BACHELOR OF SCIENCE IN COMPUTER ENGINEERING

Phone: (209) 946-2153
Location: Anderson Hall
Website: Computer Engineering (https://engineering.pacific.edu/engineering/academics/computer-engineering/)

Programs 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

For more details, see General Education (https://catalog.pacific.edu/uop/generalinformation/generaleducation/)

Minimum 28 units and 9 courses that include:

A. CORE Seminars (2 courses)

CORE 001	Problem Solving & Oral Comm	3
CORE 002	Writing and Critical Thinking	4

Note: 1) CORE Seminars cannot be taken for Pass/No Credit. ***2)*** Transfer students with 28 or more transfer credits taken after high school are exempt from both CORE seminars.

B. Breadth Requirement (7 courses, at least 3 units each)

At least one course from each of the following areas:

- Artistic Process & Creation
- Civic & Global Responsibility
- Language & Narratives
- Quantitative Reasoning
- Scientific Inquiry
- Social Inquiry
- World Perspectives & Ethics

Note: 1) No more than 2 courses from a single discipline can be used to meet the Breadth Requirement.

C. Diversity and Inclusion Requirement

All students must complete Diversity and Inclusion coursework (at least 3 units)

Note: 1) Diversity and Inclusion courses can also be used to meet the breadth category requirements, or major or minor requirements.

D. Fundamental Skills

Students must demonstrate competence in:

- Writing
- Quantitative Analysis (Math)

Note: 1) Failure to satisfy the fundamental skills requirements by the end of four semesters of full-time study at the University is grounds for academic disqualification.

II. 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
ECPE 127	Random Signals	3
Select one of the following Discrete Math electives:		4
COMP 047	Discrete Math for Computer Science	
MATH 074	Discrete and Combinatorial Mathematics	
MATH 174	Graph Theory	

Engineering Science

IDEA 010	Interdisciplinary Design and Success	2
IDEA 020	Interdisciplinary Design and Innovation	2
ENGR 030	Engineering and Computing Ethics in Society	3
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
COMP 053	Data Structures	4
ECPE 121	Digital Signal Processing	4
ECPE 131	Electronics	4
ECPE 170	Computer Systems and Networks	4
ECPE 172	Microcontrollers	4
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 five courses from technical elective options		
COMP Elective		
Select one of the following:		3-4
Any 100 or 200 level COMP course (excluding COMP 187)		
ECPE Elective		
Select two of the following:		6-8
Any 100 or 200 level ECPE course		
IDEA 130	Introduction to Mobile Robotics	4
IDEA 131	Autonomous Mobile Robotics	4
SOECS Elective		
Select two courses from BENG, CIVL, COMP, ECPE, ENGR, EMGT, EPHY, IDEA or MECH **		6-8
Cooperative Education (minimum of 32 units)		
ENGR 181	Professional Practice	1-16
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 IDEA 010 and IDEA 020.

** For SOECS elective, ECPE, EPHY, or COMP courses must be at 100 or 200 level. Excluding: COMP 187, ENGR 010, ENGR 019, ENGR 025, ENGR 030, ENGR 181, ENGR 182, ENGR 183, IDEA 010, IDEA 020, and IDEA 132.

Master of Science in Engineering Curriculum

All students who receive an MSE complete a set of core courses that cover the broader subjects of research and analysis. Students choose from one of four concentrations: Civil Engineering, Mechanical Engineering, Engineering Management, or Computer Engineering/ Electrical Engineering. Students must complete a minimum of 30 units with a Pacific cumulative grade point average of 3.0 in order to earn the Master of Science in Engineering.

A. Thesis Option

1. Students must complete a minimum of 30 units.
2. All students must perform independent research that must culminate in the completion of a thesis based on the findings of the research. For successful completion of the thesis course, students must submit a research proposal, conduct the research, write the thesis, and successfully complete a final oral defense.
3. All students complete six units of ENGR 299, Thesis Research.
4. The Concentration Requirements specified must be satisfied.

B. Non-thesis Option

1. Students must complete a minimum of 30 units.
2. For the Non-thesis Option, students may choose to do a project or they may satisfy all the unit requirements through coursework.
   a. For the *project* option, students complete up to 6 units of research under the supervision of an SOECS faculty member. Upon completion of the project, the student submits a comprehensive report.
   b. Students may elect to satisfy the entire degree through *coursework*.
   c. Both project and coursework options must satisfy the Concentration Requirements specified.

