Computer Engineering

College of Engineering

The MS and PhD programs in Computer Engineering (CPE) are offered in the College of Engineering jointly by the departments of Computer Science and Electrical and Computer Engineering. The field of computer engineering integrates expertise from both electrical engineering and computer science, emphasizing an understanding of computer architecture, hardware/software interface, and the integration of computers into products and systems at a larger scale. It involves developing technical skills in traditional areas of electrical engineering, such as analog and digital circuit design and communications systems, as well as in areas related to computer science, such as software development and operating systems. As might be expected in such a broad field, there are a great many specialty areas as well, which change regularly to match the needs of the job market. The programs support the College of Engineering's mission "to provide education, research, and service in a scholarly environment in a way that prepares our students for successful professional careers, addresses the changing needs of our other constituents, and responds to the technological challenges facing the Commonwealth and the Nation."

Degrees Offered

- Master of Science in Computer Engineering

  ◦ **Plan A:** 30 credits, including 6 credits of thesis research, plus a Master's thesis

  ◦ **Plan B:** 30 credits, plus a Master's project

- Doctor of Philosophy in Computer Engineering

  ◦ 36 credits (pre-Qualifying exam), the Qualifying Exam, plus a doctoral dissertation

Application Requirements

Master of Science in Computer Engineering

- CV (Optional)
- Personal Statement
- Transcript showing a Bachelor's degree with a minimum GPA of 3.0 in an ABET or CSAB accredited undergraduate program in Computer Engineering, Computer Science, or Electrical Engineering.
- Background in discrete math, programming, data structures, circuits, digital logic, and computer architecture.
- Assistantship Application (Optional)
- Official GRE scores
- Three letters of recommendation

- Application Deadlines:
    - Fall: July 15 (domestic applicants), March 15 (international applicants)
    - Spring: November 30 (domestic applicants), August 15 (international applicants)

Doctor of Philosophy in Computer Engineering

- CV
- Personal Statement
- Transcript showing a Bachelor's degree with a minimum GPA of 3.0 in an ABET or CSAB accredited undergraduate program in Computer Engineering, Computer Science, or Electrical Engineering.
- Background in discrete math, programming, data structures, circuits, digital logic, and computer architecture.
- [Assistantship Application (Optional)](#)
- Official GRE scores
- Three letters of recommendation
- Application Deadlines:
    - Fall: July 15 (domestic applicants), March 15 (international applicants)
    - Spring: November 30 (domestic applicants), August 15 (international applicants)

Curriculum

Both the MS and the PhD program require students to take nine credits of core coursework, to include 3 of the following courses:

- CS570 Modern Operating Systems
- EE685 Digital Computer Structure
- CS541 Compiler Design
- EE580 Embedded System Design

Students can focus their curriculum on a variety of areas, including cybersecurity, VLSI, computer architecture, quantum computing, advanced compiler techniques, and distributed operating systems. Any course in the CS and ECE departments may be used to complete the credit-hour requirements, and courses outside these departments may also apply, subject to DGS approval.

Students must maintain a 3.0 or better GPA across all CS and ECE courses, and they must have an overall GPA of 3.0 or better to complete the MS degree.

Incoming students are informed of the graduate-school and program-specific academic policies at the orientation held before classes begin each fall. A handbook is also on the CS and ECE websites.

Course Descriptions

CS 541 COMPILER DESIGN. (3) Intermediate aspects of a compilation process with an emphasis on front-end issues. Practical issues in using compiler writing tools. Code generation for expressions, control statements and procedures (including parameter passing). Symbol tables, runtime organization for simple and structured variables. Using compilers and translators for automation (filters, programs writing programs). Prereq: CS 441 or consent of instructor.

CS 570 MODERN OPERATING SYSTEMS. (3) Brief review of classical operating system concepts (process and memory management, process coordination, device drivers, file systems, starvation/deadlock). Modern topics of files systems (log-structured file systems, distributed file systems, memory-based file systems), operating system design (monolithic, communication-kernel, extensible/adaptable, distributed shared memory), multiprocessor issues (scheduling, synchronization, IPC), security (internet attacks, encryption, defenses). Inspection and modification of actual operating system code (Linux). Prereq: CS 470 and engineering standing.

EE 580 EMBEDDED SYSTEM DESIGN. (3) Embedded System Design covers the design and implementation of hardware and software for embedded computer systems. Topics include architectural support for embedded systems, power management, analog and digital I/O, real-time processing design constraints and the design of embedded systems using a real-time operating system. Prereq: EE/CPE 287, EE/CPE 380, and engineering standing or consent of instructor. (Same as CPE 580.)

EE 685 DIGITAL COMPUTER STRUCTURE. (3) Study of fundamental concepts in digital computer system structure and design. Topics include: computer system modeling based on instruction set processor (ISP) and processor-memory-switch (PMS) models, design and algorithms for ALU, processor, control unit and memory system. Special topics include floating-point arithmetic, cache design, pipeline design technologies, and parallel computer architectures. Prereq: EE 380 and EE 581 or consent of instructor.