MECHANICAL ENGINEERING

https://www.uvm.edu/cems/me/graduate_program (https://www.uvm.edu/cems/me/graduate_program/)

OVERVIEW
The main asset of the UVM mechanical engineering graduate program is certainly the human factor, including our dedicated faculty and staff, and motivated students.

Curriculum
We continuously update our curriculum to address modern topics in mechanical engineering, and to offer a breadth of courses that makes studying in our program more flexible, whether the student intends to earn an M.S. as a continuing student from local industries, or directly obtain a doctorate right from the bachelor's degree. Most of our graduate students are full-time and actively engaged in research projects with one or two faculty mentors who are dedicated to their success. The size of the program also enables them to have close interactions with the rest of the faculty, and to regularly participate in the life of the program via graduate student seminars and invited speaker presentations.

Graduate
Since its creation, students from across the United States and various countries around the world have graduated from the UVM mechanical engineering graduate program. Also, we actively seek to admit a diverse group of students in mechanical engineering to address the contemporary challenges of our society. To date, our graduates have achieved successful careers in academia as distinguished professors, in industry as engineers and entrepreneurs, and in government positions as program directors for national funding agencies or scientists at national laboratories.

Faculty and Research
The success of our graduate program is built on a distinguished faculty whose research is recognized nationally and internationally through innovation, dissemination of knowledge in high-impact journals, and research awards. Our focus is to create a research environment that is often interdisciplinary and collaborative from which our students can flourish. Our faculty is actively engaged in applied and fundamental research to address timely scientific questions relevant to mechanical engineering, using experimental, computational and theoretical methods. The mechanical engineering faculty at UVM works closely with students in five research areas: 1- Computational Multiscale Simulations & Theory; 2- Thermo-fluid & Aerospace Engineering; 3- Medical Research; 4- Dynamical Sensing, Monitoring and Control, and 5- Materials Science and Engineering.

DEGREES
- Mechanical Engineering AMP (http://catalogue.uvm.edu/graduate/mechanicalengineering/mechanicalengineeringamp/)
- Mechanical Engineering M.S. (http://catalogue.uvm.edu/graduate/mechanicalengineering/mechanicalengineeringms/)
- Mechanical Engineering Ph.D. (http://catalogue.uvm.edu/graduate/mechanicalengineering/mechanicalengineeringphd/)

FACULTY
Dubief, Yves C.; Associate Professor, Department of Mechanical Engineering; PHD, Institut National Polytechnique de Grenoble
Fiorentino, Niccolo M.; Assistant Professor, Department of Mechanical Engineering; PHD, University of Virginia
Fletcher, Douglas G.; Professor, Department of Mechanical Engineering; PHD, University of Virginia
Floreani, Rachael Ann; Associate Professor, Department of Mechanical Engineering; PHD, Colorado State University
Garimella, Suresh; President, University of Vermont, Professor, Department of Mechanical Engineering; PHD, University of California at Berkeley
Huston, Dryver R.; Professor, Department of Mechanical Engineering; PHD, Princeton University
Li, Wei; Assistant Professor, Department of Mechanical Engineering, PHD, Michigan State University
Louisos, William; Senior Lecturer, Department of Mechanical Engineering; PHD, University of Vermont
Ma, Jihong; Assistant Professor, Department of Mechanical Engineering; PHD, University of Minnesota, Twin Cities
Marshall, Jeffrey Scott; Professor, Department of Mechanical Engineering; PHD, University of California Berkeley
Meyers, Jason; Research Assistant Professor, Department of Mechanical Engineering; PHD, Univ. Libre de Bruxelles / von Kármán Institute
Sansoz, Frederic P.; Professor, Department of Mechanical Engineering; PHD, Ecole des Mines de Paris
Schadler, Linda S.; Dean, College of Engineering and Mathematical Sciences; Professor, Department of Mechanical Engineering; PHD, University of Pennsylvania

Courses
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 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. Prerequisites: 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 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 245. Advanced Heat Transfer I. 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 249. Computational Fluids Engr. 0 or 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 250. Air Breathing Propulsion. 3 Credits.
Presents a study on air-breathing propulsion systems. Initial focus will be on various types of engine systems, real and ideal parametric cycle analysis, and individual internal component performance. Will then move to contemporary propulsion topics and research that push aerospace systems to new flight envelopes. Prerequisites: ME 144, ME 240.

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.
Fibers, matrices. Unidirectional and short fiber composites.
Experimental characterization. Prerequisite: ME 101.

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 304. Adv Engineering Analysis I. 3 Credits.
Analytical methods for the solution of partial differential equations
in engineering mechanics and physics, including: eigenfunction
expansions; Fourier series; Sturm-Liouville theory and special
functions. Prerequisites: Graduate standing in engineering,
mathematics, or physical sciences or Instructor permission.

ME 305. Adv Engineering Analysis II. 3 Credits.
Advanced analytical techniques for problems in engineering
mechanics and physics, including: integral transform methods
Green’s functions, perturbation methods, and variational calculus.
Prerequisites: ME 304 or equivalent.