesis, electromechanical and servo mechanisms; application to robotic mechanisms. Prerequisite: Senior standing in ME.

ME 206. Biomechanics of Human Motion. 3 Credits.
Biomechanics of Human Motion will describe the typical processes-from small scale protein interactions to large scale joint torques-that result in human locomotion. Clinical problems and athletic performance will be discussed. Students will learn about musculoskeletal tissues related to force generation/transmission and will perform kinematic/kinetic analyses. Prerequisites: Senior or Graduate student standing in Engineering, Instructor permission. Cross-listed with: BME 206.
ME 207. Intro Biomedical Engineering. 3 Credits.
Introduction to bioengineering science including biomechanics, biomaterials, biomedical imaging, rehabilitation engineering, biomedical computing, biomedical instrumentation, and transport phenomena. Prerequisite: Senior standing in all engineering majors other than Biomedical Engineering, Graduate Student standing with Instructor permission. Cross-listed with: EE 207.

ME 208. Biomechanics: Tissue Engr. 3 Credits.
Solid biomechanics including structure, function and mechanical properties of biological tissues. Tissue engineering involving cell mechanics, scaffold materials, and signaling. Current literature topics are covered. Pre/co-requisites: Senior/Graduate standing in Engineering; Instructor permission.

ME 209. Biomechanics: Transport Proc. 3 Credits.
Transport and kinetic processes to vascular biology, respiratory mechanics and medicine. Steady and unsteady laminar flow, pulse wave reflections, curved and collapsible tube flow, turbulence. Pre/ co-requisites: Senior/Graduate standing in Engineering; Instructor permission.

ME 210. Control Systems. 3 Credits.
Analysis and design of continuous and discrete-time control systems; stability, signal flow, performance criteria, classical and state variable methods, simulation design tools, computer-based realizations. Credit not given for more than one of the courses EE 110, ME 210. Prerequisite: EE 171 or ME 111. Cross-listed with: EE 210.

ME 218. Numerical Methods for Engineer. 3 Credits.
Foundational concepts of numerical integration, numerical differentiation, and numerical approximation and solution of differential and partial differential equations of the type encountered in the analysis of engineering problems and data processing. Prerequisites: MATH 271, CS 020; MATH 122 or MATH 124. Cross-listed with: CE 218.

ME 230. Astrodynamics. 3 Credits.
Motion of spacecraft in a central gravitational field. Two and restricted three-body problems; Kepler’s equation; orbital maneuvers and rendezvous; interplanetary and lunar trajectories. Prerequisite: ME 111.

ME 233. Vortex Flows. 3 Credits.
General theorems of vorticity transport in fluids; methods for solution of vortex flows; application to wake vortices, turbulent wall-layer vortices, wing-tip vortices, intake vortices, vortex-structure interaction, vortex reconnection, vortex breakdown, tornadoes and hurricanes. Prerequisite: ME 143.

ME 234. Mechanical Vibrations. 3 Credits.
Analysis, measurement, and control of mechanical vibrations; SDOF, MDOF, and rotating systems, forced, free, and random vibrations. Prerequisite: ME 111 or Senior/ Graduate standing in engineering or physical sciences.

ME 236. Renewable Energy Harvesting. 3 Credits.
Covers the engineering fundamentals of different renewable energy technologies, including wind power, tidal power, solar power, biomass, hydropower, etc. Focus placed on the mathematical derivation and application of small scale vibration energy harvesting technologies. Prerequisite: ME 143 or CE 160.

ME 237. Turbulence. 3 Credits.
Description of turbulent flows; statistical and modeling of turbulent flows; Navier Stokes as a dynamical system; experimental and numerical approaches. Prerequisite: ME 143.

ME 238. Energy Systems Engineering. 3 Credits.
Engineering assessment of both potentially sustainable and unsustainable practical primary energy systems. Examination of options of meeting demand and impacts on the environment. Prerequisite: ME 042.

ME 239. Rocket Propulsion. 3 Credits.
Flight mechanics and propulsion requirements for atmospheric and space flight. Thermochemistry of fuels and propellants. Operating principles of chemical, electrical and nuclear propulsion systems. Pre/ co-requisites: ME 143/ME 240 recommended or permission of the Instructor.

