Computer Engineering, B.S.Cp.E.

Degree Offered

- Bachelor of Science in Computer Engineering (B.S.Cp.E.)

Nature of the Program

Computer engineers design, develop, test, and oversee the manufacture and maintenance of embedded computer hardware and software. As such, computer engineering combines portions of the knowledge of electrical engineers and computer scientists. 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, secure computer networks, and system-level software such as operating systems and applications software. The Bachelor of Science in Computer Engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org.

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.

Click here to view the Suggested Plan of Study (p. 3)

Curriculum in Computer Engineering

General Education Foundations

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

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

<table>
<thead>
<tr>
<th>General Education Foundations</th>
<th>3-6</th>
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</thead>
<tbody>
<tr>
<td>ENGL 101</td>
<td></td>
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<tr>
<td>&amp; ENGL 102</td>
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<tr>
<td>or ENGL 103</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>F2A/F2B - Science &amp; Technology</th>
<th>4-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3 - Math &amp; Quantitative Reasoning</td>
<td>3-4</td>
</tr>
<tr>
<td>F4 - Society &amp; Connections</td>
<td>3</td>
</tr>
<tr>
<td>F5 - Human Inquiry &amp; the Past</td>
<td>3</td>
</tr>
<tr>
<td>F6 - The Arts &amp; Creativity</td>
<td>3</td>
</tr>
<tr>
<td>F7 - Global Studies &amp; Diversity</td>
<td>3</td>
</tr>
<tr>
<td>F8 - Focus (may be satisfied by completion of a minor, double major, or dual degree)</td>
<td>9</td>
</tr>
</tbody>
</table>

Total Hours 31-37

Please note that not all of the GEF courses are offered at all campuses. Students should consult with their advisor or academic department regarding the GEF course offerings available at their campus.

Degree Requirements

Students must meet the following criteria to qualify for a Bachelor of Science in Computer Engineering degree:

- Complete a minimum of 126 credit hours
- Satisfy WVU's undergraduate degree requirements
- Satisfy Statler College's undergraduate degree requirements (http://catalog.wvu.edu/undergraduate/collegeofengineeringandmineralresources/policies_text)
- Complete all courses listed in the curriculum requirements with the required minimum grades
- Attain an overall grade point average of 2.25 or better
- Attain a WVU grade point average of 2.25 or better
- Attain a Statler grade point average of 2.25 or better
- A maximum of one math or science courses with a grade of D+, D, or D- may apply towards a Statler College degree
• Complete a survey regarding their academic and professional experiences at WVU, as well as post-graduation job placement or continuing education plans.

The Statler GPA is computed based on all work taken at WVU with a subject code within Statler College (BIOM, BMEG, CE, CHE, CPE, CS, CSEE, CYBE, EE, ENGR, IENG, IH&S, MAE, MINE, PDA, PNGE, SAFM, SENG) excluding ENGR 140, ENGR 150, and CS 101. The WVU GPA is computed based on all work taken at WVU. The Overall GPA is computed based on all work taken at WVU and transfer work.

Curriculum Requirements

University Requirements 16
Fundamentals of Engineering Requirements 5
Math and Science Requirements 34
Computer Engineering Program Requirements 71
Total Hours 126

University Requirements

General Education Foundations (GEF) 1, 2, 3, 4, 5, 6, 7, and 8 (31-37 Credits)
Outstanding GEF Requirements 1, 5, 6, and 7 15
ENGR 191 First-Year Seminar 1
Total Hours 16

Fundamentals of Engineering Requirements

A minimum grade of C- is required in all Fundamentals of Engineering courses.
ENGR 101 Engineering Problem Solving 1 2
Engineering Problem Solving (Select one of the following): 3
CHE 102 Introduction to Chemical Engineering
ENGR 102 Engineering Problem-Solving 2
ENGR 103 Introduction to Nanotechnology Design
MAE 102 Introduction to Mechanical and Aerospace Engineering Design
Total Hours 5

Math and Science Requirements

A minimum grade of C- is required in all Math and Science courses.
CHEM 115 & 115L Fundamentals of Chemistry 1 and Fundamentals of Chemistry 1 Laboratory (GEF 2B) 4
Calculus I (GEF 3): 4
MATH 155 Calculus 1
MATH 153 & MATH 154 Calculus 1a with Precalculus and Calculus 1b with Precalculus
MATH 156 Calculus 2 (GEF 8) 4
MATH 251 Multivariable Calculus 4
MATH 261 Elementary Differential Equations 4
MATH 375 Applied Modern Algebra 3
PHYS 111 General Physics 1 (GEF 8) 4
PHYS 112 General Physics 2 (GEF 8) 4
STAT 215 Introduction to Probability and Statistics 3
Total Hours 34

