Twin Cities Campus

Electrical Engineering M.S.E.E.

Electrical and Computer Engineering

College of Science and Engineering

Link to a list of faculty for this program.

Contact Information:
Director of Graduate Studies, Department of Electrical and Computer Engineering, University of Minnesota, 3-166 Keller Hall, 200 Union Street SE, Minneapolis, MN 55455 (612-625-3564; fax: 612-626-1136).
Email: jager001@umn.edu
Website: http://www.ece.umn.edu

- Program Type: Master's
- Requirements for this program are current for Spring 2018
- Length of program in credits: 30
- This program does not require summer semesters for timely completion.
- Degree: Master of Science in Electrical Engineering

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

The Department of Electrical and Computer Engineering offers diverse educational programs that encompass nearly all aspects of modern electrical and computer engineering, ranging from the very theoretical system and information theory to highly experimental work in novel device research and microelectronics. Emphases in the major are solid state and physical electronics, surface physics, thin films, sputtering, noise and fluctuation phenomena, quantum electronics, plasma physics, automation, power systems and power electronics theory, wave propagation, communication systems and theory, optics, lasers, fiber optics, magnetism, semiconductor properties and devices, VLSI and WSI engineering in theory and practice, network theory, signal and image processing, and computer and systems engineering. Interdisciplinary work is also available in bioelectrical sciences, control sciences, computer sciences, solar energy, applications of systems theory to urban transportation and economic planning, and biological modeling.

Students are considered for admission beginning fall semester only (except for part-time students living in Minnesota who work in industry and who may apply for other terms). The deadline for applying for fall semester is December 1.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)
- completely online (all program coursework can be completed online)
- primarily online (at least 80% of the instruction for the program is online with short, intensive periods of face-to-face coursework)
- partially online (between 50% to 80% of instruction is online)

Prerequisites for Admission

The preferred undergraduate GPA for admittance to the program is 3.40.

Other requirements to be completed before admission:
Consideration is given to students who have completed another curriculum in engineering, science, physics, or mathematics that includes sufficient preparation to pursue a graduate program in electrical engineering. In some instances, additional preparatory studies may be required after admission.

All documents must be submitted electronically. No documents should be mailed to the department or the Graduate Admissions Office.

Every applicant must submit the General Test of the GRE (except University of Minnesota bachelor of electrical engineering graduates who have a GPA of 3.40 or better). The GRE Subject Test is not required for admission.

Special Application Requirements:
Applications are accepted for fall admission only. The deadline is December 1. Additional application information is available at http://www.ece.umn.edu/ProspectiveStudentsGraduate/index.htm

Applicants must submit their test score(s) from the following:

- GRE

International applicants must submit score(s) from one of the following tests:

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- TOEFL
  - Internet Based - Total Score: 79
  - Internet Based - Writing Score: 21
  - Internet Based - Reading Score: 19
  - Paper Based - Total Score: 550
- IELTS
  - Total Score: 6.5
- MELAB
  - Final score: 80

Key to test abbreviations(GRE, TOEFL, IELTS, MELAB).

For an online application or for more information about graduate education admissions, see the General Information section of the catalog website.

Program Requirements

Plan A: Plan A requires 14 major credits, 6 credits outside the major, and 10 thesis credits.The final exam is oral.

Plan C: Plan C requires 18 to 24 major credits and 6 to 12 credits outside the major.The is no final exam.

This program may be completed with a minor.

Use of 4xxx courses toward program requirements is permitted under certain conditions with adviser approval.

A minimum GPA of 3.00 is required for students to remain in good standing.

The MSEE requires a minimum of 30 credits. Plan A requires 14 credits in EE courses, 6 credits in a minor or in related fields outside of the department, and 10 thesis credits. Plan C requires at least 18 credits from EE courses 5xxx and above, at least 6 credits in a minor or in related fields outside of the department, and additional credits from the major or related fields to meet the 30-credit minimum. Courses taken outside of the major field must be within the College of Science and Engineering.

Part-time students must choose Plan C; full-time students may choose either Plan A or Plan C. The department limits project, seminar, special investigation, directed study credits, and GRAD 999 registrations.

All courses must be taken A-F, with the exception of EE 5041, EE 8925, and graduate seminars, which are only offered S-N. Cross-listed courses must be taken under the EE designator to count towards degree requirements. Non-EE coursework that is cross-listed with Electrical Engineering does not count toward the non-EE coursework requirement

A maximum of nine 4xxx-level course credits may be used to satisfy masters degree requirements; of these, only six credits may be in EE courses. Only the 4xxx-level courses included on the lists below will be accepted.

M.S.E.E. students who wish to pursue the Ph.D. must pass the Ph.D. preliminary written examination by the end of their second year in residence. Students have two chances to pass the examination. The Ph.D. preliminary written examination is typically held in November and in April.

Coursework

Major Coursework

Courses from this list can be applied to both Plan A and Plan C major field credit requirements. Plan C students can also apply these courses toward MSEEs 30-credit minimum.

