**Department of Computer and Electrical Engineering and Computer Science**

**School of Natural Sciences, Mathematics, and Engineering**

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**Program Description**

Computer Engineering is a field, which in some sense, resides between the long-established fields of Computer Science and Electrical Engineering. It is concerned with topics such as analog and digital circuit design, embedded controllers, computer hardware, system software, computer system design, data communication, signal processing, computer networks, robotics, computer vision, graphics and image processing, and other topics in computing where hardware plays an important role. Computer engineers often work with other engineers, physical scientists, and software engineers.

The Computer and Electrical Engineering and Computer Science Department moved into a new building in Fall 2008. The department administers its own local area network which includes multiple Unix/Linux servers, two software programming labs, a walk-in lab/tutoring center, one advanced workstation lab, an isolated network lab, an AI/visualization lab, a DSP/communications lab, one digital electronics hardware lab, a power systems/electronics lab, and a robotics/control systems lab. There is also a department library/major study room with computers available to students.

An important goal of the department is to enable students to work much more closely with faculty than they would be able to at larger universities. A detailed description of student learning goals and objectives can be found at <http://www.cs.csub.edu/all_abet.pdf>.

**Requirements for the Bachelor of Science Degree in Computer Engineering**

**Total Units Required to Graduate 120 units**

**Major Requirements 95 units**

 ECE/CMPS Courses 64

 Cognate Courses 31

**Minor Requirements 0 units**

**General Education Requirements 24 units**

 First-year Seminar 0\*

 Foundational Skills 6\*

 LD Area B 0\*

 LD Area C 6

 LD Area D 3\*

AI-Hist/Gov6

JYDR3

 UD Thematic Areas (C&D) 0\*

 Capstone 0\*

 SELF 0\*\*

 GWAR 0\*\*

**Additional Units 1 unit \*\*\***

\* The following required major courses also meet general education requirements: ECE/ENGR 1618 and 1628 meet First-year Seminar, MATH 2310 or 2510 meets Foundational Skill A4, PHYS 2210 meets LD Area B1/B3, PHIL 3318 meets UD Thematic Area C, and CMPS 4928 meets Capstone. Engineering majors have the following GE modifications: Foundational Skill A3, LD Area B2, 3 units of LD Area D, and UD Thematic Area D.

\*\* The SELF requirement may be met by selecting another General Education course with a SELF overlay or by taking a stand-alone course. The GWAR requirement can be met by taking an exam, taking another General Education course with a GWAR overlay, or by taking a stand-alone course. If a student opts to take a stand-alone course for either or both of these requirements, the course(s) will add additional units to that student’s general education pathway.

\*\*\* Additional Units are required to meet the 120 unit requirement for graduation. Any accepted university units may be used to meet this requirement, including stand-alone courses for SELF and GWAR.

**SB1440 Units Required 58 units\***

\* Units required for graduation after completion of the Engineering (Computer Engineering focus) model curriculum and lower-division general education at a California community college.

**Note:** One (1) semester unit of credit normally represents one hour of in-class work and 2-3 hours of outside study per week.

**Requirements for the Major in Computer Engineering**

1. **Lower division required courses** (20 units):

ECE/ENGR 1618, 1628, ECE/ENGR/PHYS 2070, CMPS 2010, 2020, 2120

2. **Upper division required courses** (32 units):

 CMPS 3240, 3600, ECE 3040, 3070, 3200, 3220, 3250, 4910, 4928

3. **Upper division elective courses** (12 units):

 Select 12 units of electives from the following:

 **Digital Communications and Signal Processing:**

 ECE 3230, 4220, 4250, 4260

 **Control Systems, Robotics, and Digital Design:**

 ECE 4240, 4320, 4570

 **Image Processing and Computer Vision:**

ECE 4460, 4470

 **Special Topics and Independent Study**

ECE 3770, 3771, 4770, 4771, 4800, 4860, 4870, 4890

 *Only a combined total of 4 units of ECE 377x, 477x, 48xx may be used for elective credit.*

4. **Required cognate courses** (31 units):

 MATH 2510 or 2310, MATH 2520 or 2320, MATH 2530, 2610, 3200, PHYS 2210, 2220, PHIL 3318

5. **General Education Courses and Notes:**

 Some of the courses required for the Computer Engineering major also satisfy General Education requirements. Students who complete each of these courses with the appropriate grade will also satisfy the GE requirement, even if they were to change majors:

  ECE/ENGR 1618 and 1628 satisfy the First-year Seminar requirement.

