# MECHANICAL ENGINEERING

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 varied cohort 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, Robotics and Control, and 5- Materials Science and Engineering.

## DEGREES

Mechanical Engineering AMP

Mechanical Engineering M.S.

Mechanical Engineering Ph.D.

## 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
**Huston, Dryver R.;** Professor, Department of Mechanical Engineering; PHD, Princeton 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
**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
**Treers, Laura;** Assistant Professor, Department of Mechanical Engineering; PHD, University of California Berkeley

### Courses

**ME 5040. 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. Prerequisite: Graduate student in engineering, mathematics, or physical sciences or Instructor permission.

**ME 5120. 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. Prerequisite: Senior/Graduate student or Instructor permission.

**ME 5160. Continuum Mechanics. 3 Credits.**
Tensors, conservation laws, field equations for solids and fluids.

**ME 5220. Adv Engr Thermodynamics I. 3 Credits.**
Foundations of statistical mechanics. Gases and crystals. Chemical equilibrium. Irreversible processes. Prerequisite: Senior/Graduate student or permission.

**ME 5230. 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. Prerequisites: Content knowledge in fluid mechanics (such as ME 2230) is assumed.

**ME 5240. 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. Prerequisite:Successful completion of undergraduate Heat Transfer course or similar is assumed; Graduate Standing or Instructor permission.

**ME 5370. Micro and Nano Systems. 3 Credits.**
Operating principles, fabrication and design of engineered systems with submillimeter dimensions. Prerequisite: Senior/Graduate student in engineering or physical sciences.

**ME 5440. Biothermodynamics. 3 Credits.**
Inter-disciplinary; guides the student through the thermodynamics of living organisms, comprised of the study of energy transformation in the life sciences. Designed for students from the STEM disciplines. Covers Gibbs free energy, statistical thermodynamics, binding equilibria, and reaction kinetics. Prerequisites: Successful completion of Materials and Mechanics Lab such as ME 2111, Thermo-Fluid Labs such as ME 2321, or Biomedical design such as BME 3600 is assumed; Graduate student or Instructor permission. Cross-listed with: BME 5440.

**ME 5520. 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 1140, MATH 2544, and MATH 3201, or equivalent.

**ME 5980. 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. Prerequisite: Graduate student or Instructor permission; content knowledge of calculus through differential equations (such as MATH 3201) and linear algebra (such as MATH 2522 or MATH 2544) assumed. Cross-listed with: CEE 5980.

**ME 5990. Special Topics. 1-18 Credits.**
See Schedule of Courses for specific titles.

**ME 5993. 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 6110. Mechanical Behavior of Solids. 3 Credits.**
Intended to provide advanced concepts in elasticity, plasticity, creep, fracture, and fatigue of natural and engineered materials. Special emphasis is placed on the mathematics and physics of deformation in crystalline solids. Topics include: isotropic and anisotropic elasticity, deformation mechanisms at atomic scale, dislocation theory, strengthening mechanisms, theory of plasticity and yield criteria, creep and fracture. Pre/Co-requisites: Graduate student standing in engineering or physical sciences; knowledge of linear algebra, matrix analysis, introductory materials science, and mechanics, such as ME 5160 Continuum Mechanics is assumed.

**ME 6120. Advanced Dynamics. 3 Credits.**
Application of Lagrange's equation, Hamilton's principle to mechanical systems. Systems with constraints. Matrix formulation of problems in kinematics, dynamics. Stability of linear, nonlinear systems.

**ME 6230. Advanced Fluid Dynamics. 3 Credits.**
Stress in continuum; kinematics, dynamics; potential fields; Wing theory; Navier-Stokes equation; hydrodynamic stability; turbulence; laminar, turbulent boundary layer theory; transient flows; free laminar, turbulent flows; mixing.

**ME 6270. Turbulence. 3 Credits.**
Description of turbulent flows; statistical and modeling of turbulent flows; Navier Stokes as a dynamical system; experimental and numerical approaches. Prerequisite: Graduate student or Instructor permission; successful completion of undergraduate Mechanical Engineering Fluid Mechanics or similar required.

**ME 6391. Master's Thesis Research. 1-18 Credits.**
Research for the Master's Thesis.

**ME 6550. Multiscale Modeling. 3 Credits.**
Computational modeling of the physics and dynamical behavior of matter composed of diverse length and time scales. Molecular simulation. Coarse-graining. Coupled atomistic/continuum methods.

**ME 6990. Special Topics. 1-18 Credits.**
Advanced topics in recently developed technical areas. Prerequisite: Three hours with Instructor permission.

**ME 6991. 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 6993. 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 6995. Graduate Independent Research. 1-18 Credits.**
Graduate 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 7491. Doctoral Dissertation Research. 1-18 Credits.**
Research for the Doctoral Dissertation.

**ME 7990. Special Topics. 1-18 Credits.**
See Schedule of Courses for specific titles.

**ME 7991. 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 7995. Graduate Independent Research. 1-18 Credits.**
Graduate 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.