EE 5121 - Transistor Device Modeling for Circuit Simulation (3.0 cr)
EE 5141 - Introduction to Microsystem Technology (4.0 cr)
EE 5163 - Semiconductor Properties and Devices I (3.0 cr)
EE 5164 - Semiconductor Properties and Devices II (3.0 cr)
EE 5171 - Microelectronic Fabrication (3.0 cr)
EE 5173 - Basic Microelectronics Laboratory (1.0 cr)
EE 5181 - Micro and Nanotechnology by Self Assembly (3.0 cr)
EE 5231 - Linear Systems and Control (3.0 cr)
EE 5235 - Robust Control System Design (3.0 cr)
EE 5239 - Introduction to Nonlinear Optimization (3.0 cr)
EE 5251 - Optimal Filtering and Estimation (3.0 cr)
EE 5301 - VLSI Design Automation I (3.0 cr)
EE 5302 - VLSI Design Automation II (3.0 cr)

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EE 5323 - VLSI Design I (3.0 cr)
EE 5324 - VLSI Design II (3.0 cr)
EE 5327 - VLSI Design Laboratory (3.0 cr)
EE 5329 - VLSI Digital Signal Processing Systems (3.0 cr)
EE 5333 - Analog Integrated Circuit Design (3.0 cr)
EE 5351 - Applied Parallel Programming (3.0 cr)
EE 5364 - Advanced Computer Architecture (3.0 cr)
EE 5371 - Computer Systems Performance Measurement and Evaluation (3.0 cr)
EE 5381 *{Inactive}*(3.0 cr)
EE 5391 *{Inactive}*(3.0 cr)
EE 5393 - Circuits, Computation, and Biology (3.0 cr)
EE 5501 - Digital Communication (3.0 cr)
EE 5505 - Wireless Communication (3.0 cr)
EE 5531 - Probability and Stochastic Processes (3.0 cr)
EE 5542 - Adaptive Digital Signal Processing (3.0 cr)
EE 5545 - Digital Signal Processing Design (3.0 cr)
EE 5549 - Digital Signal Processing Structures for VLSI (3.0 cr)
EE 8551 - Multirate Signal Processing and Applications (3.0 cr)
EE 5561 - Image Processing and Applications: From linear filters to artificial intelligence (3.0 cr)
EE 5581 - Information Theory and Coding (3.0 cr)
EE 5583 - Error Control Coding (3.0 cr)
EE 5585 - Data Compression (3.0 cr)
EE 5601 - Introduction to RF/Microwave Engineering (3.0 cr)
EE 5602 - RF/Microwave Circuit Design (3.0 cr)
EE 5611 - Plasma-Aided Manufacturing (4.0 cr)
EE 5613 - RF/Microwave Circuit Design Laboratory (2.0 cr)
EE 5616 - Antennas: Theory, Analysis, and Design (3.0 cr)
EE 5621 - Physical Optics (3.0 cr)
EE 5622 - Physical Optics Laboratory (1.0 cr)
EE 5624 - Optical Electronics (4.0 cr)
EE 5627 - Optical Fiber Communication (3.0 cr)
EE 5628 *{Inactive}*(1.0 cr)
EE 5629 *{Inactive}*(2.0 cr)
EE 5653 - Physical Principles of Magnetic Materials (3.0 cr)
EE 5655 - Magnetic Recording (3.0 cr)
EE 5657 - Physical Principles of Thin Film Technology (4.0 cr)
EE 5705 - Electric Drives in Sustainable Energy Systems (3.0 cr)
EE 5707 - Electric Drives in Sustainable Energy Systems Laboratory (1.0 cr)
EE 5721 - Power Generation Operation and Control (3.0 cr)
EE 5725 *{Inactive}*(3.0 cr)
EE 5741 - Advanced Power Electronics (3.0 cr)
EE 5745 - Wind Energy Essentials (2.0 cr)
EE 5940 - Special Topics in Electrical Engineering I (1.0 - 4.0 cr)
EE 5950 *{Inactive}*(1.0 - 4.0 cr)
EE 5960 - Special Topics in Electrical Engineering III (1.0 - 4.0 cr)
EE 5970 *{Inactive}*(1.0 - 4.0 cr)
EE 8100 - Advanced Topics in Electronics (1.0 - 3.0 cr)
EE 8141 - Advanced Heterojunction Transistors (3.0 cr)
EE 8161 - Physics of Semiconductors (3.0 cr)
EE 8163 - Quantum Electronics (3.0 cr)
EE 8213 - Advanced System Theory (3.0 cr)
EE 8215 - Nonlinear Systems (3.0 cr)
EE 8231 - Optimization Theory (3.0 cr)
EE 8235 - Advanced Control Topics (3.0 cr)
EE 8300 - Advanced Topics in Computers (1.0 - 3.0 cr)
EE 8310 - Advanced Topics in VLSI (1.0 - 3.0 cr)
EE 8320 - Advanced Topics in Design Automation (1.0 - 3.0 cr)
EE 8331 - CMOS Data Converters: A/D and D/A (3.0 cr)
EE 8337 - Analog Circuits for Wire/Wireless Communications (3.0 cr)
EE 8367 - Parallel Computer Organization (3.0 cr)
EE 8510 - Advanced Topics in Communications (1.0 - 3.0 cr)
EE 8520 - Advanced Topics in Signal Processing (1.0 - 3.0 cr)
EE 5571 - Statistical Learning and Inference (3.0 cr)
EE 8591 - Predictive Learning from Data (3.0 cr)
EE 8601 - Advanced Electromagnetic Theory (3.0 cr)
EE 8611 - Plasma Physics (3.0 cr)