  ECE 4928 satisfies the Capstone requirement.

  PHIL 3318 satisfies UD Thematic Area C and the Computer Engineering Ethics requirement.

  PHYS 2210 satisfies LD Areas B1 and B3.

  MATH 2510 or 2310 with a grade of C or better satisfies Foundational Skill A4.

 Engineering majors have the following General Education Modifications (GEMs), which means they do not have to take courses to satisfy these GE requirements. These GEMs are specific to the three engineering majors (Computer Engineering, Electrical Engineering and Engineering Sciences). Students who change to another major will not keep the modifications:

  Foundational Skill A3 is embedded in PHYS 2210, 2220 and ECE/ENGR/PHYS 2070.

  LD Area B2 is embedded throughout the curriculum.

  3 units of LD Area D is met through EAC/ABET outcomes 3c and 3h.

  UD Thematic Area D is met through EAC/ABET outcomes 3c and 3h.

**Note:** Several of the courses required for Computer Engineering are listed under the Computer Science Degree Program (CMPS prefix). Additionally, all Computer Engineering and Electrical Engineering courses descriptions are listed under the Computer Engineering Degree Program and carry the ECE prefix.

***Lower Division***

**ECE/ENGR 1618 Introduction to Engineering I (2)**

This course will provide an introduction to the practice of engineering and the various areas within the engineering disciplines. Students will be informed of engineering curricula and career opportunities within the various engineering disciplines. This course will also introduce students to important topics for academic success, both at the major level and at the university level. Each week lecture meets for 100 minutes. (GE FYS)

**ECE/ENGR 1628 Introduction to Engineering II (2)**

This course builds on the foundational skills in engineering design and practices developed in ECE/ENGR 1618. Students will design, build, test, and present engineering projects designed to solve specified problems within given constraints. Additionally, the impact of engineering from a global, social, economic, and environmental perspective is presented through case studies. Each week lecture/discussion meets for 100 minutes. Prerequisite: ECE/ENGR 1618 (GE FYS)

**ENGR/ECE/PHYS 2070 Electric Circuits (4)**

An introduction to the analysis of electrical circuits. Use of analytical techniques based on the application of circuit laws and network theorems. Analysis of DC and AC circuits containing resistors, capacitors, inductors, dependent sources and/or switches. Natural and forced responses of first and second order RLC circuits; the use of phasors; AC power calculations; power transfer; and energy concepts. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: PHYS 2220 with a grade of C- or better, or permission of the instructor

**ECE 2770 Special Topics (1-3)**

This course will be used to supplement regularly scheduled courses with additional material at the beginning level.

**ECE 2771 Special Topics Laboratory (1)**

Optional laboratory for the study of topics at the beginning level. Co-requisite: ECE 2770

***Upper Division***

**ECE 3040 Signals and Systems (4)**

Time and frequency domain techniques for signal and system analysis. Fourier series and transforms, and Laplace transforms. Topics in differential equations and probability. Use of a numerical computing environment such as MATLAB. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520 and ENGR/ECE/PHYS 2070

**ECE 3070 Analog Circuits (4)**

Design, construction, and debugging of analog electronic circuits. Diodes, filters, oscillators, transistors, JFETs, op-amps, and basic analog circuit design. Broadband applications in networking and communications. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520 and ENGR/ECE/PHYS 2070

**ECE 3200 Digital Circuits (4)**

Introduce combinational logic and sequential logic designs, and microprocessors. Cover digital concepts, number systems, operations, and codes, logic gates, Boolean algebra and logic simplification, combinational logic and its functions, flip-flops and related devices, counters, shift registers, memory and storage, concepts of microprocessors, assembly language, computers, and buses. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: ENGR/ECE/PHYS 2070 and ECE 3070

**ECE 3220 VHDL (4)**

Introduces logic system design using a hardware description language (VHDL). Covers the VHDL language in depth and explains how to use it to describe complex combinational and sequential logic circuits. Include a weekly lab where students will get hands-on experience implementing digital systems on Field Programmable Gate Arrays. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: ENGR/ECE/PHYS 2070 and ECE 3200.