Computer Engineering Program Requirements

ECON 201 Principles of Microeconomics (GEF 4) 3
CPE 271 Introduction to Digital Logic Design 3
CPE 272 Digital Logic Laboratory 1
CPE 310 Microprocessor Systems 3
CPE 311 Microprocessor Laboratory 1  
CPE 312 Microcomputer Structures and Interfacing 3  
CPE 313 Microcomputer Structures and Interfacing Laboratory 1  
CSEE 380 Engineering Professionalism Seminar 1  
CSEE 480 Capstone Project - Design 2  
or CPE 480 Capstone Project - Design  
CSEE 481 Capstone Project - Implementation 3  
or CPE 481 Capstone Project - Implementation  
CS 110 Introduction to Computer Science 4  
CS 111 Introduction to Data Structures 4  
CS 230 Introduction to Software Engineering 4  
CS 350 Computer System Concepts 3  
CS 450 Operating Systems Structure 4  
CS 453 Data and Computer Communications 3  
EE 221 Introduction to Electrical Engineering 3  
EE 222 Introduction to Electrical Engineering Laboratory 1  
EE 223 Electrical Circuits 3  
EE 224 Electrical Circuits Laboratory 1  
EE 251 Digital Electronics 3  
EE 252 Digital Electronics Laboratory 1  
EE 327 Signals and Systems 1 3  
EE 355 Analog Electronics 3  
EE 356 Analog Electronics Laboratory 1  
CPE Technical Elective (400-level course in Computer Engineering) * 3  
Engineering Science Elective (Select one of the following): 3  
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 201</td>
<td>Material and Energy Balances 1</td>
<td></td>
</tr>
<tr>
<td>CHE 366</td>
<td>Materials Science</td>
<td></td>
</tr>
<tr>
<td>IENG 377</td>
<td>Engineering Economy</td>
<td></td>
</tr>
<tr>
<td>MAE 241</td>
<td>Statics</td>
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<tr>
<td>MAE 320</td>
<td>Thermodynamics</td>
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</tr>
</tbody>
</table>

Technical Elective (300 level or higher course in BIOM, CPE, CS, CYBE, or EE) ** *** 3  
Total Hours 71  

*  
Students choosing an AOE in Cybersecurity are not required to take the CPE Technical Elective (3 credits) or the Technical Elective (3 credits).  
**  
Excludes any 490, 491, 495  

Suggested Plan of Study  
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.  

**First Year**  

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
<th>Spring</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 155 (GEF 3)</td>
<td></td>
<td>4 MATH 156 (GEF 8)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>ENGR 101</td>
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<td>2 ENGR 102</td>
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<tr>
<td>ENGR 191</td>
<td></td>
<td>1 PHYS 111 (GEF 8)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CHEM 115 &amp; 115L (GEF 2)</td>
<td></td>
<td>4 GEF 6</td>
<td>3</td>
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<tr>
<td>ENGL 101 (GEF 1)</td>
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<td>3 GEF 7</td>
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<tr>
<td>GEF 5</td>
<td></td>
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<td>3</td>
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</tbody>
</table>

17 17
### Second Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Hours</th>
<th>Spring</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPE 271</td>
<td>3</td>
<td>CS 110</td>
<td>4</td>
</tr>
<tr>
<td>CPE 272</td>
<td>1</td>
<td>EE 223</td>
<td>3</td>
</tr>
<tr>
<td>EE 221</td>
<td>3</td>
<td>EE 224</td>
<td>1</td>
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<tr>
<td>EE 222</td>
<td>1</td>
<td>EE 251</td>
<td>3</td>
</tr>
<tr>
<td>MATH 251</td>
<td>4</td>
<td>EE 252</td>
<td>1</td>
</tr>
<tr>
<td>PHYS 112 (GEF 8)</td>
<td>4</td>
<td>MATH 261</td>
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<td>16</td>
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</tbody>
</table>

### Third Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Hours</th>
<th>Spring</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>CPE 310</td>
<td>3</td>
<td>CPE 312†</td>
<td>3</td>
</tr>
<tr>
<td>CPE 311</td>
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<td>CPE 313†</td>
<td>1</td>
</tr>
<tr>
<td>CS 111</td>
<td>4</td>
<td>CS 230</td>
<td>4</td>
</tr>
<tr>
<td>EE 327†</td>
<td>3</td>
<td>CS 350</td>
<td>3</td>
</tr>
<tr>
<td>EE 355†</td>
<td>3</td>
<td>STAT 215</td>
<td>3</td>
</tr>
<tr>
<td>EE 356†</td>
<td>1</td>
<td>ENGL 102 (GEF 1)</td>
<td>3</td>
</tr>
<tr>
<td>CSEE 380</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>16</td>
<td></td>
<td>17</td>
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</tbody>
</table>

