

# Electrical Engineering

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## Introduction

The Department of Electrical Engineering & Computer Science is one of the academic departments within the College of Engineering at the University of Missouri. It manages two sets of Programs: the Computer Science Program (CSP) and the Electrical & Computer Engineering Program (ECEP). At the undergraduate level, the EECS Department grants three distinct BS degrees including Computer Science (CS), Computer Engineering (CoE) and Electrical Engineering (EE). At the graduate level, the EECS Department offers MS degrees in CS, CpE and EE, and PhD degrees in CS and Electrical & Computer Engineering (ECE). EECS is undergoing a new wave of innovation broadly referred to as Internet of Things (IoT) or Internet of Everything (IoE) and cyber-physical systems from wearable biocompatible sensors, low power flexible integrated circuits, hybrid multicore computer architectures and hardware level security to new cryptographic protocols, mobile apps, cloud computing, deep learning, robotics, autonomous systems and smart cities. The four year undergraduate degree program prepares students for rewarding careers in hardware and software systems and lays the foundation for graduate study in the next wave of technological innovation.

The department was established in 1885 as the first Electrical Engineering department in the nation, after Thomas Edison helped generate interest in electrical engineering by presenting an electrical dynamo and some incandescent lamps to the University of Missouri in 1882. The EECS department is now home to more than 600 undergraduate students and over 300 graduate students in CS, CpE, EE and ECE, with more than 50 faculty Members (<https://engineering.missouri.edu/departments/eecs/eecs-faculty/>).

## About the Electrical and Computer Engineering Program

The Electrical and Computer Engineering Program (ECEP) in the Electrical Engineering and Computer Science (EECS) Department is the most research-active program among all other programs and units in the College of Engineering at the University of Missouri, with over \$5 million in externally funded research. The ECE Program offers a comprehensive undergraduate curriculum culminating in a capstone project that provides a solid foundation for undergraduate students to pursue rewarding careers in electrical and computer engineering. Students seeking either one of the two undergraduate degrees offered --Bachelor of Science in Computer Engineering (BS CoE) (<https://engineering.missouri.edu/degree/bachelor-of-science-in-computer-engineering/>) and Bachelor of Science in Electrical Engineering (BS EE) (<https://engineering.missouri.edu/degree/bachelor-of-science-in-electrical-engineering/>)-- are able to pursue dual degrees in related fields including information technology and computer science, as well as in the other degree of the ECEP, i.e. BS EE and BS CoE, respectively, along with majors and minors

in other Colleges. Students have opportunities to gain in-depth hands-on knowledge in specialized areas through undergraduate research experience working with faculty. Faculty research areas cover both well established and emerging fields including mobile video communication; wireless and digital communications; satellite remote sensing; geospatial image and video processing; computational neuroscience; systems biology; eldercare technology; computational intelligence, machine learning, pattern recognition, deep learning, fuzzy systems; computer vision; robotic vision; robotic assistive technology; human/robot interaction; landmine detection; pulsed power and plasma technology; nuclear and renewable energy systems; semiconductor devices; analog/mixed-signal/digital integrated circuits, photonics; accelerators and beams; antennas and radar systems; nano and microelectromechanical systems; bioMEMS; heterostructures, microfabrication; feedback and control systems; parallel processing; computer architecture; autonomous systems; real-time embedded architectures; high performance computing; sensor networks; and human-computer interfaces.

The ECEP in EECS also offers a Dual Bachelor of Science in Electrical Engineering & Physics.

At the MS and PhD levels, the ECEP offers the following graduate degrees:

- Master of Science in Computer Engineering (MS CpE) (<https://engineering.missouri.edu/degree/master-of-science-in-computer-engineering/>)
- Master of Science in Electrical Engineering (MS EE) (<https://engineering.missouri.edu/degree/master-of-science-in-electrical-engineering/>)
- PhD in Electrical and Computer Engineering (PhD ECE) (<https://engineering.missouri.edu/degree/phd-in-electrical-and-computer-engineering/>)

with options for dual Masters and the Masters in Engineering (ME) which is coursework only, without thesis. The graduate degree programs prepare graduates of four-year BS degrees in Electrical Engineering, Computer Engineering, and Computer Science or closely allied fields for further study at the doctoral level or for successful careers as specialized EE and CoE professionals in emerging fields. The PhD program is a professional research degree designed to prepare students for advanced professional careers, including college teaching and research, as well as research and development in industrial, government, and nonprofit organizations. Specialized training, state-of-the-art technology, innovation and entrepreneurship experience is available through close interaction with faculty in their respective fields of research expertise.

The faculty members in the ECE Program participate in the full spectrum of undergraduate and graduate education. Graduate education, has a strong innovation component with faculty initiated research projects funded by the federal government, state government and industry, and is often multidisciplinary in nature spanning interdepartmental and cross-college research. The aim is to produce professionals who can function well as part of interdisciplinary research teams. Close integration of research with education is a constant goal in the department's graduate programs. It emphasizes in-depth studies that can also be tailored to fit graduate students' individual interests. Additionally, members of the ECEP are among the leading faculty in University's Research Revenue, with major research projects funded by both federal agencies and industry including the National Science Foundation (NSF), National Institute of Health (NIH), National Geospatial-Intelligence Agency (NGA),

Department of Energy (DoE), and Department of Defense (DoD) as well as Microsoft, Honeywell and Monsanto, to cite just a few.