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EE 8620 - Advanced Topics in Magnetics (1.0 - 3.0 cr)
EE 8630 - Advanced Topics in Electromagnetics (1.0 - 3.0 cr)
EE 8725 - Advanced Power System Analysis and Economics (3.0 cr)
EE 8741 - Power Electronics in Power Systems (3.0 cr)
EE 8950 - Advanced Topics in Electrical and Computer Engineering (3.0 cr)

Outside Coursework

Courses from this list can be applied to both the Plan A and Plan C outside (non-EE) credit requirements. Plan C students can also apply these courses toward MSEEs 30-credit minimum.

AEM 4203 - Aerospace Propulsion (4.0 cr)
AEM 4290 - Special Topics in Fluid Mechanics (1.0 - 3.0 cr)
AEM 4301 - Orbital Mechanics (3.0 cr)
AEM 4303W - Flight Dynamics and Control [WI] (3.0 cr)
AEM 4305 - Spacecraft Attitude Dynamics and Control (3.0 cr)
AEM 4331 - Aerospace Vehicle Design (4.0 cr)
AEM 4333 - Aerospace Design: Special Projects (3.0 cr)
AEM 4371 *{Inactive}*(3.0 cr)
AEM 4490 - Special Topics in Aerospace Systems (1.0 - 3.0 cr)
AEM 4501 - Aerospace Structures (3.0 cr)
AEM 4502 - Computational Structural Analysis (3.0 cr)
AEM 4511 - Mechanics of Composite Materials (3.0 cr)
AEM 4581 - Mechanics of Solids (3.0 cr)
AEM 4590 - Special Topics in Solid Mechanics and Materials (1.0 - 3.0 cr)
AEM 4601 - Instrumentation Laboratory (3.0 cr)
AEM 4602W - Aeromechanics Laboratory [WI] (4.0 cr)
AEM 5247 - Hypersonic Aerodynamics (3.0 cr)
AEM 5253 - Computational Fluid Mechanics (3.0 cr)
AEM 5333 - Design-to-Flight: Small Uninhabited Aerial Vehicles (3.0 cr)
AEM 5401 - Intermediate Dynamics (3.0 cr)
AEM 5501 - Continuum Mechanics (3.0 cr)
AEM 5503 - Theory of Elasticity (3.0 cr)
AEM 5581 - Mechanics of Solids (3.0 cr)
AEM 5651 - Aeroelasticity (3.0 cr)
BBE 5023 - Process Control and Instrumentation (3.0 cr)
BBE 5333 *{Inactive}*(4.0 cr)
SSM 5612 - Systems Approach to Building Science and Construction (4.0 cr)
SSM 5614 - Building Systems Performance: Testing & Diagnostics (2.0 cr)
BBE 5733 - Renewable Energy Technologies (3.0 cr)
BIOC 5361 - Microbial Genomics and Bioinformatics (3.0 cr)
BIOC 5527 *{Inactive}*(4.0 cr)
BIOC 5528 - Spectroscopy and Kinetics (4.0 cr)
BIOL 4003 - Genetics (3.0 cr)
BIOL 4004 - Cell Biology (3.0 cr)
PMB 4121 - Microbial Ecology and Applied Microbiology (3.0 cr)
BIOL 4850 *{Inactive}*(1.0 - 5.0 cr)
BIOL 4950 - Special Topics in Biology (1.0 - 4.0 cr)
BIOL 5272 - Applied Biostatistics (4.0 cr)
BMEN 5001 - Advanced Biomaterials (3.0 cr)
BMEN 5041 - Tissue Engineering (3.0 cr)
BMEN 5101 - Advanced Bioelectricity and Instrumentation (3.0 cr)
BMEN 5111 - Biomedical Ultrasound (3.0 cr)
BMEN 5151 - Introduction to BioMEMS and Medical Microdevices (2.0 cr)
BMEN 5201 - Advanced Biomechanics (3.0 cr)
BMEN 5311 - Advanced Biomedical Transport Processes (3.0 cr)
BMEN 5321 - Microfluidics in Biology and Medicine (3.0 cr)
BMEN 5351 - Cell Engineering (3.0 cr)
BMEN 5401 - Advanced Biomedical Imaging (3.0 cr)
BMEN 5411 - Neural Engineering (3.0 cr)
BMEN 5412 - Neuromodulation (3.0 cr)
BMEN 5413 - Neural Decoding and Interfacing (3.0 cr)
BMEN 5421 - Introduction to Biomedical Optics (3.0 cr)
BMEN 5501 - Biology for Biomedical Engineers (3.0 cr)
BMEN 5701 - Cancer Bioengineering (3.0 cr)
CEGE 5211 - Highway Design & Traffic Operations (4.0 cr)
CEGE 5214 - Infrastructure Systems Engineering (3.0 cr)
CEGE 5341 - Wave Methods for Nondestructive Testing (3.0 cr)
CEGE 5411 - Applied Structural Mechanics (3.0 cr)

