BS SOFTWARE ENGINEERING

Program Learning Outcomes

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.

Degree Requirements and Curriculum

In addition to the program requirements listed on this page, students must also satisfy requirements outlined in more detail in the Minimum Requirements for Graduation (http://catalog.calpoly.edu/generalrequirementsbachelorsdegree/#generaleducationtext) section of this catalog, including:

- 60 units of upper-division courses
- Graduation Writing Requirement (GWR)
- 2.0 GPA
- U.S. Cultural Pluralism (USCP)

Note: No Major or Support courses may be selected as credit/no credit.

MAJOR COURSES

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC/CPE 101</td>
<td>Fundamentals of Computer Science</td>
<td>4</td>
</tr>
<tr>
<td>CSC/CPE 202</td>
<td>Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>CSC/CPE 123</td>
<td>Introduction to Computing 1</td>
<td>4</td>
</tr>
<tr>
<td>CSC/CPE 203</td>
<td>Project-Based Object-Oriented Programming and Design</td>
<td>4</td>
</tr>
<tr>
<td>CSC 225</td>
<td>Introduction to Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>CSC 248</td>
<td>Discrete Structures</td>
<td>4</td>
</tr>
<tr>
<td>CSC 300</td>
<td>Professional Responsibilities</td>
<td>4</td>
</tr>
<tr>
<td>or PHIL 323</td>
<td>Ethics, Science and Technology</td>
<td></td>
</tr>
<tr>
<td>CSC 305</td>
<td>Individual Software Design and Development</td>
<td>4</td>
</tr>
<tr>
<td>CSC 308</td>
<td>Software Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>CSC 309</td>
<td>Software Engineering II</td>
<td>4</td>
</tr>
<tr>
<td>CSC 349</td>
<td>Design and Analysis of Algorithms</td>
<td>4</td>
</tr>
<tr>
<td>CSC/CPE 357</td>
<td>Systems Programming</td>
<td>4</td>
</tr>
<tr>
<td>CSC 365</td>
<td>Introduction to Database Systems</td>
<td>4</td>
</tr>
<tr>
<td>CSC 402</td>
<td>Software Requirements Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CSC 405</td>
<td>Software Construction</td>
<td>4</td>
</tr>
<tr>
<td>CSC 406</td>
<td>Senior Project - Software Deployment</td>
<td>4</td>
</tr>
<tr>
<td>CSC 430</td>
<td>Programming Languages</td>
<td>4</td>
</tr>
<tr>
<td>CSC 484</td>
<td>User-Centered Interface Design and Development</td>
<td>4</td>
</tr>
</tbody>
</table>

Technical Electives

Select from the lists in Technical Electives Guidelines below 2,3

SUPPORT COURSES

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>IME 314</td>
<td>Engineering Economics</td>
<td>3</td>
</tr>
<tr>
<td>or IME 315</td>
<td>Financial Decision Making for Engineers</td>
<td></td>
</tr>
<tr>
<td>MATH 141</td>
<td>Calculus I (B4)</td>
<td>4</td>
</tr>
<tr>
<td>MATH 142</td>
<td>Calculus II (B4)</td>
<td>4</td>
</tr>
<tr>
<td>MATH 143</td>
<td>Calculus III (Area B Electives)</td>
<td>4</td>
</tr>
<tr>
<td>MATH 241</td>
<td>Calculus IV</td>
<td>4</td>
</tr>
<tr>
<td>MATH 244</td>
<td>Linear Analysis I</td>
<td>4</td>
</tr>
<tr>
<td>PHIL 230</td>
<td>Philosophical Classics: Knowledge and Reality (C2)</td>
<td>4</td>
</tr>
<tr>
<td>or PHIL 231</td>
<td>Philosophical Classics: Ethics and Political Philosophy</td>
<td></td>
</tr>
<tr>
<td>PSY 201/202</td>
<td>General Psychology (E)</td>
<td>4</td>
</tr>
<tr>
<td>PSY 350</td>
<td>Teamwork</td>
<td>4</td>
</tr>
<tr>
<td>or COMS 217</td>
<td>Small Group Communication</td>
<td></td>
</tr>
<tr>
<td>STAT 312</td>
<td>Statistical Methods for Engineers (Upper-Division B)</td>
<td>4</td>
</tr>
</tbody>
</table>

