Computer Engineering

Nature of Program

Computer engineers design, develop, test, and oversee the manufacture and maintenance of embedded computer hardware and software. As such, the computer engineer is part electrical engineer and part computer scientist. Embedded computer systems include applications in the automotive, communications, radio and television, consumer electronics, aircraft, robotics, and health-care industries. In addition, computer engineers design, develop, test, manufacture, and maintain complex systems including digital communications systems such as cell phone networks, computer networks such as the Internet, and system-level software such as operating systems and applications software.

Program Objectives

The objective of the bachelor's degree program in computer engineering is to produce graduates who have the knowledge, skills, and attitudes that will assure success in professional positions in business, industry, research, government service, or graduate study as well as professional schools. We carry out this mission by providing our students with a sound education in mathematics and the sciences, a broad foundation in the fundamentals of engineering, elective opportunities to develop expertise in one or more emphasis areas, and the general education necessary to put technical knowledge into perspective. Theoretical work is complemented by an emphasis on the practice of engineering, and design activity is integrated throughout the curriculum. The computer engineering program is accredited by the Engineering Accreditation Commission (EAC) of ABET.

Program Outcomes

It is our goal that by the time they graduate, B.S. computer engineering students will achieve the following learning outcomes:

- Have the ability to apply knowledge of math, engineering, and science.
- Have the ability to design and conduct experiments on both hardware and software.
- Have the ability to analyze and interpret data.
- Have the ability to design a system, component, or process to meet desired needs, including the planning, specification, detail design, implementation, and evaluation to meet most of the following needs: cost, environmental, performance, safety, and quality requirements.
- Have the ability to function on multidisciplinary teams.
- Have the ability to identify, formulate, and solve a range of computer engineering problems.
- Have an understanding of professional and ethical responsibility.
- Have the ability to communicate effectively, i.e., to convey technical material through formal written papers/reports that satisfy accepted standards for writing style, and to convey technical material through oral presentation and interaction with an audience.
- Have the broad education necessary to understand the impact of engineering solutions in a global and societal context.
- Have a recognition of the need for, and an ability to engage in, life-long learning.
- Have knowledge of contemporary issues.
- Have an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (including computer-based tools, for analysis and design).
- Have knowledge of the breadth and depth across the range of computer engineering topics.
- Have knowledge of mathematics through differential and integral calculus, basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.
- Have knowledge of probability and statistics.
- Have knowledge of discrete mathematics.

Fundamental courses in the computer engineering areas of hardware and software are taken during the second year with general fundamental engineering courses included. The third and fourth years in the curriculum concentrate on areas of computer engineering in both software and hardware with technical electives provided to allow the student to acquire more depth in a preferred area of expertise.

The computer engineering technical electives must be taken from 400-level CPE regular courses. The other technical electives should be selected from upper division regular courses in biometric systems, computer engineering, computer science, or electrical engineering. However, students with special career objectives can petition the department through their advisors for prior written permission to select technical electives from upper-division courses in mathematics, the sciences, or other areas of engineering.

A total of five humanities and social science electives (GEC electives) must be selected. The humanities and social science electives must be chosen so as to meet the University General Education Curriculum requirements and Accreditation Board for Engineering and Technology accreditation guidelines.
Curriculum in Computer Engineering

To receive a bachelor of science in computer engineering, a student must take all the courses indicated below and must attain a grade point average of 2.0 or better for all required computer engineering, electrical engineering, and computer science courses. If a required CPE, EE, or CS course is repeated, only the hours credited and the grade received for the last completion of the course are used in computing the grade point average. This requirement helps assure that the student has demonstrated overall competence in the chosen major.

It is important for students to take courses in the order specified as much as possible; all prerequisites and concurrent requirements must be observed. A typical B.S.Cp.E. degree program that completes degree requirements in four years is as follows.

GENERAL EDUCATION CURRICULUM

Please use this link to view a list of courses that meet each GEC requirement. (http://registrar.wvu.edu/current_students/general_education_curriculum)

NOTE: Some major requirements will fulfill specific GEC requirements. Please see the curriculum requirements listed below for details on which GECs you will need to select.

<table>
<thead>
<tr>
<th>General Education Curriculum</th>
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<tbody>
<tr>
<td>ENGL 101 &amp; ENGL 102 Composition And Rhetoric and Composition And Rhetoric</td>
<td>3-6</td>
</tr>
<tr>
<td>GEC 2A - Mathematics</td>
<td>3-4</td>
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<tr>
<td>GEC 2B - Natural and Physical Science</td>
<td>7-8</td>
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<tr>
<td>GEC 2C - Additional GEC 2A, B or C</td>
<td>3</td>
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<tr>
<td>GEC 3 - The Past and Its Traditions</td>
<td>3</td>
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<tr>
<td>GEC 4 - Issues of Contemporary Society</td>
<td>3</td>
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<tr>
<td>GEC 5 - Artistic Expression</td>
<td>3</td>
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<tr>
<td>GEC 6 - The Individual in Society</td>
<td>3</td>
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<tr>
<td>GEC 6F - First Year Seminar</td>
<td>1-3</td>
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<tr>
<td>GEC 7 - American Culture</td>
<td>3</td>
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<tr>
<td>GEC 8 - Western Culture</td>
<td>3</td>
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<tr>
<td>GEC 9 - Non-Western Culture</td>
<td>3</td>
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<tr>
<td>Total Hours</td>
<td>38-45</td>
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</tbody>
</table>