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CHEM 4001 - Chemistry of Biomass and Biomass Conversion to Fuels and Products [ENV] (4.0 cr)
CHEM 4011 - Mechanisms of Chemical Reactions (3.0 cr)
CHEM 4021 - Computational Chemistry (3.0 cr)
CHEM 4066 *{Inactive}*(3.0 cr)
CHEM 4101 - Modern Instrumental Methods of Chemical Analysis (3.0 cr)
CHEM 4111W - Modern Instrumental Methods of Chemical Analysis Lab [WI] (2.0 cr)
CHEM 4201 - Materials Chemistry (3.0 cr)
CHEM 4214 - Polymers (3.0 cr)
CHEM 4221 - Introduction to Polymer Chemistry (3.0 cr)
CHEM 4223W - Polymer Laboratory [WI] (2.0 cr)
CHEM 4301 - Applied Surface and Colloid Science (3.0 cr)
CHEM 4311W - Advanced Organic Chemistry Lab [WI] (4.0 cr)
CHEM 4321 - Organic Synthesis (3.0 cr)
CHEM 4322 - Advanced Organic Chemistry (3.0 cr)
CHEM 4352 - Physical Organic Chemistry (3.0 cr)
CHEM 4361 - Interpretation of Organic Spectra (3.0 cr)
CHEM 4411 - Introduction to Chemical Biology (3.0 cr)
CHEM 4412 - Chemical Biology of Enzymes (3.0 cr)
CHEM 4413 *{Inactive}*(3.0 cr)
CHEM 4501 - Introduction to Thermodynamics, Kinetics, and Statistical Mechanics (3.0 cr)
CHEM 4502 - Introduction to Quantum Mechanics and Spectroscopy (3.0 cr)
CHEM 4511W - Advanced Physical Chemistry Lab [WI] (3.0 cr)
CHEM 4601 - Green Chemistry [ENV] (3.0 cr)
CHEM 4701 - Inorganic Chemistry (3.0 cr)
CHEM 4711W - Advanced Inorganic Chemistry Lab [WI] (3.0 cr)
CHEM 4715 - Physical Inorganic Chemistry (3.0 cr)
CHEM 4725 - Organometallic Chemistry (3.0 cr)
CHEM 4735 - Bioinorganic Chemistry (3.0 cr)
CHEM 4745 - Advanced Inorganic Chemistry (3.0 cr)
CHEM 5755 - X-Ray Crystallography (4.0 cr)
CHEN 4214 - Polymers (3.0 cr)
CHEN 4401W - Senior Chemical Engineering Lab [WI] (4.0 cr)
CHEN 4501W - Chemical Engineering Design [WI] (4.0 cr)
CHEN 4502W *{Inactive}*[WI] (2.0 cr)
CHEN 4601 - Process Control (3.0 cr)
CHEN 4701 - Applied Math (3.0 cr)
CHEN 4702 - Introduction to Rheology (2.0 cr)
CHEN 4704 - Advanced Undergraduate Physical Rate Processes I: Transport (3.0 cr)
CHEN 4707 *{Inactive}*(3.0 cr)
CHEN 4708 - Advanced Undergraduate Chemical Rate Processes: Analysis of Chemical Reactors (3.0 cr)
CHEN 5751 - Biochemical Engineering (3.0 cr)
CHEN 5753 - Advanced Biomedical Transport Processes (3.0 cr)
CHEN 5771 - Colloids and Dispersions (3.0 cr)
CMB 5200 - Statistical Genetics and Genomics (4.0 cr)
CSCI 4011 - Formal Languages and Automata Theory (4.0 cr)
CSCI 4041 - Algorithms and Data Structures (4.0 cr)
CSCI 4041H *{Inactive}*(4.0 cr)
CSCI 4061 - Introduction to Operating Systems (4.0 cr)
CSCI 4131 - Internet Programming (3.0 cr)
CSCI 4211 - Introduction to Computer Networks (3.0 cr)
CSCI 4511W - Introduction to Artificial Intelligence [WI] (4.0 cr)
CSCI 4611 - Programming Interactive Computer Graphics and Games (3.0 cr)
CSCI 4707 - Practice of Database Systems (3.0 cr)
CSCI 4921 - History of Computing [TS, HIS] (3.0 cr)
CSCI 4970W - Advanced Project Laboratory [WI] (3.0 cr)
CSCI 5103 - Operating Systems (3.0 cr)
CSCI 5105 - Introduction to Distributed Systems (3.0 cr)
CSCI 5106 - Programming Languages (3.0 cr)
CSCI 5115 - User Interface Design, Implementation and Evaluation (3.0 cr)
CSCI 5125 - Collaborative and Social Computing (3.0 cr)
CSCI 5143 - Real-Time and Embedded Systems (3.0 cr)
CSCI 5161 - Introduction to Compilers (3.0 cr)
CSCI 5211 - Data Communications and Computer Networks (3.0 cr)
CSCI 5221 - Foundations of Advanced Networking (3.0 cr)
CSCI 5231 *{Inactive}*(3.0 cr)
CSCI 5271 - Introduction to Computer Security (3.0 cr)

