



Earn your Graduate Degree in Electrical Engineering

Department of Electrical Engineering
and Computer Science

<http://eecs.mines.edu>



Graduate Admission Questions?

Contact Lori Sisneros, Graduate Program Administrator

sisneros@mines.edu – (303)273-3658

Why go to graduate school?



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- Graduate-level classes
 - learn about cutting-edge topics from experts in the field
- Collaborate
 - with students, postdocs, and faculty members
- Make a difference
 - learn about the frontiers of knowledge in your field...
...and then expand them
 - address the many complex problems facing society
- Challenge yourself
 - learn how to think beyond your classes
 - learn how to ask important (but answerable) questions
 - learn how to provide convincing answers



Why go to graduate school?



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- Advanced degrees provide a competitive edge in the job market
 - Higher salaries
 - More-rapid advancement
- Career potential
 - More opportunities, more interesting jobs
 - Security against outsourcing and global competition
- Teaching / research assistantships can cover tuition and pay a stipend
 - Yearly salary ~ \$22,000
 - Full tuition, fees, and health insurance coverage
 - Assistantships are competitive - many students don't get assistantships



Doors Opened



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- M.S. Degree
 - technical positions with additional responsibilities
 - deeper, more stimulating work
 - R&D positions
- Ph.D. Degree
 - research-oriented positions in industry
 - research-oriented positions at national labs
 - teaching/research positions in academia



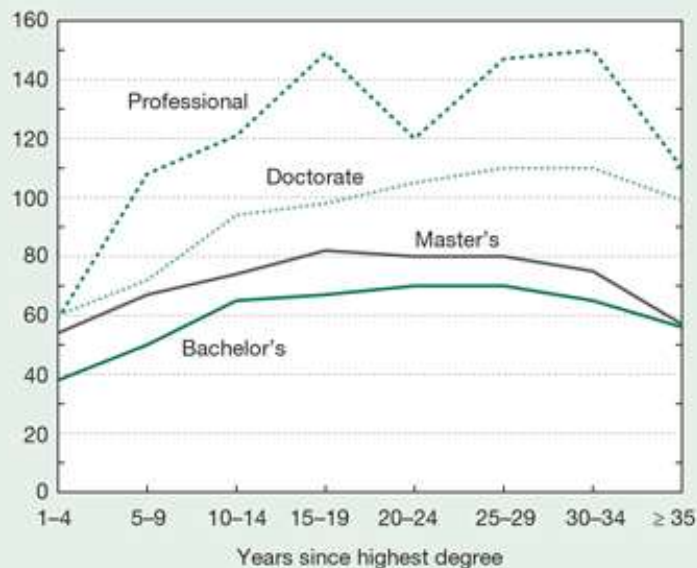
It Pays to have a Graduate Degree



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Figure 3-22
Median salaries for employed scientists and engineers, by level of and years since highest degree: 2010

Thousands of dollars



NOTE: Scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), <http://sestat.nsf.gov>.

Science and Engineering Indicators 2014

Starting salaries:

- M.S. 16% higher than B.S.
- Ph.D. 22% higher than B.S.

What does it take?



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- **Typical Admission requirements:**
 - GPA (minimum is 3.0 for CSM)
 - GRE scores ← **GRE is waived for CSM undergrads**
 - recommendation letters
 - work experience and/or research experience
 - personal statement
 - research interests vs. needs and interests of the faculty
- Typical deadlines are December-January for Fall admissions (**December 15th is CSM Priority Deadline**)
 - especially to receive priority consideration for financial aid
 - Many schools accept applications for Spring admissions

Applying to Grad School – where to apply?