Master of Science in Engineering with a concentration in Computer Engineering/ Electrical Engineering

Students must complete a minimum of 30 units with a Pacific cumulative grade point average of 3.0 in order to earn the Master of Science in Engineering degree. Six of the 30 units may be upper division undergraduate courses approved by the advisor. A single course cannot fulfill requirements in both the MSE and BS degree.

Core Courses		
ENGR 201	Techniques in Research	3
Select one of the following Math or Computational Science Elective:		3
ENGR 219	Numerical Methods for Engineering	
ENGR 250	Probability and Statistics for Engineering and Computer Science	
Breadth Elective (one from approved list for concentration)		3-4
Select one of the following options:		6-9
A) Thesis Option		
COMP 299	Thesis	
or ECPE 299	Thesis	
B) Project Option (non-thesis)		
COMP 291	Graduate Independent Study	
or ECPE 291	Graduate Independent Study	
COMP 297	Graduate Research	
or ECPE 297	Graduate Research	
C) Course Work Option (non-thesis)		
Courses approved by advisor as coherent plan		
Concentration Requirements		
Electives approved by advisor as coherent plan *		15

* Minimum of 12 units of 200 level ECPE or COMP courses for the concentration.

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B. Breadth Requirement (7 courses, at least 3 units each)

At least one course from each of the following areas:

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- Quantitative Reasoning
- Scientific Inquiry
- Social Inquiry
- World Perspectives & Ethics

Note: 1) No more than 2 courses from a single discipline can be used to meet the Breadth Requirement.

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All students must complete Diversity and Inclusion coursework (at least 3 units)

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Students must demonstrate competence in:

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PHYS 055	Principles of Physics II	5
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MATH 074	Discrete and Combinatorial Mathematics	
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Engineering Science		
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IDEA 020	Interdisciplinary Design and Innovation	2
ENGR 030	Engineering and Computing Ethics in Society	3
ECPE 041	Circuits	3
ECPE 041L	Circuits Laboratory	1
ECPE 071	Digital Design	3
ECPE 071L	Digital Design Lab	1
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COMP 053	Data Structures	4
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ECPE 131	Electronics	4
ECPE 170	Computer Systems and Networks	4
ECPE 172	Microcontrollers	4
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 five courses from technical elective options		
COMP Elective		
Select one of the following:		3-4
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Select two of the following:		6-8
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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 IDEA 010 and IDEA 020.

** For SOECS elective, ECPE, EPHY, or COMP courses must be at 100 or 200 level. Excluding: COMP 187, ENGR 010, ENGR 019, ENGR 025, ENGR 030, ENGR 181, ENGR 182, ENGR 183, IDEA 010, IDEA 020, and IDEA 132.

Electrcl 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 that may be taken concurrently: 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. Prerequisites: PHYS 055; MATH 055; COMP 061 or COMP 051 or ENGR 019 with a "C-" or better. Prerequisites that may be taken concurrently: PHYS 55, MATH 55.

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 FPGA devices. Prerequisites: Fundamental Math Skills requirement, and Sophomore or Junior or Senior standing.

ECPE 071L. Digital Design Lab. 1 Unit.
This course involves laboratory treatment of the concepts discussed in ECPE 071. Corequisites: ECPE 071. Prerequisites: Fundamental Math Skills requirement; COMP 051 or COMP 061 or ENGR 019 with a "C-" or better.

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. Also listed as BENG 121. 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. Prerequisite that may be taken concurrently: ECPE 121.

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, sampling distributions, population parameter estimation, hypothesis testing using statistical software. Prerequisites: Completion of all Fundamental Skills, MATH 055 with a "C-" or better.

ECPE 131. Electronics. 4 Units.
Introduction to semiconductor physics, devices, and their circuit models. Analysis, design, implementation, testing, and verification of practical analog and digital circuits containing diodes, bipolar junction transistors, and field effect transistors. Extensive use of computer-aided analysis and design software. The course includes a laboratory. Prerequisites: Completion of all Fundamental Skills; ECPE 041, ECPE 041L, ECPE 071, ECPE 071L, MATH 055, PHYS 055, with a "C-" or better; AP CHEM with score of 4 or higher, or IB CHEM Higher Level with score of 5 or higher, or one year of high school chemistry with a "B-" or better, or appropriate score on the Pacific Diagnostic Chemistry test or CHEM 023 with a "C-" or better. Prerequisite that may be taken concurrently: ECPE 071, ECPE 071L.