### Fourth Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Hours</th>
<th>Spring</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSEE 480</td>
<td>2</td>
<td>CSEE 481</td>
<td>3</td>
</tr>
<tr>
<td>CS 450</td>
<td>4</td>
<td>Engr. Science Elective</td>
<td>3</td>
</tr>
<tr>
<td>CS 453</td>
<td>3</td>
<td>CPE Tech. Elective</td>
<td>3</td>
</tr>
<tr>
<td>MATH 375</td>
<td>3</td>
<td>Tech. Elective</td>
<td>3</td>
</tr>
<tr>
<td>ECON 201 (GEF 4)</td>
<td>3</td>
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<td></td>
<td>15</td>
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<td>12</td>
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</tbody>
</table>

Total credit hours: 126

* Offered once per year in the semester shown.

### Area of Emphasis

- Cybersecurity

#### AREA OF EMPHASIS IN CYBERSECURITY

A minimum grade of C- is required in each course.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 453</td>
<td>Data and Computer Communications</td>
<td>3</td>
</tr>
<tr>
<td>CS 465</td>
<td>Cybersecurity Principles and Practice</td>
<td>3</td>
</tr>
<tr>
<td>CYBE 366</td>
<td>Secure Software Development</td>
<td>3</td>
</tr>
<tr>
<td>CYBE 467</td>
<td>Practicing Cybersecurity: Attacks &amp; Countermeasures</td>
<td>3</td>
</tr>
<tr>
<td>CPE 435</td>
<td>Computer Incident Response</td>
<td>3</td>
</tr>
<tr>
<td>CYBE 466</td>
<td>Host Based Cyber Defense</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours: 15

### Program Educational Objectives

The Program Educational Objectives (PEO) of the Computer Engineering (CpE) program at West Virginia University is to produce graduates who will apply their knowledge and skills to achieve success in their careers in industry, research, government service or graduate study. It is expected that in the first five years after graduation our graduates will achieve success and proficiency in their profession, be recognized as leaders, and contribute to the well-being of society.
Student Outcomes

Upon graduation, all Bachelor of Science in Computer Engineering students will have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

CPE 191. First-Year Seminar. 1-3 Hours.
Engages students in active learning strategies that enable effective transition to college life at WVU. Students will explore school, college and university programs, policies and services relevant to academic success. Provides active learning activities that enable effective transition to the academic environment. Students examine school, college and university programs, policies and services.

CPE 271. Introduction to Digital Logic Design. 3 Hours.
PR: MATH 156 or consent. Introduction to the design of digital systems. Topics include number systems, coding, Boolean and switching algebra, minimization of logic, analysis and design of combinational and sequential logic circuits.

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 293. 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 Laboratory. 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 Structures and Interfacing. 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 Structures and Interfacing Laboratory. 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 412. Mobile Robotics. 3 Hours.
PR: Consent. Introduction to fundamental topics in Mobile robotics; methods of locomotion; common mobile robot sensors, state estimation and navigation algorithms; path planning and obstacle avoidance methods; robot decision making and control processes; and mobile robot systems design.

CPE 435. Computer Incident Response. 3 Hours.
PR: CPE 310 and CPE 311 and (CS 350 or CS 355) or consent. Introduction to computer incident response, forensics, and computer security. Legal basis, proper procedures, and multiple operating systems application.

CPE 442. Introduction to Digital Computer Architecture. 3 Hours.
PR: WVU Sections require (MATH 375 or MATH 378) and CPE 310, WVUIT sections require CPE 320 and PR or CONC: CS 450. 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 462. Wireless Networking. 3 Hours.
PR: EE 327 and (STAT 215 or MATH 448). Design and analysis of modern wireless data networks. Digital modulation techniques, wireless channel models, design of cellular networks, spread spectrum, carrier sense multiple access, ad-hoc networks routing, error control coding, automatic request strategies.
CPE 480. Capstone Project - Design. 2 Hours.
PR: ENGL 102 or ENGL 103 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. Capstone Project - Implementation. 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 493. Special Topics. 1-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

CPE 494. 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 498. Honors. 1-3 Hours.
PR: Students in Honors Program and consent by the honors director. Independent reading, study or research.