COMPUTER ENGINEERING

Phone: (209) 946-2153
Location: Anderson Hall

Degrees Offered
Bachelor of Science in Computer Engineering

Computer Engineering Program
Educational Objectives
Through their careers in computer engineering or related profession, Pacific graduates are expected to demonstrate the following within a few years of earning their Bachelor's degree in Computer Engineering:

- Competency in the computer engineering profession via promotion to positions of increasing responsibility, publications, and/or conference presentations
- Adaptability to new developments in science and technology by successfully completing or pursuing graduate education in engineering or related fields, participating in professional development and/or industrial training courses, or pursuing professional licensure

Students Graduating with a BS in Computer Engineering 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.

Bachelor of Science in Computer Engineering
Students must complete a minimum of 120 units of academic work and a minimum of 32 units of Cooperative Education in order to earn the bachelor of science in computer engineering.

I. General Education Requirements

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PACS 001</td>
<td>What is a Good Society</td>
<td>4</td>
</tr>
<tr>
<td>PACS 002</td>
<td>Topical Seminar on a Good Society</td>
<td>4</td>
</tr>
<tr>
<td>PACS 003</td>
<td>What is an Ethical Life?</td>
<td>3</td>
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</tbody>
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II. Diversity Requirement
Students must complete one diversity course (3-4 units)

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ENGR 030</td>
<td>Engineering and Computing Ethics in Society</td>
<td>3</td>
</tr>
</tbody>
</table>

III. Fundamental Skills
Students must demonstrate competence in:

- Writing
- Quantitative analysis

Note: Fundamental skills must be satisfied before enrolling in upper division courses.

IV. Major Requirements
Mathematics and Science (minimum of 30 units)

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>MATH 051</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 053</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 055</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 057</td>
<td>Applied Differential Equations I: ODEs</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 053</td>
<td>Principles of Physics I</td>
<td>5</td>
</tr>
<tr>
<td>PHYS 055</td>
<td>Principles of Physics II</td>
<td>5</td>
</tr>
<tr>
<td>BENG 053</td>
<td>General Biology with Applications for Engineers I</td>
<td>3-5</td>
</tr>
<tr>
<td>BENG 063</td>
<td>General Biology with Applications for Engineers II</td>
<td></td>
</tr>
<tr>
<td>BIOL 051</td>
<td>Principles of Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 061</td>
<td>Principles of Biology</td>
<td></td>
</tr>
<tr>
<td>CHEM 024</td>
<td>Fundamentals of Chem</td>
<td></td>
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</tbody>
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Note: 1) Pacific Seminars cannot be taken for Pass/No Credit. 2) Transfer students with 28 or more transfer units complete 2 additional General Education elective courses from below in place of taking PACS 001 and PACS 002.

One course from each subdivision below:

Social and Behavioral Sciences
Two courses from the following:

- IA. Individual and Interpersonal Behavior
- IB. U.S. Studies
- IC. Global Studies

Arts and Humanities
One course from the following categories:

- IIA. Language and Literature
- IIC. Visual and Performing Arts

Note: 1) Only one course can come from each subcategory (A, B, or C) within each category. 2) No more than 2 courses from a single department may be applied to meet the breadth program requirements, with the exception of certain 1-unit GE IIC courses.

Note: 1) Transfer students with 28 units or more transfer units prior to fall 2011 are encouraged but not required to complete a designated diversity course prior to graduation. 2) Courses may be used also to meet general education and/or major/minor requirements.

Computer Engineering
Select two of the following:

- ECPE Elective
- COMP Elective

Electives: Select four courses from technical elective options

- ENGR 025
- ECPE 196
- ECPE 195
- ECPE 174
- ECPE 173
- ECPE 172
- ECPE 170
- ECPE 131L
- ECPE 131
- ECPE 127
- ECPE 121
- COMP 053
- COMP 051

Computer Engineering Core

- COMP 051 Introduction to Computer Science 4
- COMP 053 Data Structures 4
- ECPE 121 Digital Signal Processing 4
- ECPE 127 Random Signals 3
- ECPE 131 Electronics 3
- ECPE 131L Electronics Lab 1
- ECPE 170 Computer Systems and Networks 4
- ECPE 172 Microcontrollers 4
- ECPE 173 Computer Organization and Arch 3
- ECPE 174 Advanced Digital Design 4
- ECPE 195 Senior Project I 2
- ECPE 196 Senior Project II 2
- ENGR 025 Professional Practice Seminar 1

