ELECTRICAL ENGINEERING

OVERVIEW
The Electrical Engineering program at the University of Vermont (UVM) offers programs of study leading to the M.S. and Ph.D. degrees in Electrical Engineering. In addition, the EE program partners with other academic units to offer M.S. and Ph.D. degrees in materials science and the Ph.D. degree in bioengineering. Areas of research expertise in electrical engineering include digital signal processing, control systems, electromagnetics and optics, electric energy systems, solid-state physical electronics, semiconductor materials and devices, wireless communications, VLSI design and testing, and biomedical engineering.

DEGREES
- Electrical Engineering AMP
- Electrical Engineering M.S.
- Electrical Engineering Ph.D.

FACULTY
Almassalki, Mads; Assistant Professor, School of Engineering; PHD, University of Michigan Ann Arbor
Frolik, Jeff L.; Associate Professor, School of Engineering; PHD, University of Michigan Ann Arbor
Hines, Paul D.; Assistant Professor, School of Engineering; PHD, Carnegie Mellon University
Ossareh, Hamid; Assistant Professor, Department of Electrical and Biomedical Engineering; PHD, University of Michigan Ann Arbor
Oughstun, Kurt Edmund; Professor, School of Engineering; PHD, University of Rochester
Varhue, Walter John; Professor, School of Engineering; PHD, University of Virginia
Xia, Tian; Associate Professor, School of Engineering; PHD, University of Rhode Island

Courses
EE 209. Transmission Line Analysis. 3 Credits.
Fourier-Laplace transform analysis of steady-state and transient phenomena on transmission lines. Phasor representation and complex variable analysis. Prerequisite: MATH 271.

EE 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, EE 210. Prerequisite: EE 171 or ME 111. Cross-listed with: ME 210.

EE 211. Real-Time Control Systems. 3 Credits.
Digital control systems analysis and design. Techniques for system analysis and controller design, e.g., system identification, linearization, gain scheduling, and control of systems with saturation and time delays. State space models and discretization of continuous-time systems. Prerequisites: EE 110 or EE 210 or ME 210.

EE 212. Computer Vision. 3 Credits.
Introduction to computer vision systems for interactive and industrial applications using both hard/software computational approaches. Pre/co-requisites: CS 110; MATH 122 (preferred) or MATH 124 or MATH 271.

EE 213. Systems & Synthetic Biology. 3 Credits.
Applying engineering tools to the design and analysis of biomolecular processes; gene regulatory networks; nonlinear dynamics in molecular biology; biological circuit design; biological signal processing. Prerequisites: Background required: Differential Equations, Linear Algebra, Programming. Cross-listed with: CSYS 213, ME 213.

EE 215. Electric Energy Systems Analys. 3 Credits.
Transmission line, generator, transformer modeling and control, per-unit conversion, power flow calculations and software, symmetric components and fault analysis, protection/relaying, stability analysis, smart grid. Prerequisite: EE 113. Co-requisite: MATH 122 (preferred) or MATH 124.

EE 217. Smart Grid. 3 Credits.
Smart Grid: Using information/communication technology to modernize electric power/energy systems, including generation, transmission, distribution and consumption. Electricity physics/economics/policy; renewable energy; energy storage; demand response; energy efficiency; distributed generation; advanced metering infrastructure; distribution automation; microgrids; synchrophasors; HVDC and FACTS systems. Prerequisite: EE 113 or Graduate standing. Co-requisite: EE 215 recommended.

EE 221. Digital VLSI Circuit Design. 0 or 3 Credits.
Design of VLSI circuits using a modular approach with industrial grade software: schematic capture; circuit design languages (HDL); full-custom layouts; mixed signals; synthesis. Laboratory. Prerequisites: EE 121. Pre/co-requisites: EE 131.

EE 222. Analog VLSI Circuit Design. 0 or 3 Credits.
The design, layout, and simulation of VLSI analog circuits. Emphasis on small signal models and circuits used in operational amplifiers. Prerequisites: EE 121; Instructor permission.

EE 224. Principles VLSI System Design. 3 Credits.

EE 227. Biomedical Instrumentation. 3 Credits.
Measurement techniques for biomedical engineering research and industry, and health care institutions. Integrated biomedical monitoring, diagnostic, and therapeutic instrumentation. Prerequisite: EE 100 or EE 004. Co-requisites: EE 121, ANPS 020; Instructor permission. Alternate years.
EE 228. Sensors. 3 Credits.
Sensor design, interrogation, and implementation. A wide variety of electrical, electronic, optical, mechanic, and cross-disciplinary devices. System designs, measurement techniques, and methodologies. Prerequisite: Senior standing in Engineering or Physics.

EE 231. Digital Computer Design I. 3 Credits.
Hardware organization and realization, hard-wired and microprogrammed control units, interrupt and I/O systems. Hardware design language introduced and used for computer design. Prerequisites: EE 131, either EE 134 or CS 101.

EE 232. Digital Computer Design II. 3 Credits.
Memory designs, error control, high-speed addition, multiplication, and division, floating-point arithmetic, CPU enhancements, testing and design for testability. Prerequisite: EE 231.

EE 233. Microprocessor Systems & Appl. 0 or 4 Credits.
Basic principles of mini/microcomputers; A/D; D/A; channels, magnetic devices, display devices, mechanical devices; interface designs of analog systems to mini/microcomputers; principles of microprogramming; bit-slice-based microcomputers. Prerequisite: Department permission; CS 101 desirable.

EE 241. Electromagnetic Wave Theory. 3 Credits.
Electromagnetic radiation and wave propagation in complex media and systems: angular spectrum of plane waves, dispersive pulse propagation, applications to communications, imaging and remote sensing. Prerequisite: EE 141 or equivalent.