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CSCI 5302 - Analysis of Numerical Algorithms (3.0 cr)
CSCI 5304 - Computational Aspects of Matrix Theory (3.0 cr)
CSCI 5403 *{Inactive}*(3.0 cr)
CSCI 5421 - Advanced Algorithms and Data Structures (3.0 cr)
CSCI 5451 - Introduction to Parallel Computing: Architectures, Algorithms, and Programming (3.0 cr)
CSCI 5461 - Functional Genomics, Systems Biology, and Bioinformatics (3.0 cr)
CSCI 5471 - Modern Cryptography (3.0 cr)
CSCI 5481 - Computational Techniques for Genomics (3.0 cr)
CSCI 5511 - Artificial Intelligence I (3.0 cr)
CSCI 5512 - Artificial Intelligence II (3.0 cr)
CSCI 5521 - Machine Learning Fundamentals (3.0 cr)
CSCI 5523 - Introduction to Data Mining (3.0 cr)
CSCI 5525 - Machine Learning: Analysis and Methods (3.0 cr)
CSCI 5551 - Introduction to Intelligent Robotic Systems (3.0 cr)
CSCI 5552 - Sensing and Estimation in Robotics (3.0 cr)
CSCI 5561 - Computer Vision (3.0 cr)
CSCI 5607 - Fundamentals of Computer Graphics 1 (3.0 cr)
CSCI 5608 - Fundamentals of Computer Graphics II (3.0 cr)
CSCI 5609 - Visualization (3.0 cr)
CSCI 5611 - Animation & Planning in Games (3.0 cr)
CSCI 5619 - Virtual Reality and 3D Interaction (3.0 cr)
CSCI 5707 - Principles of Database Systems (3.0 cr)
CSCI 5708 - Architecture and Implementation of Database Management Systems (3.0 cr)
CSCI 5801 - Software Engineering I (3.0 cr)
CSCI 5802 - Software Engineering II (3.0 cr)
ESCI 5201 - Time-Series Analysis of Geological Phenomena (3.0 cr)
ESCI 5204 - Geostatistics and Inverse Theory (3.0 cr)
ESCI 5205 *{Inactive}*(3.0 cr)
ESCI 5302 - Isotope Geology (3.0 cr)
ESCI 5353 - Electron Microprobe Theory and Practice (3.0 cr)
GCD 5036 - Molecular Cell Biology (3.0 cr)
IE 5111 - Systems Engineering I (2.0 cr)
IE 5112 *{Inactive}*(3.0 cr)
IE 5113 - Systems Engineering II (4.0 cr)
IE 5441 - Financial Decision Making (4.0 cr)
MATH 4065 - Theory of Interest (4.0 cr)
MATH 4152 - Elementary Mathematical Logic (3.0 cr)
MATH 4242 - Applied Linear Algebra (4.0 cr)
MATH 4281 - Introduction to Modern Algebra (4.0 cr)
MATH 4428 - Mathematical Modeling (4.0 cr)
MATH 4512 - Differential Equations with Applications (3.0 cr)
MATH 4567 - Applied Fourier Analysis (4.0 cr)
MATH 4603 - Advanced Calculus I (4.0 cr)
MATH 4604 - Advanced Calculus II (4.0 cr)
MATH 4653 - Elementary Probability (4.0 cr)
MATH 4707 - Introduction to Combinatorics and Graph Theory (4.0 cr)
MATH 4990 - Topics in Mathematics (1.0 - 4.0 cr)
MATH 5067 - Actuarial Mathematics I (4.0 cr)
MATH 5068 - Actuarial Mathematics II (4.0 cr)
MATH 5075 - Mathematics of Options, Futures, and Derivative Securities I (4.0 cr)
MATH 5076 - Mathematics of Options, Futures, and Derivative Securities II (4.0 cr)
MATH 5165 - Mathematical Logic I (4.0 cr)
MATH 5166 *{Inactive}*(4.0 cr)
MATH 5248 - Cryptology and Number Theory (4.0 cr)
MATH 5251 - Error-Correcting Codes, Finite Fields, Algebraic Curves (4.0 cr)
MATH 5335 - Geometry I (4.0 cr)
MATH 5336 *{Inactive}*(4.0 cr)
MATH 5378 - Differential Geometry (4.0 cr)
MATH 5385 - Introduction to Computational Algebraic Geometry (4.0 cr)
MATH 5445 - Mathematical Analysis of Biological Networks (4.0 cr)
MATH 5447 - Theoretical Neuroscience (4.0 cr)
MATH 5467 - Introduction to the Mathematics of Image and Data Analysis (4.0 cr)
MATH 5485 - Introduction to Numerical Methods I (4.0 cr)
MATH 5486 - Introduction To Numerical Methods II (4.0 cr)
MATH 5525 - Introduction to Ordinary Differential Equations (4.0 cr)
MATH 5535 - Dynamical Systems and Chaos (4.0 cr)

