

COMPUTER ENGINEERING

Phone: (209) 946-2153

Location: Anderson Hall

Website: Computer Engineering (<http://www.pacific.edu/Academics/Schools-and-Colleges/School-of-Engineering-and-Computer-Science/Academics-/Majors/Computer-Engineering-.html>)

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, or participating in professional development and/or industrial training courses

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

PACS 001	What is a Good Society	4
PACS 002	Topical Seminar on a Good Society	4
PACS 003	What is an Ethical Life?	3

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

IIB. ENGR 030

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.

II. Diversity Requirement

Students must complete one diversity course (3-4 units)

ENGR 030	Engineering Ethics and Society	3
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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.

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)

MATH 051	Calculus I	4
MATH 053	Calculus II	4
MATH 055	Calculus III	4
MATH 057	Applied Differential Equations I: ODEs	4
PHYS 053	Principles of Physics I	5
PHYS 055	Principles of Physics II	5
Select one of the following Science electives:		3-5

BENG 053	General Biology with Applications for Engineers I	
BENG 063	General Biology with Applications for Engineers II	
BIOL 051	Principles of Biology	
BIOL 061	Principles of Biology	
CHEM 024	Fundamentals of Chem	
CHEM 025	General Chemistry	
CHEM 027	General Chemistry	

Select one of the following Discrete Math electives:		4
COMP 047	Discrete Math for Computer Science	
MATH 049	Introduction to Abstract Mathematics	
MATH 074	Discrete and Combinatorial Mathematics	
MATH 110	Numerical Analysis	
MATH 148	Cryptography	
MATH 174	Graph Theory	

Engineering Science

ENGR 010	Dean's Seminar	1
ECPE 005	Introduction to Electrical and Computer Engineering	1
ECPE 041	Circuits	3
ECPE 041L	Circuits Laboratory	1
ECPE 071	Digital Design	3
ECPE 071L	Digital Design Lab	1

Computer Engineering Core

COMP 051	Introduction to Computer Science	4
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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 194	Core Assessment Exam (CAE)	0
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 133	Solid State Devices
ECPE 135	Power Electronics
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, or MECH* 3-4

Cooperative Education (Minimum 32 units to include)

ENGR 181	Professional Practice	1-18
ENGR 182	Professional Practice	1-18
ENGR 183	Professional Practice	1-18

* ECPE or COMP courses must be at 100 level.
Excluding ENGR 010, ENGR 025, ENGR 030, ENGR 181, ENGR 182, and ENGR 183.

Computer Engineering Faculty

Jennifer Ross, Associate Professor and Chair of Electrical and Computer Engineering, 1993, BS in Electrical Engineering University of Illinois, 1988; MS in Electrical Engineering, University of California Berkeley, 1990. PhD in Electrical Engineering University of California Berkeley, 1993; Solid state, short wavelength lasers, analog circuits and devices.

Rahim Khoie, Professor of Electrical and Computer Engineering and Program Director of Engineering Physics, 2002, BSEE, 1977, Abadan Institute of Technology, Abadan, Iran; MS, 1980, University of Pittsburgh; PhD, 1986, University of Pittsburgh. High speed electron devices, Quantum effect devices, Solid state physics, Renewable energy, Analog and digital electronics, and Embedded Systems.

Elizabeth Basha, Assistant Professor of Electrical and Computer Engineering, 2010, BS in Computer Engineering, University of the Pacific, 2003; SM in Electrical Engineering and Computer Science, Massachusetts Institute of Technology, 2005; PhD in Electrical Engineering and Computer Science, Massachusetts Institute of Technology, 2010. Sensor networks, autonomous robotics, international development.

Kenneth F. Hughes, Associate Professor of Electrical and Computer Engineering, 1993, BS, Information and Computer Science, Georgia Institute of Technology, 1985; MS, Computer Science, University of South Florida, 1989; PhD, Computer Science and Engineering, University of South Florida, 1994. Robotics, sensors and sensor fusion, computer vision, artificial intelligence, embedded systems, microprocessors and microcontrollers, digital systems.

Cherian Mathews, Professor of Electrical and Computer Engineering, 2005, BE in Electrical Engineering, Anna University, Chennai, India, 1987; MS in Electrical Engineering, Purdue University, 1989; PhD in Electrical Engineering, Purdue University, 1993; Statistical signal processing, Array signal processing, Real-time digital signal processing using DSP processors, power systems.

David Mueller, Assistant Professor of Electrical and Computer Engineering, 2015, BS Electrical and Computer Engineering, 2006; MS Electrical Engineering, 2008; PhD Electrical and Computer Engineering, 2015, University of Missouri - Columbia. Semiconductor devices, Optical electronics, Computational intelligence, Robotics, Device simulation, Photovoltaics, Renewable energy, Device fabrication and characterization.

Vivek Pallipuram, Assistant Professor of Electrical and Computer Engineering, 2015, BS National Institute of Technology, Tiruchirappalli, India 2008; MS Computer Engineering, Clemson University, 2010; PhD Computer Engineering, Clemson University, 2013. Computer architecture, High performance computing, Cloud computing, Machine learning, Statistics, & Digital signal processing.

Jeffrey Shafer, Assistant Professor of Electrical and Computer Engineering, 2010, BS, Computer Engineering, University of Dayton, 2002; MS, Electrical Engineering, University of Dayton, 2004; PhD, Electrical and Computer Engineering, Rice University, 2010; Computer

architecture, Network systems architecture, Data-intensive computing, Cloud computing, Virtualization.

Huihui Xu, Assistant Professor of Bioengineering, 2014, B.E., Biomedical Engineering, Zhejiang University, Hangzhou, Zhejiang, China, 2006; M.S., Applied Mathematics, Zhejiang University, Hangzhou, Zhejiang, China, 2002; Ph.D., Bioengineering, University of Illinois at Chicago, Chicago, IL., 2006; Biomedical Engineering, Biomedical Imaging, Bio-instrumentation.

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 PHYS 170. Prerequisite: MATH 057, PHYS 055 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. 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 includes 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 digital modulations. 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 071, ECPE 071L, ECPE 170 with a "C-" or better.

ECPE 174. Advanced Digital Design. 4 Units.

Students learn how to analyze, 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 194. Core Assessment Exam (CAE). 0 Units.

Each student in the ECPE department is required to take the Core Assessment Exam (CAE). The CAE tests students' knowledge of the material covered in the core courses and in basic math. Prerequisites: Completion of all Fundamental Skills; ECPE 041, ECPE 041L, ECPE 071, ECPE 071L, MATH 055, PHYS 055, COMP 051 with a "C-" or better.

ECPE 195. Senior Project I. 2 Units.

This course instructs students in the application of design processes and teamwork. Topics include multiple interdisciplinary team design experiences of increasing complexity. Projects incorporate consideration of engineering standards and realistic constraints such as economics, the environment, sustainability, manufacturability, and safety. Students are given instruction and practice in documentation and as well as oral and written communications skills. Prerequisites: Completion of all Fundamental Skills; ECPE 071, ECPE 071L, ECPE 121, ECPE 131, ECPE 131L with a "C-" or better. Prerequisite, may be taken concurrently: ECPE 194 with a "C-" or better.

ECPE 196. Senior Project II. 2 Units.

This capstone design course integrates earlier studies, including ECPE 195, to perform interdisciplinary team design projects. Student design teams define a requirements document, a test document, and a design document for a prescribed product, then design, build and test a prototype. Complete documentation is expected. Final oral and written reports and project demonstrations are required. Prerequisites: Completion of all Fundamental Skills; ECPE 194 and 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.