

## BIOMEDICAL ENGINEERING

### OVERVIEW

<https://www.uvm.edu/cems/ebe>

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The University of Vermont (UVM) offers interdisciplinary graduate programs in Biomedical Engineering that leverage core strengths in engineering and collaborations with researchers across campus, including those in UVM's Larner College of Medicine.

The M.S. in Biomedical Engineering gives students the opportunity to develop advanced engineering skills and domain expertise so that they may apply engineering methods to address problems related to human health. Students enrolled in the M.S. in BME program pursue a 2-year, personalized plan of study that includes only coursework, a project, or a research-oriented thesis. Students who complete their undergraduate studies at UVM may complete the M.S. in BME coursework in 1 year through an Accelerated Master's Program (AMP).

The Ph.D. in Biomedical Engineering is a flexible, dynamic degree that trains aspiring researchers to apply engineering techniques to the study of biological systems. Research areas include bioinstrumentation, biomechanics, biomedical imaging, biomedical systems and signal analysis, clinical engineering, digital health, implant design, rehabilitation engineering, simulation and modeling, biomaterials, tissue engineering, and biomathematics.

### DEGREES

Biomedical Engineering AMP  
Biomedical Engineering M.S.  
Biomedical Engineering Ph.D.

### FACULTY

**Bates, Jason H. T.;** Professor, Department of Medicine-Pulmonary; DSC, Canterbury University; PHD, University of Otago

**Berger, Christopher Lewis;** Professor, Department of Molecular Physiology and Biophysics; PHD, University of Minnesota Twin Cities

**Bernstein, David;** Assistant Professor, Department of Electrical and Biomedical Engineering; PHD, Boston University

**Beynon, Bruce David;** Professor, Department of Orthopaedics and Rehabilitation; PHD, University of Vermont

**Brasino, Michael;** Assistant Professor, Department of Electrical and Biomedical Engineering; Ph.D. Materials Science and Engineering, The University of Colorado at Boulder

**Caporizzo, Matthew;** Assistant Professor, Department of Molecular Physiology and Biophysics; PHD, University of Pennsylvania

**Cipolla, Marilyn Jo;** Professor, Department of Neurological Sciences; PHD, University of Vermont

**Doiron, Amber;** Assistant Professor, Department of Electrical and Biomedical Engineering; PHD, University of Texas at Austin

**Fiorentino, Niccolo M.;** Associate Professor, Department of Mechanical Engineering; PHD, University of Virginia

**Floreani, Rachael Ann;** Associate Professor, Department of Mechanical Engineering; PHD, Colorado State University

**Jangraw, David;** Assistant Professor, Department of Electrical and Biomedical Engineering; PHD, Columbia University

**Majumdar, Dev;** Assistant Professor, Department of Surgery; PHD, University of California Los Angeles

**Spector, Peter Salem;** Professor, Department of Medicine-Cardiology; MD, Albert Einstein College of Medicine

**Warsaw, David;** Professor, Department of Molecular Physiology and Biophysics; PHD, University of Vermont

**Weiss, Daniel;** Professor, Department of Medicine-Pulmonary; MD, PHD, Mount Sinai School of Medicine

### Courses

#### **BME 5150. Nanobiomaterials. 3 Credits.**

Covers the classes of nanomaterials used biomedically, the biological response, and material testing. Content includes applications of nanomaterials in drug delivery, nano-topography of surfaces, sensors, and imaging as well as the topic of nanotoxicity.

#### **BME 5330. Advanced Biomedical Systems. 3 Credits.**

Uses the study of lung mechanics as a vehicle for teaching a range of mathematical modeling and data analysis methods central to the study of physiological systems. Students will gain a detailed understanding of how the lung works as a mechanical system and various diseases that affect mechanical function. At the same time, they will learn about applications of a range of mathematical and signal processing techniques. Prerequisite: Graduate standing or Instructor permission.

#### **BME 5350. Microbiome Engineering. 3 Credits.**

Introduces the burgeoning field of microbiome engineering. Covers approaches to manipulate the structure and function of the human microbiome to treat diseases by surveying the primary literature. Develops computational and quantitative reasoning skills necessary to analyze the data that enable understanding of the microbiome. Prerequisite: Previous experience with computer coding is suggested but not required.

#### **BME 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: ME 5440.

**BME 5800. Clinical Devices & Instruments. 3 Credits.**

Focuses on the development, design and adaptation of biomedical devices and instruments in exciting active areas of biomedical device development and applications at UVM and the UVM Medical Center (UVMCMC). Includes lectures on commercialization and manufacturing. Team-taught by faculty in the Larner College of Medicine and the UVMCMC. Credit not awarded for both BME 5800 and BME 3810. Prerequisites: Biomedical Engineering Graduate student or Instructor permission; Content knowledge in ANPS 1190, ANPS 1200, BME 2000, and BME 2050 is assumed.

**BME 5990. Special Topics. 1-18 Credits.**

See Schedule of Courses for specific titles.

**BME 6391. Master's Thesis Research. 1-18 Credits.**

Research for the Master's Thesis.

**BME 6710. Brain-Computer Interfaces. 3 Credits.**

Includes writing Python software to analyze data from the human brain and decode it to develop brain-computer interfaces (BCIs) that can predict a person's response/intent from brain activity alone. Includes work with real examples of neural data, particularly non-invasive electroencephalography (EEG) recordings. Discusses the design and ethics of real-world BCIs. Prerequisites: At least 2 semesters of coding, at least 1 of these semesters in Python or Matlab.

**BME 6930. Graduate Seminar. 1 Credit.**

Presentation and discussion of advanced problems, research, and current topics in Electrical Engineering by faculty, Graduate students, and outside guest speakers.

**BME 6990. Special Topics. 1-18 Credits.**

See Schedule of Courses for specific titles.

**BME 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.

**BME 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.

**BME 7491. Doctoral Dissertation Research. 1-18 Credits.**

Research for the Doctoral Dissertation.

**BME 7990. Special Topics. 1-18 Credits.**

See Schedule of Courses for specific titles.

**BME 7993. 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.

**BME 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.