Life Science Support Elective

Select from the following (B2): 4

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 111</td>
<td>General Biology</td>
<td></td>
</tr>
<tr>
<td>BIO 161</td>
<td>Introduction to Cell and Molecular Biology</td>
<td></td>
</tr>
<tr>
<td>BIO 213</td>
<td>Life Science for Engineers</td>
<td></td>
</tr>
<tr>
<td>&amp; BMED 213</td>
<td>Bioengineering Fundamentals</td>
<td></td>
</tr>
<tr>
<td>BOT 121</td>
<td>General Botany</td>
<td></td>
</tr>
<tr>
<td>MCRO 221</td>
<td>Microbiology</td>
<td></td>
</tr>
<tr>
<td>MCRO 224</td>
<td>General Microbiology I</td>
<td></td>
</tr>
</tbody>
</table>

Mathematics Support Elective

Select from the following: 4

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 248</td>
<td>Methods of Proof in Mathematics</td>
<td>4</td>
</tr>
<tr>
<td>MATH 335</td>
<td>Graph Theory</td>
<td></td>
</tr>
<tr>
<td>MATH 336</td>
<td>Combinatorial Math</td>
<td></td>
</tr>
<tr>
<td>MATH 451</td>
<td>Numerical Analysis I</td>
<td></td>
</tr>
</tbody>
</table>

Physical Science Support Electives

Select one of the following series (B1 & B3; Area B Electives): 4

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 124</td>
<td>General Chemistry for Physical Science and Engineering I</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 125</td>
<td>and General Chemistry for Physical Science and Engineering II</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 126</td>
<td>and General Chemistry for Physical Science and Engineering III</td>
<td></td>
</tr>
<tr>
<td>PHYS 141</td>
<td>General Physics IA</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 132</td>
<td>and General Physics II</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 133</td>
<td>and General Physics III</td>
<td></td>
</tr>
</tbody>
</table>
GENERAL EDUCATION (GE)
(See GE program requirements below.)

FREE ELECTIVES
Free Electives

Total units

1 An additional 4 units of CPE/CSC Technical Electives may substitute for CSC/CPE 123, although new students are strongly encouraged to take CSC/CPE 123.
2 Consultation with advisor is recommended prior to selecting Technical Electives; bear in mind your selections may impact pursuit of post-baccalaureate studies and/or goals.
3 An additional 4 units of CPE/CSC Technical Electives is needed if CSC/CPE 123 is not taken.
4 Required in Major or Support; also satisfies General Education (GE) requirement.
5 If a General Education (GE) course is used to satisfy a Major or Support requirement, additional units of Free Electives may be needed to complete the total units required for the degree.

Technical Electives Guidelines
Courses used to satisfy any other Major, Support, or General Education requirement are not allowed to count toward the Technical Electives requirement. Credit/No Credit grading is not allowed.

Contact the Computer Science and Software Engineering department for further information.