Curriculum Requirements

Non-Computer Engineering Core

Students must complete a minimum of 130 credit hours to graduate - the total at the bottom reflects all possible course combinations.

| CHEM 115 Fundamentals of Chemistry | 4 |
| ECON 201 Principles of Microeconomics (GEC 4) | 3 |
| ECON 202 Principles of Macroeconomics (GEC 8) | 3 |
| ENGR 101 Engineering Problem Solving 1 | 2 |
| ENGR 102 Engineering Problem-Solving 2 | 3 |
| ENGR 199 Orientation to Engineering | 1 |
| Choose from one of the following: | |
| MATH 155 or MATH 153 & MATH 154 Calculus 1 Calculus 1a with Precalculus and Calculus 1b with Precalculus | 4 |
| MATH 156 Calculus 2 | 4 |
| MATH 251 Multivariable Calculus | 4 |
| MATH 261 Elementary Differential Equations | 4 |
| MATH 375 Applied Modern Algebra | 3 |
| PHYS 111 General Physics | 4 |
| PHYS 112 General Physics | 4 |
| STAT 215 Intro Probability & Statistics | 3 |
| Engineering Science Elective (Choose one) | 3 |
CHE 201  Material & Energy Balances 1
CHE 366  Materials Science
IENG 377  Engineering Economy
MAE 241  Statics
MAE 320  Thermodynamics

**Computer Engineering Core Requirements**
A minimum GPA of 2.0 is required in all departmental courses.

- CPE 271  Intro Digital Logic Design 3
- CPE 272  Digital Logic Laboratory 1
- CPE 310  Microprocessor Systems 3
- CPE 311  Microprocessor Lab 1
- CPE 312  Microcomputer Struct/Interfacing 3
- CPE 313  Microcomputer Struct/Interfacing Lab 1
- CPE 480  Senior Design Seminar 2
- CPE 481  Senior Design Project 3
- CS 110  Introduction-Computer Science 4
- CS 111  Introduction-Data Structures 4
- CS 230  Intro to Software Engineering 4
- CS 350  Computer System Concepts 3
- CS 450  Operating System Structure 3
- EE 221  Intro Electrical Engineering 3
- EE 222  Intro Electrical Engr Lab 1
- EE 223  Electrical Circuits 3
- EE 224  Electrical Circuits Lab 1
- EE 251  Digital Electronics 3
- EE 252  Digital Electronics Lab 1
- EE 327  Signals and Systems 1 3
- EE 355  Analog Electronics 3
- EE 356  Analog Electronics Lab 1
- CPE 400-level Technical Elective 3
- Technical Elective upper division course (selected fro BIOM, CS, CPE, EE) 3
- GEC Electives 1, 3, 5, 6, 7, 9 (Students who take ENGL 103 must take another technical Elective Course or a department approved course). 21

**Total Hours** 130

**Suggested Plan of Study**

**First Year**

**Fall**

- See Engineering or General Engineering curricula 17

**Spring**

- See Engineering or General Engineering curricula 17

**Second Year**

**Fall**

- CPE 271 4 CS 110 4
- & CPE 272
- EE 221 4 EE 223 4
- & EE 222
- & EE 222
- MATH 251 4 EE 251 4
- & EE 252
- PHYS 112 4 ENGL 102 3

**Spring**

- MATH 251 4
- PHYS 112 4
### Third Year

<table>
<thead>
<tr>
<th>Subject</th>
<th>Fall Hours</th>
<th>Spring Hours</th>
<th>Total Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPE 310 &amp; CPE 311</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>CS 111</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>EE 327*</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>EE 355</td>
<td>4</td>
<td>3</td>
<td>7</td>
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<tr>
<td>&amp; EE 356*</td>
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<tr>
<td>MATH 375</td>
<td>3</td>
<td>18</td>
<td>21</td>
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<tr>
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<th>Fall Hours</th>
<th>Spring Hours</th>
<th>Total Hours</th>
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<tr>
<td><strong>Total credit hours: 130</strong></td>
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</table>

* Offered once per year in the semester shown.

** The Engineering Science Elective (ESE) for Computer Engineering majors should be chosen from the following list: MAE 241, MAE 320, IENG 377, CHE 201, CHE 366

*** Two technical electives for a total of six credit hours are required. One must be a 400 level course in Computer Engineering. The other must be an upper division course (300 level or higher) in Biometric Systems, Computer Engineering, Computer Science, or Electrical Engineering.