ME 240. Compressible Flow. 3 Credits.
Theory of compressible flow. Normal and oblique shocks; expansion waves; unsteady wave motion; method of characteristics; linearized external flows; conical and 3D flows. Prerequisite: ME 143 or equivalent.

ME 242. Adv Engr Thermodynamics I. 3 Credits.
Foundations of statistical mechanics. Gases and crystals. Chemical equilibrium. Irreversible processes. Prerequisite: Senior/Graduate standing or permission.

ME 243. Incompressible Flow. 3 Credits.
Intermediate treatment of incompressible fluid flow; Navier-Stokes equations; two-dimensional potential flows; wing theory; vorticity and vortex structures; laminar and turbulent boundary layers. Prerequisites: ME 143 or equivalent.

ME 244. Adv Engr Thermodynamics II. 3 Credits.
Analytical methods for multidimensional steady and transient heat conduction; phase change and moving boundaries. Thermal radiation exchange in enclosures; view factors; emitting/absorbing gases. Prerequisites: ME 144 or equivalent, or by Instructor permission.

ME 245. Advanced Heat Transfer I. 3 Credits.
Project-based. Computational methods for solving the Navier-Stokes equations and combined thermo-fluid flows; finite-differences and finite-volume techniques; use of standard commercial CFD software. Prerequisite: ME 143 or equivalent.

ME 252. Mechanical Behavior Materials. 3 Credits.
Isotropic and anisotropic elasticity; theory of plasticity; deformation mechanisms in crystalline solids; dislocation theory; creep behavior; advanced fatigue and fracture mechanisms. Prerequisites: ME 101; Instructor permission.
ME 255. Adv Engineering Materials. 3 Credits.
Advanced material processing; physical and mechanical principles of high-temperature alloys, light-weight materials, thin films, nanomaterials, and biomedical materials; elements of computational materials design. Prerequisites: Senior/Graduate standing; or Instructor permission.

ME 257. Composite Materials. 3 Credits.

ME 259. Computational Solid Mechanics. 3 Credits.
Project-based. Computational methods using the finite element analysis (FEA) applied to linear elastic and non-linear problems in the mechanics of deformable solids and structures, contact mechanics, and fracture mechanics. Hands-on computational experience using a commercial FEA software. Prerequisites: ME 014, MATH 124, and MATH 271, or equivalent.

ME 265. QR: Integrated Product Dev. 3 Credits.
Project-based course focusing on the entire product life cycle. Team dynamics, process and product design, quality, materials, management, and environmentally-conscious manufacturing. Prerequisite: Senior standing.

ME 270. Structural Dynamics. 3 Credits.
Vibrations, matrices, earthquake engineering, stability and wave propagation. Prerequisites: Senior/Graduate standing in Engineering or physical sciences, or Instructor permission. Cross-listed with: CE 272.

ME 271. Micro and Nano Systems. 3 Credits.
Operating principles, fabrication and design of engineered systems with submillimeter dimensions. Prerequisites: Senior/Graduate standing in Engineering or physical sciences.

ME 281. Seminar. 1 Credit.
Presentation and discussion of advanced mechanical engineering problems and current developments. Prerequisite: Senior/Graduate engineering enrollment.

ME 282. Seminar. 1 Credit.
Presentation and discussion of advanced mechanical engineering problems and current developments. Prerequisite: Senior/Graduate engineering enrollment.

ME 290. Internship. 1-18 Credits.
On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

ME 292. Independent Study. 1-18 Credits.
A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

ME 295. Advanced Special Topics. 1-18 Credits.
Content is dictated by expanding professional interest in newly developing, or recently developed, technical areas in which there is particular need or opportunity. Prerequisite: Senior/Graduate standing.

ME 297. Teaching Assistantship. 1-3 Credits.
Undergraduate student service as a teaching assistant, usually in an introductory level course in the discipline, for which credit is awarded. Offered at department discretion.

ME 298. Undergraduate Research. 1-18 Credits.
Undergraduate student work on individual or small team research projects under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

ME 299. Cooperative Ed Experience. 12 Credits.
On-site, full-time, supervised work experience that satisfies the educational objectives defined by the Department of Mechanical Engineering co-op program. Prerequisite: Senior standing.