Technical Electives

Electives: Select four courses from technical elective options 12

COMP Elective

Select one of the following: 3-4

- COMP 127 Web Applications
- COMP 129 Software Engineering
- COMP 135 Human-Computer Interface Design
- COMP 137 Parallel Computing
- COMP 141 Programming Languages
- COMP 147 Computing Theory
- COMP 151 Artificial Intelligence
- COMP 153 Computer Graphics
- COMP 155 Computer Simulation
- COMP 157 Design and Analysis of Algorithms
- COMP 159 Computer Game Technologies
- COMP 163 Database Management Systems
- COMP 173 Operating Systems
- COMP 175 System Administration and Security
- COMP 191 Independent Study
- COMP 197 Undergraduate Research

ECPE Elective

Select two of the following: 3-4

- ECPE 124 Digital Image Processing
- ECPE 133 Solid State Devices
- ECPE 135 Power State Devices
- ECPE 136 VLSI Design
- ECPE 141 Advanced Circuits
- ECPE 144 Applied Electromagnetics
- ECPE 155 Autonomous Robotics
- ECPE 161 Automatic Control Systems
- ECPE 162 Communication Systems
- ECPE 163 Energy Conversion
- ECPE 165 Power System Analysis
- ECPE 177 Computer Networking
- ECPE 178 Computer Network Security
- ECPE 191 Independent Study
- ECPE 197 Undergraduate Research

ECPE or COMP Elective

Select one course from ECPE or COMP electives listed above 3-4

SOECS Elective

Select one course from BENG, CIVL, COMP, ECPE, ENGR, EMGT, EPHY, or MECH

Cooperative Education (Minimum 32 units to include)

- ENGR 181 Professional Practice 3-4
- ENGR 182 Professional Practice 1-16
- ENGR 183 Professional Practice 1-16

* Students who transfer in with 28 or more units are exempt from taking ECPE 005
** ECPE, EPHY, or COMP courses must be at 100 level. Excluding ENGR 010, ENGR 019, ENGR 025, ENGR 030, ENGR 181, ENGR 182, and ENGR 183.

Electrical Computer Engr Courses

ECPE 005. Introduction to Electrical and Computer Engineering. 1 Unit.
This course introduces students to various sub-disciplines of Electrical and Computer Engineering and to the tools, both hardware and software, that are used in Electrical & Computer Engineering. Prerequisite: ENGR 010 with a "C-" or better.

ECPE 041. Circuits. 3 Units.
Students study concepts of voltage, current, power, energy. Topics include ideal circuit elements and their I/V characteristics, Kirchhoff's laws, circuit analysis using node voltage and mesh current methods, Thevenin's and Norton's theorems, maximum power transfer, and operational amplifier circuits. The course examines step response of 1st order (RC, RL) and 2nd order (RLC) circuits, phasor analysis, impedance calculations, sinusoidal steady state response, instantaneous, average, and reactive power, frequency response, bandwidth of first order, and lowpass and highpass filters. Prerequisite: PHYS 055; MATH 055; COMP 051 or ENGR 019 with a "C-" or better. Corequisite: ECPE 041L.

ECPE 041L. Circuits Laboratory. 1 Unit.
Students study the use of standard test equipment to make DC and AC measurements and characterize electric circuits. Circuit simulation is taught with software tools, and data analysis is emphasized. Corequisite: ECPE 041.

ECPE 071. Digital Design. 3 Units.
Students study number systems, binary arithmetic, and Boolean logic. Topics include the analysis and synthesis of combinational and sequential circuits and the use of MSI, LSI, FPGA and CPLD devices. Prerequisite: Fundamental Math Skills requirement; COMP 051 or ENGR 019 with a "C-" or better. Recommended: ECPE 071L.
ECPE 071L. Digital Design Lab. 1 Unit.
This course involves laboratory treatment of the concepts discussed in ECPE 071. Prerequisites: Fundamental Math Skills requirement; COMP 051 or ENGR 019 with a "C-" or better. Corequisite: ECPE 071.

ECPE 121. Digital Signal Processing. 4 Units.
Students analyze discrete-time signals and systems using Z transforms and Fourier transforms, the fast Fourier transform and its applications, digital filters and their applications and implementation of DSP algorithms using Matlab and Simulink. Prerequisites: ECPE 041 and MATH 057 with a "C-" or better.

ECPE 124. Digital Image Processing. 4 Units.
This course is the analysis and design of algorithms in digital image processing. Topics include: image formation, file format, pixel-based processing, object recognition, filtering and edge detection, image transforms, segmentation, stereo-vision, and motion tracking. Prerequisites: COMP 053, ECPE 121 with a "C-" or better.