Select Technical Electives from the following: 1, 2

- CSC 313 Teaching Computing
- CSC/CPE 321 Introduction to Computer Security
- CSC 323 Cryptography Engineering
- CSC 325 Introduction to Privacy: Policy and Technology
- CSC 344 Music Programming
- CSC 366 Database Modeling, Design and Implementation
- CSC 369 Introduction to Distributed Computing
- CSC 371 Game Design
- CSC 377 Introduction to Mixed Reality
- CSC 378 Interactive Entertainment Engineering
- CSC 400 Special Problems 2
- CSC 409 Current Topics in Software Engineering
- CSC 422 Network Security
- CSC 424 Software Security
- CSC/CPE 425 Wireless Security
- CSC 429 Current Topics in Computer Security
- CSC/CPE 431 Compiler Construction
- CSC 436 Mobile Application Development
- CSC 437 Dynamic Web Development
- CSC 445 Theory of Computation I
- CSC 448 Bioinformatics Algorithms
- CSC/CPE 453 Introduction to Operating Systems
- CSC/CPE 454 Implementation of Operating Systems
- CSC/CPE 458 Current Topics in Computer Systems
- CSC 466 Knowledge Discovery from Data
- CSC 468 Database Management Systems Implementation
- CSC/CPE 469 Distributed Systems
- CSC/CPE 471 Introduction to Computer Graphics
- CSC 473 Advanced Rendering Techniques
- CSC 474 Computer Animation
- CSC/CPE 476 Real-Time 3D Computer Graphics Software
- CSC 477 Scientific and Information Visualization
- CSC 478 Current Topics in Computer Graphics
- CSC 480 Artificial Intelligence
- CSC 481 Knowledge Based Systems
- CSC 482 Speech and Language Processing
- CSC 486 Human-Computer Interaction Theory and Design
- CSC 487 Deep Learning
- CSC 490 Selected Advanced Topics 2
- CSC 496 Selected Advanced Laboratory 2
- CSC 497 Research Senior Project I & CSC 498 and Research Senior Project II
- CSC 508 Software Engineering I
- CSC 509 Software Engineering II
- CSC/CPE 515 Computer Architecture
- CSC 521 Computer Security
- CSC 524 System Security
- CSC 530 Languages and Translators
- CSC 540 Theory of Computation II
- CSC 549 Advanced Algorithm Design and Analysis
- CSC 550 Operating Systems
- CSC 560 Database Systems
- CSC/CPE 564 Computer Networks: Research Topics
- CSC 566 Topics in Advanced Data Mining
- CSC/CPE 569 Distributed Computing
- CSC 570 Current Topics in Computer Science
- CSC 572 Computer Graphics
- CSC 580 Artificial Intelligence
- CSC 581 Computer Support for Knowledge Management
- CSC 582 Computational Linguistics
- CPE 315 Computer Architecture
- CPE 400 Special Problems for Undergraduates 2
- CPE 416 Autonomous Mobile Robotics
- CPE 419 Applied Parallel Computing
- CPE/EE 428 Computer Vision
- CPE 464 Introduction to Computer Networks
- CPE 465 Advanced Computer Networks
CPE 488/
IME 458/MATE
458

DATA 301
Introduction to Data Science

The following restrictions must be satisfied
4 of these units must be satisfied by a course that has as a
prerequisite either
1) An upper-division course required by the major
(excluding CSC 357) or
2) Another Technical Elective

Select from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC 325</td>
<td>Introduction to Privacy: Policy and Technology</td>
</tr>
<tr>
<td>CSC 366</td>
<td>Database Modeling, Design and Implementation</td>
</tr>
<tr>
<td>CSC 409</td>
<td>Current Topics in Software Engineering</td>
</tr>
<tr>
<td>CSC 422</td>
<td>Network Security</td>
</tr>
<tr>
<td>CSC 424</td>
<td>Software Security</td>
</tr>
<tr>
<td>CSC/CPE 425</td>
<td>Wireless Security</td>
</tr>
<tr>
<td>CSC 429</td>
<td>Current Topics in Computer Security</td>
</tr>
<tr>
<td>CSC/CPE 431</td>
<td>Compiler Construction</td>
</tr>
<tr>
<td>CSC 437</td>
<td>Dynamic Web Development</td>
</tr>
<tr>
<td>CSC 448</td>
<td>Bioinformatics Algorithms</td>
</tr>
<tr>
<td>CSC/CPE 454</td>
<td>Implementation of Operating Systems</td>
</tr>
<tr>
<td>CSC 466</td>
<td>Knowledge Discovery from Data</td>
</tr>
<tr>
<td>CSC 468</td>
<td>Database Management Systems Implementation</td>
</tr>
<tr>
<td>CSC 473</td>
<td>Advanced Rendering Techniques</td>
</tr>
<tr>
<td>CSC 474</td>
<td>Computer Animation</td>
</tr>
<tr>
<td>CSC/CPE 476</td>
<td>Real-Time 3D Computer Graphics Software</td>
</tr>
<tr>
<td>CSC 477</td>
<td>Scientific and Information Visualization</td>
</tr>
<tr>
<td>CSC 478</td>
<td>Current Topics in Computer Graphics</td>
</tr>
<tr>
<td>CSC 481</td>
<td>Knowledge Based Systems</td>
</tr>
<tr>
<td>CSC 482</td>
<td>Speech and Language Processing</td>
</tr>
<tr>
<td>CSC 486</td>
<td>Human-Computer Interaction Theory and Design</td>
</tr>
<tr>
<td>CSC 487</td>
<td>Deep Learning</td>
</tr>
<tr>
<td>CSC 497</td>
<td>Research Senior Project I</td>
</tr>
<tr>
<td>&amp; CSC 498</td>
<td>and Research Senior Project II</td>
</tr>
<tr>
<td>CSC 508</td>
<td>Software Engineering I</td>
</tr>
<tr>
<td>CSC 509</td>
<td>Software Engineering II</td>
</tr>
<tr>
<td>CSC/CPE 515</td>
<td>Computer Architecture</td>
</tr>
<tr>
<td>CSC 521</td>
<td>Computer Security</td>
</tr>
<tr>
<td>CSC 530</td>
<td>Languages and Translators</td>
</tr>
<tr>
<td>CSC 540</td>
<td>Theory of Computation II</td>
</tr>
<tr>
<td>CSC 549</td>
<td>Advanced Algorithm Design and Analysis</td>
</tr>
<tr>
<td>CSC 550</td>
<td>Operating Systems</td>
</tr>
<tr>
<td>CSC 560</td>
<td>Database Systems</td>
</tr>
<tr>
<td>CSC/CPE 564</td>
<td>Computer Networks: Research Topics</td>
</tr>
<tr>
<td>CSC 566</td>
<td>Topics in Advanced Data Mining</td>
</tr>
<tr>
<td>CSC 572</td>
<td>Computer Graphics</td>
</tr>
<tr>
<td>CSC 580</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>CSC 581</td>
<td>Computer Support for Knowledge Management</td>
</tr>
<tr>
<td>CSC 582</td>
<td>Computational Linguistics</td>
</tr>
<tr>
<td>CPE 416</td>
<td>Autonomous Mobile Robotics</td>
</tr>
<tr>
<td>CPE 465</td>
<td>Advanced Computer Networks</td>
</tr>
</tbody>
</table>