Research facilities are well established around faculty expertise in the broad emphasis areas of Communications and Signal Processing (SP), Intelligent Systems and Robotics (ISR), Physical and Power Electronics (PPE), Applied Physics (AP), Systems Modeling and Control (SMC), Computer Architecture and Systems (CAS), Nano/Micro Technology (NMT). Faculty in the Electrical and Computer Engineering Program work closely with faculty in the Computer Science Program within the EECS Department.

For highly motivated undergraduate students a fast-track five year program of study leading to the BS plus MS degrees in CpE or EE is available. Accelerated BS to MS Program (<https://gradschool.missouri.edu/admissions/eligibility-process/accelerated-masters-applicants/>)

Teaching assistantships with the EECS Department and research assistantships with faculty are available to fund graduate study especially at the PhD level.

## Summary

The ECE Program offers undergrad degrees:

- Bachelor of Science in Computer Engineering (BS CpE) (<https://catalog.missouri.edu/collegeofengineering/computerengineering/bscoe-computer-engineering/>)
- Bachelor of Science in Electrical Engineering (BS EE) (<https://catalog.missouri.edu/collegeofengineering/electricalengineering/bsee-electrical-engineering/>)
- Dual Bachelor of Science in Electrical Engineering & Physics

with many more options for dual degrees within the EECS department and outside.

Graduates with BS degrees in CpE, EE, CS or closely related areas can choose to pursue advanced study towards the following degrees:

- Master of Science in Computer Engineering (MS) (<https://catalog.missouri.edu/collegeofengineering/computerengineering/ms-computer-engineering/>)
- Master of Science in Electrical Engineering (MS) (<https://catalog.missouri.edu/collegeofengineering/electricalengineering/ms-electrical-engineering/>)
- Doctoral Degree in Electrical and Computer Engineering (PhD) (<https://catalog.missouri.edu/collegeofengineering/electricalcomputerengineering/phd-electrical-computer-engineering/>)

The MS and PhD are professional research degrees designed to prepare students for advanced professional careers, including teaching and research at university level, as well as research and development in industrial, government, and nonprofit organizations.

The ECE Program offers learning and research opportunities for both undergraduate and graduate students in the areas of:

- mobile video communication;
- wireless and digital communications;
- satellite remote sensing;
- geospatial image and video processing;
- computational neuroscience;
- systems biology;

- eldercare technology;
- computational intelligence, including machine learning, pattern recognition, deep learning, fuzzy systems;
- computer vision;
- robotic vision;
- robotic assistive technology;
- human/robot interaction;
- landmine detection;
- pulsed power and plasma technology;
- nuclear and renewable energy systems;
- semiconductor devices;
- analog/mixed-signal/digital integrated circuits;
- photonics;
- accelerators and beams;
- antennas and radar systems;
- nano and microelectromechanical systems;
- bioMEMS;
- heterostructure and microfabrication;
- feedback and control systems;
- parallel processing;
- computer architecture;
- autonomous systems;
- real-time embedded architectures;
- high performance computing;
- sensor networks; and
- human-computer interfaces.

## Research

The ECEP in EECS is the most research-active program among all programs and units in the College of Engineering at the University of Missouri, with over \$5 million in expenditures with faculty conducting research in the broad emphasis areas of:

- Communications and Signal Processing (CSP)
- Intelligent Systems and Robotics (ISR)
- Physical and Power Electronics (PPE)
- Applied Physics (AP)
- Systems Modeling and Control (SMC)
- Computer Architecture and Systems (CAS)
- Nano/Micro Technology (NMT)

## Faculty

**Professor** M. Almasri\*\*, D. Anderson\*\*, P. Calyam\*\*, J. Cheng\*\*, C. Davis\*\*, J. Gahl\*\*, S. Gangopadhyay\*\*, S. Goggins\*\*, D. Ho\*\*, K. Islam\*\*, N. Islam\*\*, S. Kovaleski\*\*, S. Nair\*\*, K. Palaniappan\*\*, Y. Shang\*\*, C. R. Shyu\*\*, D. Xu\*\*, X. Wan\*\*, Y. Zhao\*\*

**Associate Professor** R. Chadha\*\*, G. DeSouza\*\*, T. Engel\*\*, M. Haider\*\*, K. Anuarul Hoque\*\*, M. Jurczyk\*\*, T. Kazic\*\*, J. Legarsky\*\*, T. Malik\*\*, P. Rao\*\*, J. Uhlmann\*\*, Y. Zhao\*\*

**Assistant Professor** F. Bunyak\*\*, Q. Huang\*\*, M. Korkali\*\*, J. Malof\*\*, P. Valettas\*, P. Zhu

**Assistant Research Professor** A. Buck, A. Cannaday, J. Hurt

**Assistant Teaching Professor** S. Afreen Eliza\*, E. Ufuktepe\*, A. Shiri Sichani\*

**Associate Teaching Professor** J. Fischer, J. Ries

**Teaching Professor A. Ouda\***

**Professor Emeritus** M. Devaney, J. Keller\*\*, R. O'Connell\*\*, M. Prelas\*\*, M. Skubic\*\*, G. K. Springer\*\*, H. Tyrer\*, X. Zhuang\*\*