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- Visit websites and ask faculty in your area of interest
- Important factor (for research): Who will be your advisor?
 - Not always known when admitted, but try to get an idea
 - Consider advisor's reputation, funding, working style
- Apply to several places, especially if:
 - You are applying for thesis-based degrees, or
 - You are applying to highly selective schools

Grad School at CSM



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- The EECS department has
 - 25 faculty (15 in EE)
 - ~61 M.S. students (38 in EE)
 - ~40 Ph.D. students (23 in EE)
- Research volume: ~\$1.5 million/yr.
- Focus areas
 - Antennas and Wireless Communications
 - Information and Systems Sciences
 - Energy Systems and Power Electronics



Funding: Teaching Assistantships (TAs)



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- Responsibilities:
 - Teach, grade, supervise lab sessions
 - Approximately 20 hours/week
- Typical terms:
 - Stipend, tuition, fees, health insurance paid
 - Typically for one year (your first year)
- Positions are awarded **by the department**
 - Can apply for this when applying for admission



Funding: Research Assistantships (RAs)

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- Faculty write proposals to industry & government
 - If contracts are awarded, **faculty hire students** to conduct research
- Students address the proposed technical problems
 - Students become experts on the problem under study
 - Faculty and funding agency learn from students
 - This research typically becomes the student's thesis project
- Typical terms:
 - Stipend, tuition, fees, health insurance paid
 - Can go for multiple years





Funding: Fellowships

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- Responsibilities:
 - Varies; often no strings attached
- Typical terms:
 - Tuition, fees, health insurance paid
 - Duration can range from 1 semester to several years
- Sources:
 - The university/department itself
 - Government agencies
 - Non-government programs
- See
http://www.mines.edu/HowToPay_GS#CSMF

External Fellowships



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Advancing Science, Serving Society (AAAS)

Science & Technology Policy Fellowships

<http://fellowships.aaas.org/index.shtml>

Since 1981, EPA's NCER has managed the AAAS Science and Engineering Fellows Program, in cooperation with the American Association for the Advancement of Science (AAAS). The fellowship program is designed to provide an opportunity to learn first-hand how scientific and technological information is used in environmental policy-making; to provide a unique public policy learning experience; to demonstrate the value of science, technology, and economics in addressing societal problems; and to make practical contributions to the more effective use of scientific and technical knowledge in the programs of the U.S. government. Fellows will work in offices throughout the EPA on projects of mutual interest to the Fellows and the hosting offices. Applications are accepted by AAAS in the fall of each year.

Eligibility: ME/EE/CS

Must hold a doctoral level degree and be a US Citizen. Engineering disciplines (applicants with a MS in engineering and three or more years of professional experience also qualify).

Approximate Deadline: November 1

Zonta International

Amelia Earhart Fellowship

<http://www.zonta.org/WhatWeDo/InternationalPrograms/AmeliaEarhartFellowship.aspx>

Today, women remain a distinct minority in science and engineering, representing approximately 10 percent of professionals in these fields. The Amelia Earhart Fellowship program helps talented women, pursuing advanced studies in the typically male-dominated fields of aerospace-related sciences and engineering, achieve their educational goals. The Fellowship enables these women to invest in state-of-the-art computers to conduct their research, purchase expensive books and resource materials, and participate in specialized studies around the globe. Established in 1938 in honor of famed pilot and Zontian, Amelia Earhart, the Amelia Earhart Fellowship is awarded annually to women pursuing Ph.D./doctoral degrees in aerospace-related sciences or aerospace-related engineering. The Fellowship of US\$10,000, awarded to 35 Fellows around the globe each year, may be used at any university or college offering accredited post-graduate courses and degrees in these fields.

Eligibility: ME/EE/CS

Must be a female pursuing a Ph.D./doctoral degree in the field of aerospace-related sciences or aerospace-related engineering.

Approximate Deadline: November 15

The National GEM Consortium

M.S. Engineering Fellowship Program

<http://www.gemfellowship.org/gem-fellowship>

GEM's fellowship programs span the entire recruitment, retention, and professional development spectrum. GEM's principal activity is the provision of graduate fellowships at the MS and Ph.D. levels coupled with paid summer internships. GEM also offers programming on the importance of graduate school and tools for access and successful matriculation. The objective of this program is to promote the benefits of a master's degree within industry. GEM Fellows are provided practical engineering summer work experiences through an employer sponsor and a portable academic year fellowship of tuition, fees, and a stipend which may be used at any participating GEM Member University where the GEM Fellow is admitted.