ECPE 127. Random Signals. 3 Units.
This course is an introduction to probability and statistics in engineering applications. Students will become familiar with discrete and continuous random variables and their probability models. Topics include counting methods, reliability problems, probability mass functions (PMF), probability density functions (PDF), cumulative distribution functions (CDF), conditional PDF's, expected value and variance, joint and marginal PDF's and CDF's, functions of two random variables. Prerequisites: Completion of all Fundamental Skills, MATH 055 with a "C-" or better.

ECPE 131. Electronics. 3 Units.
This course introduces students to semiconductor physics. Topics include modeling, analysis, and simulation of analog and digital circuits containing diodes, bipolar junction transistors, and MOSFETs. Other topics include analysis and design of single stage amplifiers, frequency response of amplifiers, gain, bandwidth, DC biasing, and small signal analysis of amplifiers. Prerequisites: Completion of all Fundamental Skills; ECPE 041, ECPE 041L, ECPE 071, ECPE 071L; MATH 055, PHYS 055, completion of CHEM 024 or CHEM 025 or CHEM 027 or BIOL 051 or BIOL 061 or BENG 053 or BENG 063 with a "C-" or better. Prerequisite that may be taken concurrently: ECPE 071, ECPE 071L Corequisite: ECPE 131L.

ECPE 131L. Electronics Lab. 1 Unit.
Students examine the use of standard electronic test equipment and simulation tools to analyze, design, and test electronic circuits. Emphasis on analog circuits. Prerequisites: Completion of all Fundamental Skills. Corequisite: ECPE 131.

ECPE 133. Solid State Devices. 4 Units.
This course introduces concepts related to the crystal structure of semiconductors and electronic, optical, and magnetic properties of semiconductors. Dynamics of carriers under equilibrium and non-equilibrium conditions are presented as a frame work for understanding the behavior of a number of devices including Metal-Oxide-Semiconductor (MOS) and Hetero-junction Bipolar (HBT) devices. On such a background, the course builds an understanding of the latest advances in the field. This course is cross listed with EPHY 144. Prerequisites: Completion of all Fundamental Skills; PHYS 055, MATH 057, ECPE 041 with a "C-" or better.

ECPE 135. Power Electronics. 4 Units.
Switch-Mode DC-DC converters, Feedback control of converters, Rectifiers and power factor correction circuits, switch mode DC power supplies, applications to motor control and renewable energy integration to the grid. Includes laboratory. Prerequisites: Completion of all Fundamental Skills; ECPE 131 and ECPE 131L with a "C-" or better. Prerequisite may be taken concurrently: ECPE 121 with a "C-" or better.

ECPE 136. VLSI Design. 4 Units.
Students examine issues in VLSI design. Topics include logic families, sizing, timing models, fabrication, layout, high speed and low power design tradeoffs, circuit simulation and device modeling. Prerequisites: Completion of all Fundamental Skills; ECPE 071, ECPE 071L, ECPE 131, ECPE 131L with a "C-" or better. (Spring odd years).

ECPE 141. Advanced Circuits. 4 Units.
Analysis and design of circuits in the continuous time domain. Topics include: frequency response, Laplace transforms, Fourier transforms, stability and feedback. Applications include high order filter design and controls. Prerequisites: ECPE 041, ECPE 041L, and MATH 057 with a "C-" or better.

ECPE 144. Applied Electromagnetics. 4 Units.
The purpose of this course is for students to gain an understanding of transmission lines and field theory as it applies to communication circuits and systems. Electromagnetic wave propagation, reflection, and transmission through common materials are examined. This course is cross listed with EPHY 144. Prerequisites: Completion of all Fundamental Skills; PHYS 055, MATH 057, ECPE 041 with a "C-" or better.

ECPE 155. Autonomous Robotics. 4 Units.
This course is an overview of the design of autonomous robotics. Students study architectures for robot organization and control, configurations of fixed and mobile robots, sensors and actuators. Students also study the design of algorithms and knowledge representations. Prerequisites: Completion of all Fundamental Skills; COMP 053 and ECPE 172 with a "C-" or better or permission of instructor.

ECPE 161. Automatic Control Systems. 4 Units.
Students study component and system transfer functions, open and closed loop response; stability criteria, applications to engineering systems. This course include a laboratory. Prerequisites: Completion of all Fundamental Skills and ECPE 121 with a "C-" or better.

ECPE 162. Communication Systems. 4 Units.
Students examine signal characterization in time and frequency domains. Topics include baseband communication, pulse code modulation, multiplexing, complex envelope representation of bandpass signals, AM, FM, and digitalmodulations. Students also examine applications to radio, television, telephone, and cellular phone systems. A laboratory is included. Prerequisites: Completion of all Fundamental Skills and ECPE 121 with a "C-" or better. (Spring).