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 133 and PHYS 170. Prerequisite: PHYS 055 with a "C-" or better. Prerequisite that may be taken concurrently: MATH 057 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 with a "C-" or better. Prerequisites that may be taken concurrently: ECPE 121 or ECPE 141 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. (Spring odd years). Prerequisites: Completion of all Fundamental Skills; ECPE 071, ECPE 071L, ECPE 131 with a "C-" or better.

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, 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; Prerequisite that may be taken concurrently: ECPE 121 or ECPE 141.

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. 4 Units.
Students study electric power generation and transmission, three-phase systems, power system component models, per-unit system and single line diagrams, power flow analysis, unbalanced systems, symmetrical components, and fault studies. Prerequisites: Completion of all Fundamental Skills and ECPE 041 with a "C-" or better, Junior standing.

ECPE 170. Computer Systems and Networks. 4 Units.
The course investigates the operation of a modern computer system and its components. Students examine the processor data path and memory hierarchy by writing assembly programs and high-level simulations. The course also provides an introduction to computer networks and socket programming. Prerequisites: Completion of all Fundamental Skills; ECPE 071 or COMP 047 with a "C-" or better; 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; COMP 053, ECPE 071, and ECPE 071L with a "C-" or better.

ECPE 173. Computer Organization and Architecture. 3 Units.
The objective of this course is to give students a deeper understanding of how a complete modern computer system operates. Students learn about design of a processing unit, pipelining, memory hierarchy, parallelism, and more advanced architecture topics. Prerequisites: Completion of all Fundamental Skills; ECPE 071L and ECPE 170 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.
Topics examined in this course include computer networks and the internet, LAN and WAN architectures, and packet switched networks and routing. Students learn about the internet protocol stack, socket programming and client/server systems, wireless networking and security. Also listed as COMP 177. Junior or Senior standing. Prerequisites: Completion of all Fundamental Skills; COMP 053 and ECPE 170 with a "C-" or better.

ECPE 178. Computer Network Security. 3 Units.
This course is an examination of computer security from a defensive and offensive perspective. Topics include attack methods used by threat actors (including scanning, exploits, privilege escalation, malware, and social engineering methods), their detection, and their prevention by network and host-based techniques. Additionally, cryptographic techniques are introduced in order to provide secure communications channels that guarantee message confidentiality, authenticity, and integrity. 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 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.

ECPE 225. Digital Signal Processing with Applications. 3 Units.
Topics include discrete time signals, systems, spectral analysis (DTFT), the Discrete Fourier Transform and the Fast Fourier Transform algorithm, decimation and interpolation, multi-rate signal procession, and filtering random signals. Additional course content is speech processing, speech models and characteristics, short time Fourier analysis, linear predictive coding. Image processing: 2D signals and systems, image coding, image enhancement is also addressed. Prerequisites: ECPE 121 with a "C" or better or equivalent and Graduate or blended students in the School of Engineering and Computer Science or permission of instructor.

ECPE 226. Computational Intelligence. 3 Units.
Computational intelligence is broadly defined as the concepts, models, and algorithms inspired by intelligent biological systems. Students will apply computational intelligence paradigms and techniques to real world data sets and optimization problems. Topics include types of learning, theory of generalization, linear and logistic regression, non-linear transformation, fundamentals of neural networks, evolutionary computation and optimization, fuzzy set theory and fuzzy logic, and other current topics in computational intelligence. Familiarity with basics in linear algebra, probability, and analysis of algorithms recommended. Prerequisites: Graduate or blended students in the School of Engineering and Computer Science.

ECPE 233. Quantum and Nano Devices. 3 Units.
Students study advanced topics related to recent development of the emerging field of nanoelectronics where the feature lengths of the electron devices are of the order of several nanometers. They also study transport phenomenon in nano-structures that use a quantum atomistic transport approach. Topics include: quantum confined effects, nanofabrication, quantum wells, quantum wires, quantum dots, and quantum optoelectronic devices. The purpose of this course is to prepare the framework for analyzing, modeling, and designing of these non-scale electron devices. Prerequisites: familiarity with MATLAB, light familiarity with physics of semiconductor devices, light exposure to quantum physics, ability to solve second order differential equations, and an exposure to complex analysis, Graduate or blended students in the School of Engineering and Computer Science or permission of the instructor.