Eligibility: M.S. - ME/EE/CS

Must be American Indian/Native, African American, or Hispanic and be a U.S. citizen or U.S. permanent resident. Also must be a senior or graduate and have a GPA of 2.8/40.

Approximate Deadline: November 15

The National GEM Consortium

Ph.D. Engineering Fellowship Program

<http://www.gemfellowship.org/gem-fellowship>

GEM's fellowship programs span the entire recruitment, retention, and professional development spectrum. GEM's principal activity is the provision of graduate fellowships at the MS and Ph.D. levels coupled with paid summer internships. GEM also offers programming on the importance of graduate school and tools for access and successful matriculation. The objective of this program is to offer doctoral fellowships to underrepresented minority students who have either completed, are currently enrolled in a master's in engineering program, or received admittance into a PhD program directly from a bachelor's degree program. Fellowships may be used at any participating GEM Member University where the GEM Fellow is admitted.

Eligibility: Ph.D. - ME/EE/CS

Must be American Indian/Native, African American, or Hispanic and be a U.S. citizen or U.S. permanent resident. Also must be a senior, master's student or graduate and have a GPA of 3.0/40.

Approximate Deadline: November 15

External Fellowships



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Colorado School of Mines

Graduate Student Government Grant Programs

<http://gradschool.mines.edu/GSA-Grants>

Graduate Continuance Fellowship, GSG Lecture Series Grant, Meeting Attendee Travel Grant, Presenter Travel Grant, UG travel Grant, and Family Assistance Grant. The Graduate Student Government recognizes that a fundamental way in which it can support graduate students is through various grant/fellowship programs to promote research, travel, and graduate life. We are always interested in feedback on our grant programs, to ensure they're meeting the needs of Mines graduate students. Please contact a GSG Council Member if you have ideas for new grant programs or improvements to existing grant programs.

Eligibility: ME/EE/CS

IBM Ph.D. Fellowship Awards Program

International Business Machines Corporations (IBM)

<http://www.research.ibm.com/university/phdfellowship/>

The IBM Ph.D. Fellowship Awards Program is an intensely competitive worldwide program, which honors exceptional Ph.D. students who have an interest in solving problems that are important to IBM and fundamental to innovation in many academic disciplines and areas of study. These include: computer science and engineering (including cyber security, cloud, and mobile computing), electrical and mechanical engineering, physical sciences (including chemistry, material sciences, and physics), mathematical sciences (including analytics of massive scale data with uncertainty, operations research, and optimization), public sector and business sciences (including urban policy and analytics, social technologies, learning systems and natural language understanding), and service science, management, and engineering (SSME).

Eligibility: Ph.D. ME/EE/CS

Must be nominated by a doctoral faculty member and enrolled full-time in a college or university Ph.D. program.

Approximate Deadline: October 28

Institute of Electrical and Electronics Engineers (IEEE)

IEEE Grants and Fellowships

http://www.ieee.org/membership_services/membership/students/awards/index.html

IEEE offers a variety of scholarships, grants, and fellowships for IEEE Student members. Submit a project or paper for consideration and have the opportunity to win and gain peer recognition for your effort. The IEEE Standards Education Program offers grants of US\$500 for students and US\$300 for faculty to help with university student design projects that include an industry-standards component. Examples of industry standards include: IEEE 802.11 Standard for Wireless LANS, IEEE 11073 Standards for Health Infomatics, National Electric Safety Code, etc.

Eligibility: EE

Approximate Deadlines: March 15, June 15, October 15

National Aeronautics and Space Administration (NASA)

NASA Postdoctoral Program

<http://nasa.orau.org/postdoc/index.htm>

Our activities contribute to the achievement of the Nation's science and technology goals and priorities, one of which is "Educational Excellence: We involve the education community in our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds." NASA uses its unique resources to support educational excellence for all. The NASA Postdoctoral Program provides talented postdoctoral scientists and engineers with valuable opportunities to engage in ongoing NASA research programs and serves as a source of talent to ensure the continued quality of the NASA research workforce. These one- to three-year Fellowship appointments are competitive and are designed to advance NASA's missions in space science, earth science, aeronautics, space operations, exploration systems, and astrobiology.