### COURSES

**CPE 271. Intro Digital Logic Design. 3 Hours.**
PR: MATH 156 or consent. An introduction to the design of digital networks and computers. Topics include number systems, coding, Boolean and switching algebra, logic design, minimization of logic, sequential networks, and design on digital subsystems. (3 hr. lec.).

**CPE 272. Digital Logic Laboratory. 1 Hour.**
CoReq: CPE 271. Experiments with digital electronic circuits including number systems, design and application of modern digital circuitry for both combinational and sequential logic circuits. (3 hr. lab.).

**CPE 293A-Z. Special Topics. 1-6 Hours.**
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

**CPE 310. Microprocessor Systems. 3 Hours.**
PR: CPE 271 and CPE 272 and PR or CONC: CPE 311. Theory and design of microprocessors: organization and architecture of modern processors; integration of microprocessors with RAM, ROM, and I/O devices; machine language, assembly language and software development (3 hr. lec.).

**CPE 311. Microprocessor Lab. 1 Hour.**
CoReq: CPE 310. Machine language, assembly language and hardware and software interfacing. (This includes editing, linking, and debugging.) Memory, I/O and basic techniques of microprocessor interfacing. (3 hr. lab.).

**CPE 312. Microcomputer Struct/Interfng. 3 Hours.**
PR: CPE 310 and CPE 311 and EE 251 and EE 252 and CoReq: CPE 313 and CS 350. Design of computer systems with emphasis on interface hardware including communications, high power interface devices, line driver/receiver circuits, A/D and D/A devices, and utilization of software techniques for programmed, interrupt, and direct memory access. (3 hr. lec.).

**CPE 313. Microcomputer Strct/Intrfc Lab. 1 Hour.**
PR: CPE 310 and CPE 311 and CoReq: CPE 312. A microprocessor based single-board computer is designed and built. A semester project is required using standard I/O techniques. (3 hr. lab.).

**CPE 435. Computer Incident Response. 3 Hours.**
PR: CPE 310 and CPE 311 and CS 350 or consent. Introduction to computer incident response, forensics, and computer security. Legal basis, proper procedures, and multiple operating systems application.
CPE 442. Intro Digital Computer Arch. 3 Hours.
PR: MATH 375 and CPE 310 and CPE 311. Control, data, and demand-driven computer architecture; parallel processing, pipelining, and vector processing; structures and algorithms for array processors, systolic architectures, design of architectures. (3 hr. lec.).

CPE 450. Intro Microelectronics Circuit. 3 Hours.
PR: EE 251. (VLSI-Very Large Scale Integrated) circuit design, including layout, simulation and performance optimization of basic digital logic functions and combinations of such basic functions into more complex digital system functions. CAD tools are used for projects. (3 hr. lec.).

CPE 462. Wireless Networking. 3 Hours.

CPE 480. Senior Design Seminar. 2 Hours.
PR: ENGL 102 and consent. Penultimate semester group senior design projects with individual design assignments appropriate to student’s discipline. Complete system-level designs of the subsequent semester’s project presented in written proposals and oral presentations. (Equivalent to BIOM 480, CS 480, and EE 480). (2 hr. lec., 1 hr. conf.).

CPE 481. Senior Design Project. 3 Hours.
PR: CPE 480. Continuation of CPE 480. Detailed design and implementation of the system including choice of components, algorithm development, interfacing troubleshooting, working in groups, and project management. Also covers professional topics, including ethics, liability, safety, socio-legal issues, risks and employment agreements. (1 hr. lec., 1 hr. conf., 2 hr. lab.).

CPE 484. Real-Time Systems Development. 3 Hours.
PR: CS 350 or working knowledge of C programming language and UNIX. Characteristics of real-time systems, system and software development standards, structured and object oriented development methods for real-time systems, using a computer aided software engineering (CASE) tool in the development of a large engineering project. Emphasis is on real-time systems requirements analysis and design. This is a project based course. (3 hr. lec.).

CPE 490. Teaching Practicum. 1-3 Hours.
PR: Consent. Teaching practice as a tutor or assistant.

CPE 491. Professional Field Experience. 1-18 Hours.
PR: Consent. (May be repeated up to a maximum of 18 hours.) Prearranged experiential learning program, to be planned, supervised, and evaluated for credit by faculty and field supervisors. Involves temporary placement with public or private enterprise for professional competence development.

CPE 493A-Z. Special Topics. 1-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

CPE 494A-Z. Seminar. 1-3 Hours.
PR: Consent. Presentation and discussion of topics of mutual concern to students and faculty.

CPE 495. Independent Study. 1-6 Hours.
Faculty supervised study of topics not available through regular course offerings.

CPE 496. Senior Thesis. 1-3 Hours.
PR: Consent.

CPE 498A-Z. Honors. 1-3 Hours.
PR: Students in Honors Program and consent by the honors director. Independent reading, study or research.