ECPE 251. High-Performance Computing. 3 Units.
This course investigates modern HPC systems and architectures including multiprocessor clusters, General-Purpose Graphical Processing Units (GP-GPUs), and Xeon Phi co-processors. Students develop effective parallel programs by applying parallel programming principles, parallelism models, and communication models. Topics include: taxonomy of parallel machines, supercomputer topology, shared memory systems, OpenMP, distributed systems, message passing interface, CPU architecture, compute unified device architecture, HPC performance modeling. Prerequisite: Graduate or blended student in the School of Engineering and Computer Science and ECPE 170 with a "C" or better.

ECPE 253. Advanced Computer Graphics. 3 Units.
Students study advanced topics in computer-generated graphics such as procedural modeling, surface simplification, shaders, texture synthesis and mapping, volume rendering, ray tracing, photon mapping, image-based rendering techniques, non-photorealistic rendering, 3D hardware/GPUs and animation. Course includes programming projects and presentation of research topics. Prerequisites: COMP 153 or ECPE 153 with a "C" or better, C programming experience (C++ or Java is acceptable, but students are expected to program in C), Graduate or blended students in the School of Engineering and Computer Science or permission of the instructor.

ECPE 255. Robotics. 3 Units.
This course explores high-level issues of autonomous robotics. The course will focus on theory, design, and implementation of making intelligent and autonomous robots. The course will examine these topics from the perspective of individual robots, swarm robots, and multi-agent robots. Students will learn both theory and practice through simulations and work on robot platforms. Prerequisites: ECPE 170 or ECPE 172 or MECH 104 with a “C“ or better and Graduate or blended students in the School of Engineering and Computer Science.

ECPE 259. Sensor Networks for Engineering Systems. 3 Units.
This course introduces sensor networks for infrastructure systems from sensor selection, system design, implementation, acquisition, and analysis. Examination of application across multiple engineering disciplines. Project based components with laboratory. Prerequisites: ECPE 131, ECPE 121; or ENGR 019, ENGR 121; or COMP 055, COMP 157 with a "C" or better; Graduate or blended students in the School of Engineering and Computer Science; or permission of instructor.

ECPE 263. Recent Topics in Renewable Energy. 3 Units.
Recent Trends in global warming and the rising cost of energy has resulted in significant interest in renewable energy sources that include solar thermal, solar photovoltaics, hydrogen fuel cells, biomass, geothermal, wind, hydraulic, and hybrid technologies. This course is a survey of these energy sources and covers the theory, economic feasibility, current level of technological development, renewability, abundance, and environmental impacts of the renewable sources and compares them to the non-renewable sources which include oil, gas, coal, nuclear, and other current energy technologies. The emphasis is given to research in these fields by the students' term papers and projects. Prerequisite: Graduate or blended students in the School of Engineering and Computer Science or permission of instructor.

ECPE 276. Cloud Computing. 3 Units.
Cloud computing has become mainstream in the field of information technology, providing highly scalable computing resources for applications with no up-front capital investment and operating costs proportional to the actual use. Students will study the technological underpinnings that enable modern cloud computing, including virtualization technology, datacenter networks, programming models, and middleware systems. This course will provide a survey of current research focused on improving the performance, security, fault-tolerance, and energy efficiency of cloud computing systems. Further, students will utilize these cloud computing technologies as application programmers to construct distributed large-scale data processing systems. Prerequisites: Graduate or blended students in the School of Engineering and Computer Science and ECPE 170 with a "C" or better.

ECPE 287. Internship. 1-4 Units.

ECPE 291. Graduate Independent Study. 1-4 Units.
Special individual projects are undertaken under the direction of one or more faculty. Prerequisite: Graduate or blended students in the School of Engineering and Computer Science or permission of instructor.

ECPE 293. Special Topics. 1-4 Units.
Special courses are organized and offered from time to time to meet the needs or interests of a group of students. Prerequisite: Graduate or blended students in the School of Engineering and Computer Science or permission of the instructor.

ECPE 297. Graduate Research. 1-4 Units.

ECPE 297D. Graduate Research. 1-4 Units.

ECPE 299. Thesis. 1-6 Units.
Minimum of six units is required for Thesis Option students. Prerequisites: Graduate or blended students in the School of Engineering and Computer Science and permission of the research advisor.