ECPE 163. Energy Conversion. 4 Units.
Students study three phase power systems. Topics include magnetic circuits, transformers, rotating machines: DC, induction, and synchronous machines as well as equivalent circuits and characteristic curves of transformers and rotating machines, renewable energy sources and technologies. the course includes a laboratory. Prerequisites: Completion of all Fundamental Skills; ECPE 041 and ECPE 041L; PHYS 055 with a "C-" or better.

ECPE 165. Power System Analysis. 3 Units.
Students study electrical power generation and transmission, Three-phase systems, power system component models, per-unit system and single line diagrams, power flow analysis. Prerequisites: Completion of all Fundamental Skills and ECPE 041 with a "C-" or better. Junior standing.

ECPE 170. Computer Systems and Networks. 4 Units.
This course is a comprehensive and holistic examination of the modern computing environment. Students gain an understanding of the various hardware and software components that enable computers and networks to process information and execute applications. Students learn to apply this knowledge in the development of efficient and robust software applications. Prerequisites: Completion of all Fundamental Skills; ECPE 071, COMP 053 with a "C-" or better.
ECPE 172. Microcontrollers. 4 Units.
Students study the design and implementation of digital monitoring and control systems that use micro-controllers. Topics include hardware and software development, interfacing input and output devices, assembly and C programming as well as representative applications. The course includes a laboratory. Prerequisites: Completion of all Fundamental Skills; ECPE 071 and ECPE 071L with a "C-" or better.

ECPE 173. Computer Organization and Arch. 3 Units.
The objective of this course is to give students an understanding of how a complete modern computer system operates. Students learn about design of control, datapath and arithmetic-logic units. Other topics include pipelining, memory hierarchy and assembly language programming. Prerequisites: Completion of all Fundamental Skills; ECPE 170; ECPE 172 or ECPE 174 with a "C-" or better.

ECPE 174. Advanced Digital Design. 4 Units.
Students learn how to analysis, design, and implement synchronous state machines using programmable logic devices. Topics include CAD-based simulation and development that use schematic capture and hardware description languages, and representative applications. The course includes a laboratory. Prerequisites: Completion of all Fundamental Skills; ECPE 071 and ECPE 071L with a "C-" or better.

ECPE 177. Computer Networking. 4 Units.
Students study computer networks and the Internet. Topics include LAN and WAN architectures, packet switched networks and routing, the 7-layer OSI model and Internet protocol stack, socket programming and client/server systems as well as wireless security. The course includes a laboratory. Also listed as COMP 177. Prerequisites: Completion of all Fundamental Skills; COMP 053 and ECPE 170 with a "C-" or better. Junior or Senior standing.

ECPE 178. Computer Network Security. 3 Units.
This course is an examination of the pervasive security threats related to the Internet, data communications and networking. Topics include TCP/IP protocols, authentication, encryption, malware, cybercrime, and social engineering. Emphasis is on computer and network attack methods, their detection, prevention and analysis, and the integration of the tools and techniques employed in this effort. Includes lab. Prerequisites: Completion of all Fundamental Skills and ECPE 170 or COMP 175 with a "C-" or better.

ECPE 191. Independent Study. 1-4 Units.
Special individual projects are undertaken under the direction of one or more faculty members knowledgeable in the particular field of study. Permission of department chairperson and faculty members involved.

ECPE 195. Senior Project I. 2 Units.
This first semester capstone design course instructs students in the application of design processes and interdisciplinary teamwork. Student teams select a project and develop requirements, test, and design documents. Projects incorporate consideration of engineering standards and realistic constraints such as economics, the environment, sustainability, manufacturability, or safety. Components are evaluated and selected. Feasibility is analyzed through prototyping or simulation and results are presented via oral and written reports. This course is cross listed with EPHY 195. Prerequisites: Completion of all Fundamental Skills; ECPE 131 and ECPE 131L; ECPE 121, ECPE 141, ECPE 172 or ECPE 174 with a "C-" or better.

ECPE 196. Senior Project II. 2 Units.
This second-semester capstone design course, interdisciplinary teams complete the design of their projects. Full implementation is completed, including iteration, optimization, and refinement; justifications for design decisions are analyzed. Testing is performed and results are evaluated to demonstrate satisfaction of specifications. Final oral and written reports, complete documentation, and a project demonstration are required. This course is cross listed with EPHY 196. Prerequisites: Completion of all Fundamental Skills; ECPE 195 with a "C-" or better.

ECPE 197. Undergraduate Research. 1-4 Units.
This course offers applied or basic research in electrical and/or computer engineering under faculty supervision. Permission of faculty supervisor and department chair. The student must be in good academic standing.