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MATH 5583 - Complex Analysis (4.0 cr)
MATH 5587 - Elementary Partial Differential Equations I (4.0 cr)
MATH 5588 - Elementary Partial Differential Equations II (4.0 cr)
MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)
MATH 5652 - Introduction to Stochastic Processes (4.0 cr)
MATH 5654 - Prediction and Filtering (4.0 cr)
MATH 5705 - Enumerative Combinatorics (4.0 cr)
MATH 5707 - Graph Theory and Non-enumerative Combinatorics (4.0 cr)
MATH 5711 - Linear Programming and Combinatorial Optimization (4.0 cr)
MATS 5517 - Microscopy of Materials (3.0 cr)
MATS 5531 *{Inactive}*(3.0 cr)
MATS 5771 - Colloids and Dispersions (3.0 cr)
ME 5113 - Aerosol/Particle Engineering (4.0 cr)
ME 5223 - Materials in Design (4.0 cr)
ME 5228 - Introduction to Finite Element Modeling, Analysis, and Design (4.0 cr)
ME 5241 - Computer-Aided Engineering (4.0 cr)
ME 5243 - Advanced Mechanism Design (4.0 cr)
ME 5247 - Applied Stress Analysis (4.0 cr)
ME 5281 - Feedback Control Systems (4.0 cr)
ME 5286 - Robotics (4.0 cr)
ME 5312 - Solar Thermal Technologies (4.0 cr)
ME 5344 - Thermodynamics of Fluid Flow With Applications (4.0 cr)
ME 5351 - Computational Heat Transfer (4.0 cr)
ME 5461 - Internal Combustion Engines (4.0 cr)
MOT 4001 - Leadership, Professionalism and Business Basics for Engineers (2.0 cr)
MPHY 5170 - Radiation Therapy Physics I (3.0 cr)
MPHY 5171 - Medical and Health Physics of Imaging I (3.0 cr)
MPHY 5174 - Medical and Health Physics of Imaging II (3.0 cr)
NSC 5040 - Brain Networks: From Connectivity to Dynamics (4.0 cr)
NSC 5202 - Theoretical Neuroscience: Systems and Information Processing (3.0 cr)
NSC 5203 - Basic and Clinical Vision Science (3.0 cr)
NSC 5561 - Systems Neuroscience (4.0 cr)
PHSL 5061 - Principles of Physiology for Biomedical Engineering (4.0 cr)
PHSL 5101 - Human Physiology (5.0 cr)
PHSL 5201 - Computational Neuroscience I: Membranes and Channels (3.0 cr)
PHYS 4001 - Analytical Mechanics (4.0 cr)
PHYS 4002 - Electricity and Magnetism (4.0 cr)
PHYS 4041 - Computational Methods in the Physical Sciences (4.0 cr)
PHYS 4051 - Methods of Experimental Physics I (5.0 cr)
PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)
PHYS 4101 - Quantum Mechanics (4.0 cr)
PHYS 4121W - History of 20th-Century Physics [WI] (3.0 cr)
PHYS 4201 - Statistical and Thermal Physics (3.0 cr)
PHYS 4211 - Introduction to Solid-State Physics (3.0 cr)
PHYS 4303 - Electrodynamics and Waves (3.0 cr)
PHYS 4511 - Introduction to Nuclear and Particle Physics (3.0 cr)
PHYS 4611 - Introduction to Space Physics (3.0 cr)
PHYS 4621 - Introduction to Plasma Physics (3.0 cr)
PHYS 4911 - Introduction to Biopolymer Physics (3.0 cr)
PHYS 5001 - Quantum Mechanics I (4.0 cr)
PHYS 5002 - Quantum Mechanics II (4.0 cr)
PHYS 5011 - Classical Physics I (4.0 cr)
PHYS 5012 - Classical Physics II (4.0 cr)
PHYS 5041 - Mathematical Methods for Physics (4.0 cr)
PHYS 5081 - Introduction to Biopolymer Physics (3.0 cr)
PHYS 5201 - Thermal and Statistical Physics (3.0 cr)
PHYS 5402 *{Inactive}*(4.0 cr)
PHYS 5701 - Solid-State Physics for Engineers and Scientists (4.0 cr)
PSY 5036W - Computational Vision [WI] (3.0 cr)
PSY 5038W - Introduction to Neural Networks [WI] (3.0 cr)
STAT 4101 - Theory of Statistics I (4.0 cr)
STAT 4102 - Theory of Statistics II (4.0 cr)
STAT 5021 - Statistical Analysis (4.0 cr)
STAT 5031 *{Inactive}*(4.0 cr)
STAT 5101 - Theory of Statistics I (4.0 cr)
STAT 5102 - Theory of Statistics II (4.0 cr)

