

# Electrical & Systems Engineering

## About Electrical & Systems Engineering

The mission of our undergraduate programs is to instill in students the knowledge and perspective — appropriate for both a professional career and the pursuit of advanced degrees — of fields that rely on key electrical engineering and systems principles and practices. Such principles and practices include rigorous quantitative reasoning and robust engineering design. This mission is accomplished by ensuring that students achieve both depth and breadth of knowledge in their studies and by maintaining a high degree of flexibility in the curriculum. Our programs also seek to provide good preparation for life, including the ability to communicate in written and oral forms and a desire to continue learning throughout life. In addition, these programs aim to provide the opportunity and training necessary for students to acquire the skills and attitudes to become leaders.

The department offers courses of study leading to degrees in both electrical engineering and systems science and engineering. Opportunities for study and research currently available in the department include semiconductor theory and devices, optoelectronics, nanophotonics, communication theory and systems, information theory, signal and image processing, tomographic imaging, linear and nonlinear dynamics and control, robotics, identification and estimation, multisensor fusion and navigation, computational mathematics, optimization, optimal control, autonomous systems, operations research and financial engineering. Students are encouraged to participate in research activities as soon as they have received training in the fundamentals appropriate for a given research area.

Electrical engineering is the profession for those intrigued with electrical phenomena and eager to contribute their skills to a society increasingly dependent on electricity and sophisticated electronic devices. It is a profession of broad scope, with many specialty careers designed for engineers who seek an endless diversity of career paths on the cutting edge of technology. The Institute of Electrical and Electronics Engineers publishes transactions on about 60 different topics, from aerospace and electronic systems to visualization and computer graphics. This is a breadth so great that no single electrical engineering department can hope to span it. Moreover, those fields themselves encompass still more fascinating specialties. We provide the basics; the future is the student's to shape.

Systems science and engineering is based on an approach that views an entire system of components as an entity rather than simply as an assembly of individual parts; each component is designed to fit properly with the other components rather than to function by itself. The engineering and mathematics of systems is a rapidly developing field. It is one of the most modern segments of applied mathematics as well as an engineering discipline. It is concerned with the identification, modeling, analysis, design and control of systems that are potentially as large and complex as the U.S. economy or as precise and vital

as a space voyage. Its interests run from fundamental theoretical questions to the implementation of operational systems. It draws on the most modern and advanced areas of mathematics. A very important characteristic of the systems field is that its practitioners must, of necessity, interact within a wide interdisciplinary environment, not only with various engineers and scientists but also with economists, biologists and sociologists. Such interaction is both emphasized and practiced in the programs.

Our Department of Electrical & Systems Engineering offers a challenging basic curriculum, a broadly qualified faculty, and modern facilities so that students can receive a contemporary preparation for a career in electrical or systems engineering.

## Undergraduate Degree Programs

The Department of Electrical & Systems Engineering (ESE) offers four undergraduate degree programs: two professional degrees and two applied science degrees. The two professional degrees are the Bachelor of Science in Electrical Engineering (BSEE) and the Bachelor of Science in Systems Science & Engineering (BSSSE). These two programs are accredited by the Engineering Accreditation Commission of ABET. The two applied science degrees are the Bachelor of Science in Applied Science (Electrical Engineering) and the Bachelor of Science in Applied Science (Systems Science & Engineering). All programs have flexible curricula as well as specific requirements, and students may elect programs of study tailored to individual interests and professional goals.

In the professional BSEE curriculum, there are required courses in electrical circuits, signals and systems, digital systems and electromagnetic fields, along with laboratory and design courses, which provide students with a common core of experience. Subsequently, the student may orient the program toward breadth so that many disciplines within the profession are spanned or toward a specialty with more emphasis on depth in one or more disciplines. Areas of specialization include modern electronics, applied physics, telecommunications, control systems, and signal and image processing.

Students in the professional BSSSE degree program take required courses in engineering mathematics, signals and systems, operations research, and automatic control systems, along with laboratory and design courses. This program emphasizes the importance of real-world applications of systems theory; accordingly, students are required to take a concentration of courses in one of the traditional areas of engineering or science. There are numerous elective courses in control theory and systems, signal processing, optimization, robotics, probability and stochastic processes, and applied mathematics.

Students enrolled in any of the ESE undergraduate degree programs have a variety of opportunities to augment their educational experience at Washington University. Students may participate in the Pre-Medical Engineering program or in the Cooperative Education program. Some students pursue double majors, in which two sets of degree requirements — either within or outside the ESE department — are satisfied concurrently.

Students who seek a broad undergraduate education in electrical engineering or systems science and engineering but who plan on careers outside of engineering may pursue the applied science degrees: Bachelor of Science in Applied Science (Electrical Engineering) and Bachelor of Science in Applied Science (Systems Science & Engineering). These programs of study are appropriate for students planning to enter medical, law or business school and who desire a more technical undergraduate experience than what otherwise may be available to them.

The ESE department also offers a variety of educational opportunities for students enrolled in other departments. These include the second major in systems science and engineering and the second major in electrical engineering, which are open to students inside as well as outside of the McKelvey School of Engineering, such as the College of Arts & Sciences and Olin Business School. They also include the minor in quantum engineering, the minor in electrical engineering, the minor in energy engineering, the minor in mechatronics, the minor in robotics, and the minor in systems science & engineering.

## **Bachelor's/Master's Programs in Electrical & Systems Engineering**

Students enrolled in any of the undergraduate degree programs in the McKelvey School of Engineering may choose to extend their educational experience by enrolling in a five-year Bachelor's/Master's program. The Master of Science in Electrical Engineering (MSEE), the Master of Science in Systems Science and Mathematics (MSSSM), and the Master of Science in Engineering Data Analytics and Statistics (MSEDAS) degrees are participating graduate degrees, and these may be combined with any undergraduate degree that provides the appropriate background.

General requirements for the Bachelor's/Master's programs include the residency and other applicable requirements of the university and the McKelvey School of Engineering, which are found elsewhere in this Bulletin. In summary, students must complete all the degree requirements for both the undergraduate and graduate degrees.

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Website: <https://ese.wustl.edu/academics/undergraduate-programs/index.html>