**ECE 3230 Digital Communications (4)**

This course focuses on the representation of signals and noise, Gaussian processes, correlation functions and power spectra, linear systems and random processes, performance analysis and design of coherent and noncoherent communication systems, phase-shift-keying, frequency-shift-keying, and M-ary communication systems, optimum receivers and signal space concepts, information and its measure, source encoding, channel capacity, and error correcting coding. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520, ENGR/ECE/PHYS 2070, ECE 3040

**ECE 3250 Embedded Systems (4)**

Introduce embedded systems. Cover embedded concepts, NI sbRIO embedded system devices, LabVIEW RT and FPGA modules, combinational and sequential logic circuits design, finite state machines, memory and storage, sensor and motor interface. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: ECE 3070 and ECE 3200

**ECE 3320 Fields and Waves (4)**

This course focuses on the fundamentals of electromagnetics. Students are expected to acquire expertise in vector analysis, electrostatic and magnetic fields, Maxwell’s equations, plane waves, reflection, attenuation, and impedance. Knowledge of circuit theory, Matlab, differential equations, and calculus are required to successfully complete the course. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520 and ENGR/ECE/PHYS 2070.

**ECE 3340 Control Systems (4)**

Introduce control system analysis and design. Cover control system modeling, time response, reduction of multiple systems, stability analysis, steady-state errors, root locus technique, PID controller, and fuzzy controller. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: ECE 3040.

**ECE 3370 Power Systems Fundamentals (4)**

This course is an introductory subject in the field of electric power systems. Electric power systems have become increasingly important as a way of transmitting and transforming energy in industrial, military and transportation uses. The course covers basic elements of power system, three-phase circuit analysis, transformers, transmission line configuration, the per unit system and power flow. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: ENGR/ECE/PHYS 2070 and ECE 3040

**ECE 3380 Power Electronics and Electric Drives (4)**

The course is an introduction to switched-mode power converters, electromechanical energy conversion systems, and electric drives. It provides a basic knowledge of circuitry for the control and conversion of electrical power with high efficiency. These converters can change and regulate the voltage, current, or power; dc-dc converters, ac-dc rectifiers, dc-ac inverters, and ac-ac cycloconverters are in common use. Applications include electronic power supplies, aerospace and vehicular hybrid power systems, and renewable energy systems. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: ECE 3070, ECE 3320, ECE 3370.

**ECE 3770 Special Topics (1-3)**

This course will be used to supplement regularly scheduled courses with additional material at the intermediate level. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements.

**ECE 3771 Special Topics Laboratory (1)**

Optional laboratory for the study of topics at the intermediate level. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Co-requisite: ECE 3770

**ECE 4220 Digital Signal Processing (4)**

This course provides an introduction to principles of Digital Signal Processing (DSP) including sampling theory, aliasing effects, frequency response, Finite Impulse Response filters, Infinite Impulse Response filters, spectrum analysis, Z transforms, Discrete Fourier Transform and Fast Fourier Transform. Overviews of modern DSP applications such as modems, speech processing, audio and video compression and expansion, and cellular protocols. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520, ENGR/ECE/PHYS 2070, ECE 3040

**ECE 4240 Microprocessor System Design (4)**

Introduce microprocessor architecture and organization. Cover bus architectures, types and buffering techniques, Memory and I/O subsystems, organization, timing and interfacing, Peripheral controllers and programming. Design a microprocessor system. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: ENGR/ECE/PHYS 2070 and ECE 3200

**ECE 4250 Wireless Communications (4)**

In this course analytical characterizations of mobile communications channels are developed. The main techniques for mitigating the mobile communication channel effects such as Equalization, Diversity, etc. are examined. Multiple access techniques used in wireless communications, such as FDMA as well as digital TDMA and CDMA techniques are presented. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520, ENGR/ECE/PHYS 2070, ECE 3040