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STAT 5201 - Sampling Methodology in Finite Populations (3.0 cr)
STAT 5302 - Applied Regression Analysis (4.0 cr)
STAT 5303 - Designing Experiments (4.0 cr)
STAT 5401 - Applied Multivariate Methods (3.0 cr)
STAT 5421 - Analysis of Categorical Data (3.0 cr)
STAT 5511 - Time Series Analysis (3.0 cr)

Plan A

Plan A students have the option to apply the following courses to their major field credit requirement. A maximum of 2 credits from the following subset of this list can be used: EE 8190, EE 8210, EE 8230, EE 8360, EE 8370, EE 8370, EE 8500, EE 8610, EE 8660, EE 8920, EE 8925, EE 8940.

EE 4111 - Advanced Analog Electronics Design (4.0 cr)
EE 4161W - Energy Conversion and Storage [WI] (3.0 cr)
EE 4163 - Energy Conversion and Storage Laboratory (1.0 cr)
EE 4231 - Linear Control Systems: Designed by Input/Output Methods (3.0 cr)
EE 4233 - State Space Control System Design (3.0 cr)
EE 4235 - Linear Control Systems Laboratory (1.0 cr)
EE 4237 - State Space Control Laboratory (1.0 cr)
EE 4301 - Digital Design With Programmable Logic (4.0 cr)
EE 4303 - Introduction to Programmable Devices Laboratory (1.0 cr)
EE 4341 - Embedded System Design (4.0 cr)
EE 4363 - Computer Architecture and Machine Organization (4.0 cr)
EE 4389W - Introduction to Predictive Learning [WI] (3.0 cr)
EE 4501 - Communications Systems (3.0 cr)
EE 4505 - Communications Systems Laboratory (1.0 cr)
EE 4541 - Digital Signal Processing (3.0 cr)
EE 4607 - Wireless Hardware System Design (3.0 cr)
EE 4701 - Electric Drives (3.0 cr)
EE 4703 - Electric Drives Laboratory (1.0 cr)
EE 4721 - Introduction to Power System Analysis (3.0 cr)
EE 4722 - Power System Analysis Laboratory (1.0 cr)
EE 4741 - Power Electronics (3.0 cr)
EE 4743 - Switch-Mode Power Electronics Laboratory (1.0 cr)
EE 5041 - Industrial Assignment for Graduate Students (1.0 cr)
EE 8190 - Electronics Seminar (1.0 cr)
EE 8210 - System Theory Seminar (1.0 cr)
EE 8230 - Control Theory Seminar (1.0 cr)
EE 8360 - Computer Systems Seminar (1.0 cr)
EE 8370 - Computer Aided Design Seminar (1.0 cr)
EE 8500 - Seminar: Communications (1.0 cr)
EE 8610 - Seminar: Electronics, Fields, and Photonics (1.0 cr)
EE 8660 - Seminar: Magnetics (1.0 cr)
EE 8920 - Teaching Experience in Electrical and Computer Engineering (1.0 cr)
EE 8925 - Ethics in Electrical and Computer Engineering (1.0 cr)
EE 8940 - Special Investigations (1.0 - 3.0 cr)

Thesis Credits

All Plan A students must take at least 10 master's thesis credits.
EE 8777 - Thesis Credits: Master's (1.0 - 18.0 cr)

Plan C

Plan C students have the option to apply the following courses toward MSEEs 30-credit minimum. These courses do not satisfy the major or outside (non-EE) credit requirements.
A maximum of 2 credits of the following may be applied: EE 5041, EE 8190, EE 8210, EE 8230, EE 8360, EE 8370, EE 8500, EE 8610, EE 8660, EE 8920, EE 8925, and EE 8940.

EE 4111 - Advanced Analog Electronics Design (4.0 cr)
EE 4161W - Energy Conversion and Storage [WI] (3.0 cr)
EE 4163 - Energy Conversion and Storage Laboratory (1.0 cr)
EE 4231 - Linear Control Systems: Designed by Input/Output Methods (3.0 cr)
EE 4233 - State Space Control System Design (3.0 cr)
EE 4235 - Linear Control Systems Laboratory (1.0 cr)
EE 4237 - State Space Control Laboratory (1.0 cr)
EE 4301 - Digital Design With Programmable Logic (4.0 cr)
EE 4303 - Introduction to Programmable Devices Laboratory (1.0 cr)
EE 4341 - Embedded System Design (4.0 cr)
EE 4363 - Computer Architecture and Machine Organization (4.0 cr)
EE 4389W - Introduction to Predictive Learning [WI] (3.0 cr)