Eligibility: ME/EE/CS

Approximate Deadlines: March 1, July 1, November 1

Department of Defense

National Defense Science and Engineering Fellowships

<http://ndseg.asee.org/>

As a means of increasing the number of U.S. citizens and nationals trained in science and engineering disciplines of military importance, the Department of Defense (DoD) plans to award approximately 200 new three-year graduate fellowships in April 2014, subject to the availability of funds. The DoD will offer these fellowships to individuals who have demonstrated the ability and special aptitude for advanced training in science and engineering

Eligibility: ME/EE/CS

Must be enrolled in their final year of undergraduate studies and have completed less than two full-time years of graduate study.

Approximate Deadline: December 12

National Science Foundation

National Science Foundation Graduate Research Fellowship Program

<http://www.nsf.gov/index.jsp>

The National Science Foundation's Graduate Research Fellowship Program (GRFP) helps ensure the vitality of the human resource base of science and engineering in the United States and reinforces its diversity. The program recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based masters and doctoral degrees at accredited US institutions. The NSF welcomes applications from all qualified students and strongly encourages under-represented populations, including women, under-represented racial and ethnic minorities, and persons with disabilities, to apply for this fellowship.

Eligibility: ME/EE/CS

Approximate Deadline: Varies

Graduate Degree Options – M.S.



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- Master of Science, non-thesis option
 - 30 credit hours of coursework
 - Timeline: 1.5 years after completion of undergraduate work
 - Not supported by teaching and research assistantships

Rather like the undergrad experience; but with higher level, more specialized courses

- Master of Science, thesis option
 - 24 credit hours of coursework
 - 6 credit hours of thesis work
 - Timeline: 1.5 – 2 years after completion of undergraduate work
 - Occasionally supported by teaching and research assistantships

Work more closely with faculty; research involves a different kind of thinking

Graduate Degree Options – Ph.D.



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- Doctor of Philosophy
 - 36 credit hours of coursework
 - 24 credit hours of thesis work
 - Timeline: ~4 – 5 years after completion of undergraduate work
 - Certainly supported by teaching and research assistantships
 - *Main focus is research*
 - *Work closely with faculty and other researchers*
 - *Explore new ideas & solutions to problems*
 - *Write a dissertation and journal papers*
 - *Attend and present at conferences*
-
- You can go directly for the Ph.D. degree, or get an M.S. along the way
 - M.S. graduates tend to go into industry; Ph.D. graduates can go into academia, industry or government labs

EE Graduate Courses by Track



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Antennas and Wireless Communications Track MS Non-Thesis or Thesis

AWC Track Core Courses	12.0 Credits
AWC EE Technical Electives	12.0 Credits
and either AWC EE Electives or Thesis Credits	6.0 Credits

All students must take 3 the following courses which are scheduled to be approved by the Graduate Counsel for the 2014-15 academic year:

Advanced Engineering Electromagnetics

Computational Electromagnetics

Antennas

and choose at least one of the following:

EENG513	WIRELESS COMMUNICATION SYSTEMS	3.0
EENG515	MATHEMATICAL METHODS FOR SIGNALS AND SYSTEMS	3.0
EENG535	RF AND MICROWAVE ENGINEERING	3.0
Radar Systems (to be approved for 2014-15 academic year)		

EE Graduate Courses by Track



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Information and Systems Sciences Track

MS Non-Thesis and Thesis

ISS Track Core	12.0 Credits
ISS Track Technical Electives	12.0 Credits
ISS Track Electives or Thesis Credits	6.0 Credits

All students must take:

EENG515	MATHEMATICAL METHODS FOR SIGNALS AND SYSTEMS	3.0
-------------------------	----------------------------------------------	-----

and choose at least 3 of the following:

EENG509	SPARSE SIGNAL PROCESSING	3.0
EENG510	IMAGE AND MULTIDIMENSIONAL SIGNAL PROCESSING	3.0
EENG517	THEORY AND DESIGN OF ADVANCED CONTROL SYSTEMS	3.0
EENG519	ESTIMATION THEORY AND KALMAN FILTERING	3.0
MATH534	MATHEMATICAL STATISTICS I	3.0
MEGN544	ROBOT MECHANICS: KINEMATICS, DYNAMICS, AND CONTROL	3.0