EE 245. Quantum Electronics. 3 Credits.
A theoretical description of light-matter interactions in photon emitting resonant cavities. A practical understanding of laser design and operation. Prerequisite: EE 141.

EE 247. Physical Optics. 3 Credits.

EE 261. Semiconductor Materials/Device. 3 Credits.
Energy band theory, effective mass, band structure and electronic properties of semiconductors. Transport of electrons and holes in bulk materials and across interfaces. MOSFETs, BJTs, pn junctions, and Schottky barriers. Prerequisite: EE 163.

EE 262. Solid-State Materials&Devices. 3 Credits.

EE 266. Science & Tech Integrated Cir. 3 Credits.
Science and technology of integrated circuit fabrication. Interaction of processing with material properties, electrical performance, economy, and manufacturability. Prerequisite: EE 163 or EE 261; Co-requisite: EE 164 or EE 262.

EE 272. Information Theory. 3 Credits.
Introduction to probability concepts of information theory; entropy of probability models; theoretical derivations of channel capacity; coding methods and theorems, sampling theorems. Prerequisite: STAT 143, STAT 151, or STAT 153.

EE 273. Digital Communications. 3 Credits.
Digital modulation/demodulation methods and BER performance; source entropy and channel capacity; optimal detection; convolutional codes and decoding algorithms. Pre/co-requisites: EE 174 and STAT 151.

EE 275. Digital Signal Processing. 3 Credits.
Sampling and reconstruction of signals. DFT, FFT and the z-transform. FIR and IIR filter design. Speech coding. Accompanying lab: EE 289. Pre/co-requisites: EE 171; Instructor permission.

EE 276. Image Processing & Coding. 3 Credits.
Image enhancement techniques by point and spatial operations. Data compression techniques to include scalar quantization, entropy coding, transform and sub-band coding. Labs on PC hardware; PC and Unix-based software. Prerequisite: EE 275.

EE 277. Image Anyl&PATTERN RECOGNITION. 3 Credits.

EE 278. Wireless Communication. 3 Credits.
Modern wireless systems, including cellular design, propagation modeling, multiple access and equalization techniques. Pre/co-requisites: EE 174, STAT 151.

EE 279. Wireless Sensor Networks. 3 Credits.
Applications of and technologies behind wireless sensor networks. A systems-level perspective that integrates wireless networking, antennas, radio frequency circuitry, sensors, digital signal processing, embedded systems, and energy. Term project. Prerequisite: EE 174 or Instructor permission.

EE 281. Materials Science Seminar. 1 Credit.
Presentation and discussion of advanced electrical engineering problems and current developments. Prerequisite: Senior or Graduate Engineering enrollment.

EE 295. Special Topics. 1-18 Credits.
Special topics in developing areas of Electrical Engineering. Prerequisite: Senior standing, or Instructor permission.

EE 301. System Theory. 3 Credits.
EE 302. Stochastic Processes. 3 Credits.
Probability theory, random variables and stochastic processes. Response of linear systems to random inputs. Applications in engineering. Prerequisites: EE 171 or ME 111; and STAT 151 or STAT 143.

EE 310. Multivariable Feedback Systems. 3 Credits.
Linear feedback control systems. Builds on undergraduate frequency domain methods and graduate-level state-variable methods in order to develop feedback design concepts for linear multivariable systems. Focus on approaches leveraged by practicing engineers. Prerequisite: EE 110 or EE 210 or ME 210 or EE 301 or Instructor permission.

EE 312. Intro Optimum Control Systems. 3 Credits.
Optimal control problem formulation and solution; including the calculus of variations, Pontryagin’s maximum principle, Hamilton-Jacob theory, dynamic programming, and computational methods. Prerequisite: EE 210.

EE 314. Nonlinear System Theory. 3 Credits.
Basic nonlinear methods including computational and geometrical techniques for analysis of nonlinear systems. Describing function methods and bifurcation and catastrophe theory. Sensitivity and stability considerations. Prerequisite: EE 210 or MATH 230.

EE 338. Semiconductor Dev Model&Simul. 3 Credits.
Analysis and application of computer models for semiconductor process and device simulation. Strategies for development of device models for circuit simulation. Prerequisites: EE 262; Instructor permission.

EE 341. ST:Electromagnetic Field Thry. 3 Credits.
For advanced students in the field of electromagnetism. Topics selected from special interests of staff with lectures and readings from current literature.

EE 352. Adv Semicond Device Phys & Des. 3 Credits.
MOSFET, bipolar, and CMOS device parameters, their characterization, and their relation to process technology. Description and use of computer-aided process and device models. Prerequisite: EE 262.

EE 354. MOS Analog Integrted Circ Dsgn. 3 Credits.
Analysis and design of MOS analog integrated circuits. Each student will design, layout, test, and document an analog integrated circuit using computer-aided-design techniques. Prerequisites: EE 338.

EE 365. Optoelectronic Devices. 3 Credits.
Optical and electro optical properties of semiconductors. Applications to photodetectors, solar cells, light emitting diodes and lasers. Prerequisites: EE 142, EE 261.

EE 366. Solid State & Semicond Thry. 3 Credits.

EE 371. Estimation Theory. 3 Credits.

EE 373. Adv Topics in Communications. 3 Credits.
Advanced topics of current interest in communication systems. Topics may include channel coding/decoding, software radio, ad-hoc networks, wireless systems, etc. Prerequisite: EE 273 or Instructor permission.

EE 391. Master’s Thesis Research. 1-18 Credits.
EE 392. Master’s Project. 1-3 Credits.
Master’s Project.

EE 393. 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.

EE 395. Advanced Special Topics. 1-18 Credits.
Advanced topics of current interest in electrical engineering. Prerequisite: Instructor permission.

EE 491. Doctoral Dissertation Research. 1-18 Credits.