Up to 4 units may be taken from the Approved External Electives listed below:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AERO 450</td>
<td>Introduction to Aerospace Systems Engineering</td>
</tr>
<tr>
<td>ART 376</td>
<td>The Art of Mixed Reality</td>
</tr>
<tr>
<td>ART 384</td>
<td>Digital 3D Modeling and Design</td>
</tr>
<tr>
<td>BUS 310</td>
<td>Introduction to Entrepreneurship</td>
</tr>
<tr>
<td>CHEM 216</td>
<td>Organic Chemistry I</td>
</tr>
<tr>
<td>CHEM 217</td>
<td>Organic Chemistry II</td>
</tr>
<tr>
<td>CHEM 218</td>
<td>Organic Chemistry III</td>
</tr>
<tr>
<td>CHEM 312</td>
<td>Survey of Organic Chemistry</td>
</tr>
<tr>
<td>ECON 339</td>
<td>Econometrics</td>
</tr>
<tr>
<td>EE 201</td>
<td>Electric Circuit Theory</td>
</tr>
<tr>
<td>&amp; EE 251</td>
<td>and Electric Circuits Laboratory</td>
</tr>
<tr>
<td>EE 314</td>
<td>Introduction to Communication Systems</td>
</tr>
<tr>
<td>EE/CPE 336</td>
<td>Microprocessor System Design</td>
</tr>
<tr>
<td>EE 424</td>
<td>Introduction to Remote Sensing</td>
</tr>
<tr>
<td>ENVE 542</td>
<td>Sustainable Environmental Engineering</td>
</tr>
<tr>
<td>IME 301</td>
<td>Operations Research I</td>
</tr>
<tr>
<td>IME 356</td>
<td>Manufacturing Automation</td>
</tr>
<tr>
<td>MATH 206</td>
<td>Linear Algebra I</td>
</tr>
<tr>
<td>MATH 242</td>
<td>Differential Equations I</td>
</tr>
<tr>
<td>MATH 248</td>
<td>Methods of Proof in Mathematics</td>
</tr>
<tr>
<td>MATH 341</td>
<td>Theory of Numbers</td>
</tr>
<tr>
<td>MATH 350</td>
<td>Mathematical Software</td>
</tr>
<tr>
<td>MATH 412</td>
<td>Introduction to Analysis I</td>
</tr>
<tr>
<td>ME 211</td>
<td>Engineering Statics</td>
</tr>
<tr>
<td>ME 212</td>
<td>Engineering Dynamics</td>
</tr>
<tr>
<td>ME 405</td>
<td>Mechatronics</td>
</tr>
<tr>
<td>PHIL 412</td>
<td>Epistemology</td>
</tr>
<tr>
<td>PHIL 422</td>
<td>Philosophy of Mind</td>
</tr>
<tr>
<td>PSY 329</td>
<td>Research Methods in Psychology</td>
</tr>
<tr>
<td>PSY 333</td>
<td>Quantitative Research Methods for the Behavioral Sciences</td>
</tr>
<tr>
<td>PSY 357</td>
<td>Cognition</td>
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<tr>
<td>STAT 323</td>
<td>Design and Analysis of Experiments I</td>
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<tr>
<td>STAT 324</td>
<td>Applied Regression Analysis</td>
</tr>
<tr>
<td>STAT 330</td>
<td>Statistical Computing with SAS</td>
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<tr>
<td>STAT 331</td>
<td>Statistical Computing with R</td>
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<td>STAT 334</td>
<td>Applied Linear Models</td>
</tr>
<tr>
<td>STAT 416</td>
<td>Statistical Analysis of Time Series</td>
</tr>
<tr>
<td>STAT 418</td>
<td>Categorical Data Analysis</td>
</tr>
<tr>
<td>STAT 419</td>
<td>Applied Multivariate Statistics</td>
</tr>
</tbody>
</table>
Total units 16