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EE 4501 - Communications Systems (3.0 cr)
EE 4505 - Communications Systems Laboratory (1.0 cr)
EE 4541 - Digital Signal Processing (3.0 cr)
EE 4607 - Wireless Hardware System Design (3.0 cr)
EE 4701 - Electric Drives (3.0 cr)
EE 4703 - Electric Drives Laboratory (1.0 cr)
EE 4721 - Introduction to Power System Analysis (3.0 cr)
EE 4722 - Power System Analysis Laboratory (1.0 cr)
EE 4741 - Power Electronics (3.0 cr)
EE 4743 - Switch-Mode Power Electronics Laboratory (1.0 cr)
EE 5041 - Industrial Assignment for Graduate Students (1.0 cr)
EE 8190 - Electronics Seminar (1.0 cr)
EE 8210 - System Theory Seminar (1.0 cr)
EE 8230 - Control Theory Seminar (1.0 cr)
EE 8360 - Computer Systems Seminar (1.0 cr)
EE 8370 - Computer Aided Design Seminar (1.0 cr)
EE 8500 - Seminar: Communications (1.0 cr)
EE 8610 - Seminar: Electronics, Fields, and Photonics (1.0 cr)
EE 8660 - Seminar: Magnetics (1.0 cr)
EE 8920 - Teaching Experience in Electrical and Computer Engineering (1.0 cr)
EE 8925 - Ethics in Electrical and Computer Engineering (1.0 cr)
EE 8940 - Special Investigations (1.0 - 3.0 cr)

Project Requirement

Plan C students must complete a paper and project. The following courses satisfy all or a portion of the requirement. Contact the EE department for additional information.

EE 5171 - Microelectronic Fabrication (3.0 cr)
EE 5235 - Robust Control System Design (3.0 cr)
EE 5301 - VLSI Design Automation I (3.0 cr)
EE 5324 - VLSI Design II (3.0 cr)
EE 5327 - VLSI Design Laboratory (3.0 cr)
EE 5329 - VLSI Digital Signal Processing Systems (3.0 cr)
EE 5333 - Analog Integrated Circuit Design (3.0 cr)
EE 5364 - Advanced Computer Architecture (3.0 cr)
EE 5371 - Computer Systems Performance Measurement and Evaluation (3.0 cr)
EE 5505 - Wireless Communication (3.0 cr)
EE 5545 - Digital Signal Processing Design (3.0 cr)
EE 5601 - Introduction to RF/Microwave Engineering (3.0 cr)
EE 5602 - RF/Microwave Circuit Design (3.0 cr)
EE 5611 - Plasma-Aided Manufacturing (4.0 cr)
EE 5613 - RF/Microwave Circuit Design Laboratory (2.0 cr)
EE 5621 - Physical Optics (3.0 cr)
EE 5624 - Optical Electronics (4.0 cr)
EE 5627 - Optical Fiber Communication (3.0 cr)
EE 5653 - Physical Principles of Magnetic Materials (3.0 cr)
EE 5655 - Magnetic Recording (3.0 cr)
EE 5657 - Physical Principles of Thin Film Technology (4.0 cr)
EE 5725 *{Inactive}*(3.0 cr)
EE 8161 - Physics of Semiconductors (3.0 cr)
EE 8337 - Analog Circuits for Wire/Wireless Communications (3.0 cr)
EE 8591 - Predictive Learning from Data (3.0 cr)
EE 8611 - Plasma Physics (3.0 cr)
EE 8965 - Plan C Project I (3.0 cr)
EE 8967 - Plan C Project II (1.0 - 3.0 cr)

Program Sub-plans

A sub-plan is not required for this program.
Students may not complete the program with more than one sub-plan.

Rochester

The University of Minnesota Rochester (UMR) offers the MS degree in electrical engineering. Students may complete all degree requirements in Rochester by combining courses taught by College of Science and Engineering faculty in person (face-to-face), or via streaming video using the UNITE (University-Industry Television for Education) instructional television system. UNITE enables students to watch class live via the internet or pick up class on a special server at a later time.

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Integrated B.E.E./M.S.E.E.

The Department of Electrical and Computer Engineering offers an integrated bachelor of electrical engineering (BEE) and master of science in electrical engineering (MSEE). The integrated BEE/MSEE program offers students the opportunity to earn both degrees in five years. The programs were established to allow high-achieving University undergraduates the opportunity to work toward a masters degree while simultaneously working toward their undergraduate degree. The combined program offers several advantages: flexibility in fulfilling required courses for both degrees during the senior year; eligibility for graduate assistantships and fellowships; and the ability to save money by completing up to 16 graduate credits at the undergraduate tuition rate.

Both the BEE and MSEE degrees must be completed in their entirety, with no courses shared between them. The graduate degree cannot be earned before the undergraduate requirements are satisfied.

Eligibility requirements:

Application to the integrated program is open to University students in the electrical engineering or computer engineering program who have completed a majority of the required upper division courses for their undergraduate degree and have a cumulative GPA of 3.4 or higher. Students with a GPA between 3.2 and 3.4 may also apply, but must submit a GRE score.

Integrated B.Comp.E./M.S.E.E.

The Department of Electrical and Computer Engineering offers an integrated bachelor of computer engineering (B.Comp.E.) and master of science in electrical engineering (MSEE). Benefits, eligibility requirements, and degree-completion requirements outlined for the BEEE/MSEE integrated program also apply to the B.Comp.E/MSEE.

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