EE Graduate Courses by Track



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Energy Systems and Power Electronics Track MS Non-Thesis or Thesis

ESP Track Core	12.0 Credits
ISS Track Technical Electives	12.0 Credits
ISS Track Electives or Thesis Credits	6.0 Credits

Choose at least 2 of the following:

<u>EENG570</u>	ADVANCED HIGH POWER ELECTRONICS	3.0
<u>EENG580</u>	POWER DISTRIBUTION SYSTEMS ENGINEERING	3.0
<u>EENG581</u>	POWER SYSTEM OPERATION AND MANAGEMENT	3.0

EE Graduate Courses



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Other EE Courses offered to be used toward EE Core or EE Electives:

EENG512	COMPUTER VISION	3.0
EENG513	WIRELESS COMMUNICATION SYSTEMS	3.0
EENG535	RF AND MICROWAVE ENGINEERING	3.0
MEGN540	MECHATRONICS	3.0
MEGN545	ADVANCED ROBOT CONTROL	3.0
EGGN589	DESIGN AND CONTROL OF WIND ENERGY SYSTEMS	3.0
EENG617	INTELLIGENT CONTROL SYSTEMS	3.0
EENG618	NONLINEAR AND ADAPTIVE CONTROL	3.0
EENG683	COMPUTER METHODS IN ELECTRIC POWER SYSTEMS	3.0

Combined BS/MS Program



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

- While you are an undergraduate, you can start taking graduate courses for the CSM MS-NT graduate degree
- Advantages:
 - If you already have enough courses for your undergraduate degree, you can get a head start on the graduate degree, perhaps allowing you to finish it sooner
 - You pay less tuition as an undergraduate than as a graduate student
- To take advantage of this
 - You have to be accepted into the “combined program”
 - You have to tell the registrar in advance, if the course should be counted towards the graduate degree

EE Faculty



DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE



[Ravel Ammerman](#) Teaching Professor

Expertise: *Electrical safety, power system analysis, engineering education*



[Stephanie Claussen](#) Teaching Associate Professor

Expertise: *optoelectronic device design and fabrication, optical material characterization, and engineering pedagogy*



[Vibhuti Dave](#) Teaching Professor

Expertise: *Digital Logic Design, Computer Arithmetic, VLSI Design*



[Atef Elsherbeni](#) Professor/Dobelman Chair

Expertise: *Scattering/diffraction of electromag. (EM) waves, computational EM using FDTD, field visualiz/software devel. for EM education, RFID/sensor Integrated FRID systems, reflector/printed antennas & antenna arrays.*



[Randy Haupt](#) Professor & Dept Head

Expertise: *Antennas, phased arrays, smart antennas, genetic algorithms and optimization, signal processing, wireless communications, computational methods, design*



[William Hoff](#) Associate Professor

Expertise: *Computer vision, image understanding, medical imaging*



[Kathryn Johnson](#) Associate Professor

Expertise: *Control systems, nonlinear and adaptive control, wind energy*



[Salman Mohagheghi](#) Assistant Professor

Expertise: *Power system control and dynamics, renewable and distributed energy systems, situational awareness, utility automation*



[Kevin Moore](#) Dean & Professor

Expertise: *Control systems, iterative learning control, robotics, mobile sensor/actuator networks*



[Jeff Schowalter](#) Teaching Professor

Expertise: *Biomedical instrumentation, engineering education, engineering design & analog electronics*



[PK Sen](#) Professor

Expertise: *Power electronics*



[Marcelo Simões](#) Associate Professor

Expertise: *Power electronics, energy conversion systems for renewable energy apps, intelligent control*



[Gongguo Tang](#) Assistant Professor

Expertise: *Compressive sensing, radar sensing, sensor array and network, computer vision, electromagnetics, bioinformatics, and social network and media.*



[Tyrone Vincent](#) Professor

Expertise: *Control systems, system identification*



[Michael Wakin](#) Associate Professor

Expertise: *Signal and image processing, compressive sensing*