**Adjunct** Y. Adu-Gyamfi, I. Akturk\*\*, H. Ali akbarpour\*\*, S. Bok, G. Guidoboni\*\*, B. Harrison, T. Hossain, B. Huhman, T. Joshi, J. Kiafi, J. Lin\*, M. Maschmann\*, A. Mosa, Y. S. Zeng

\* Graduate Faculty Member - membership is required to teach graduate-level courses, chair master's thesis committees, and serve on doctoral examination and dissertation committees.

\*\* Doctoral Faculty Member - membership is required to chair doctoral examination or dissertation committees. Graduate faculty membership is a prerequisite for Doctoral faculty membership.

## Undergraduate

- BSEE in Electrical Engineering (<https://catalog.missouri.edu/collegeofengineering/electricalengineering/bsee-electrical-engineering/>)

**Advising and Scholarship Contact**

Engineering Advising

Office Phone: 573-884-6961

Email: [muengrading@missouri.edu](mailto:muengrading@missouri.edu)

Website: <https://engineering.missouri.edu/student-services/advising/>

The Department of Electrical Engineering and Computer Science (EECS) offers both the Bachelor of Science with a major in Electrical Engineering and the Bachelor of Science with a major in Computer Engineering. The undergraduate program in both degrees at the University of Missouri provides students with the requisite fundamentals in either discipline and prepares them for beginning practice in both the traditional and emerging fields of these disciplines. The degree programs are flexible 120-credit structures that provide the fundamentals of engineering, in addition to a thorough coverage of the major specialties within their respective fields. In addition, technical electives allow concentration in selected areas.

The EECS department emphasizes close interaction with industry. Industry engineers visit regularly and industry-sponsored student projects are provided to give extra dimension to the program.

Many students in the EECS department combine the electrical engineering major with the computer engineering major in a special 142-credit program. These students receive both the BS EE and BS CoE degrees.

Students interested in interdisciplinary studies may use some electives to study business, pre-medicine, prelaw, and other areas. Students are able to choose from a wide variety of courses offered by other departments in the College of Engineering, as well as from other MU colleges, taking advantage of the multidisciplinary nature of the campus.

Both the Bachelor of Science in Electrical Engineering (BS EE) and the Bachelor of Science in Computer Engineering (BS CoE) require that students earn a 2.0 GPA or better in all courses that have an MU engineering prefix. All ECE courses require a grade of C or better in ECE prerequisites.

Engineering design in both the electrical engineering and computer engineering programs is provided through an integrated laboratory structure. Beginning with the first laboratory course in the fourth semester of each program, students have a significant design and laboratory experience in each semester of their respective programs.

In addition to the major core requirements, students must complete all University graduation requirements including University general education, as well as all degree and college or school requirements.

## Electrical and Computer Engineering (ECE) Honors Program

The ECE Honors Program follows the general rules and philosophy of the College of Engineering Honors Program. Students may enter the program from the beginning of the junior year and must have a GPA of 3.0/4.0 at the start. Eligible students participate in the program by enrolling in ECE 4995 Undergraduate Honors Research in Electrical Computer Engineering for one to three credit hours, which replaces an equivalent number of hours of ECE technical electives.

The heart of the program is a research or advanced design project culminating in an undergraduate honors thesis. The project is conducted under the supervision of the honors advisor, who is an ECE faculty member selected by mutual agreement between the student and the professor. Satisfactory completion of the project requires approval (signatures) of the honors thesis by both the honors advisor and an additional faculty member, who serves as second reader of the thesis. Students who complete the program and graduate with a GPA of at least 3.0 receive the designation "Honors Scholar in Engineering" at graduation and on their diploma.

Another valuable feature of the Honors Program is that participants may reduce the number of credit hours required for degree completion to the University minimum of 120 by substituting up to six hours of credit from graduate courses through dual (undergraduate/graduate) enrollment during the last four semesters of the undergraduate program and after completion of the honors project.

## Graduate

- MS in Electrical Engineering (<https://catalog.missouri.edu/collegeofengineering/electricalengineering/ms-electrical-engineering/>)
  - with emphasis in Neural Engineering (<https://catalog.missouri.edu/collegeofengineering/electricalengineering/ms-electrical-engineering-neural-engineering/>)

The Department of Electrical Engineering and Computer Science (EECS) offers both the Master of Science with a major in Electrical Engineering and the Master of Science with a major in Computer Engineering, as well as a Doctor of Philosophy Degree in Electrical and Computer Engineering. The graduate program in both degrees at the University of Missouri provides students with the requisite fundamentals in either discipline and prepares them for beginning practice in both the traditional and emerging fields of these disciplines. The degree programs are flexible 30-credit structures that provide the fundamentals of engineering, in addition to a thorough coverage of the major specialties within their respective fields. In addition, technical electives allow concentration in selected areas.