1 A total of 16 Technical Elective units selected from upper-division and graduate CSC and CPE courses open to those in the major and not otherwise required by the major. An additional 4 units of CPE/CSC Technical Electives is needed if CSC/CPE 123 is not taken.

2 Up to a combined 4 units may be taken from CSC 400, CPE 400, CSC 490, or CSC 496.

**General Education (GE) Requirements**

- 72 units required, 36 of which are specified in Major and/or Support.
- If any of the remaining 36 units is used to satisfy a Major or Support requirement, additional units of Free Electives may be needed to complete the total units required for the degree.
- See the complete GE course listing (http://catalog.calpoly.edu/generalrequirementsbachelorsdegree/#generaleducationtext).
- A grade of C- or better is required in one course in each of the following GE Areas: A1 (Oral Communication), A2 (Written Communication), A3 (Critical Thinking), and B4 (Mathematics/Quantitative Reasoning).

### Area A

**English Language Communication and Critical Thinking**

<table>
<thead>
<tr>
<th>Area</th>
<th>Course Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Oral Communication</td>
<td>4</td>
</tr>
<tr>
<td>A2</td>
<td>Written Communication</td>
<td>4</td>
</tr>
<tr>
<td>A3</td>
<td>Critical Thinking</td>
<td>4</td>
</tr>
</tbody>
</table>

### Area B

**Scientific Inquiry and Quantitative Reasoning**

<table>
<thead>
<tr>
<th>Area</th>
<th>Course Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>Physical Science (4 units in Support)</td>
<td>0</td>
</tr>
<tr>
<td>B2</td>
<td>Life Science (4 units in Support) ^1</td>
<td>0</td>
</tr>
<tr>
<td>B3</td>
<td>One lab taken with either a B1 or B2 course</td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>Mathematics/Quantitative Reasoning (8 units in Support) ^1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Upper-Division B (4 units in Support) ^3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Area B Electives (8 units in Support) ^1</td>
<td>0</td>
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</table>

### Area C

**Arts and Humanities**

Lower-division courses in Area C must come from three different subject prefixes.

<table>
<thead>
<tr>
<th>Area</th>
<th>Course Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Arts: Arts, Cinema, Dance, Music, Theater</td>
<td>4</td>
</tr>
<tr>
<td>C2</td>
<td>Humanities: Literature, Philosophy, Languages other than English (4 units in Support) ^1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Lower-Division C Elective - Select a course from either C1 or C2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Upper-Division C</td>
<td>4</td>
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</tbody>
</table>

### Area D

**Social Sciences**

<table>
<thead>
<tr>
<th>Area</th>
<th>Course Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>American Institutions (Title 5, Section 40404 Requirement)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Area D Elective - Select either a lower-division D2 or upper-division D course</td>
<td>4</td>
</tr>
</tbody>
</table>