**ECE 4260 Wireless Networks (4)**

This course focuses on wireless data communications including wireless internet. The students acquire knowledge into the current and future state-of-the-art of technology in the field of wireless communications. Another goal of the course is to ensure student(s) can explain the impact of commercial, political, and regulatory factors on the design of wireless systems. The course will treat current relevant technologies, and the exact content may change from year to year. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: MATH 2320 or 2520

**ECE 4320 Instrumentation, Control, Data Acquisition (4)**

Introduce basic concepts in Instrumentation, Control and Data Acquisition. Cover analog and digital signal inputs, outputs, and generation. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: ENGR/ECE/PHYS 2070 and ECE 3070

**ECE 4330 Mechatronics (4)**

Intelligent electro-mechanical systems. Topics include electronics (A/D, D/A converters, op-amps, filters, power devices), software program design (event-driven programming, state machine-based design), DC and stepper motors, basic sensing and basic mechanical design. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: CMPS 2020 with a grade of C- or better, ECE 3070, and ECE 3200

**ECE 4370 Power Systems Analysis (4)**

This course follows the discussions from the first course in power systems. This course focuses on power flow, symmetrical components, faulted system analysis, and protection schemes. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: ECE 3370

**ECE/CMPS 4460 Image Processing (4**)

Digital image acquisition, image enhancement and restoration, image compression, computer implementation and testing of image processing techniques. Students gain hands-on experience of complete image processing systems, including image acquisition, processing, and display through laboratory experiments. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: CMPS 2020 with a grade of C- or better

**ECE/CMPS 4470 Computer Vision (4)**

Imaging formation, early vision processing, boundary detection, region growing, two-dimensional and three-dimensional object representation and recognition techniques. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: CMPS 2020 with a grade of C- or better

**ECE 4570 Robotics (4)**

Introduce robotic systems. Cover Mindstorms NXT, motion control, target steering and trajectory planning, obstacle avoidance, line tracking, and multiple sensor fusion. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: ENGR/ECE/PHYS 2070 and ECE 3040

**ECE 4770 Special Topics (1-3)**

This course will often be used to supplement other courses with additional work at a more advanced level. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Prerequisite: Permission of the instructor

**ECE 4771 Special Topics Laboratory (1)**

Optional laboratory for the study of topics at a more advanced level. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Co-requisite: ECE 4770. Prerequisite: Permission of the instructor

**ECE 4800 Undergraduate Research (1-4)**

Independent study into a research topic under the supervision of a faculty member. Students will establish the research goals and objectives with their faculty supervisor. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Prerequisite: Permission of the instructor

**ECE 4860 Internship (1-4)**

Internships may be arranged by the department with various agencies, businesses, or industries. The assignments and coordination of work projects with conferences and reading, as well as course credits, evaluation, and grading are the responsibility of the faculty liaison (or course instructor), working with the field supervisor. Offered on a credit, no-credit basis only. The department will determine the number of credit units offered. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Prerequisite: Permission of the instructor

**ECE 4870 Cooperative Education (1-4)**

The Cooperative Education program offers a sponsored learning experience in a work setting, integrated with a field analysis seminar. The field experience is contracted by the Cooperative Education office on an individual basis, subject to approval by the department. The field experience, including the seminar and reading assignments, is supervised by the cooperative education coordinator and the faculty liaison (or course instructor), working with the field supervisor. Students are expected to enroll in the course for at least two semesters. Offered on a credit, no-credit basis only. The department will determine the number of credit units offered. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Prerequisite: Permission of the instructor

**ECE 4890 Experiential Prior Learning (1-4)**

Majors in Computer and Electrical Engineering with significant prior experience in computers and/or electronics may have some of their experience count for academic credit toward their degree. In order to be considered for experiential learning credit the student must have completed CMPS 2010 and have the approval of the department. Only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Prerequisite: CMPS 2010 with a grade of C- or better and permission of the instructor

**ECE 4910 Senior Project I (2)**

After consultation with the faculty supervisor and investigation of relevant literature, the student(s) shall prepare a substantial project with significance in the designated area. The timeline, teamwork responsibilities, milestones, and presentation(s) will be scheduled. Prerequisite: Upper-division standing.

**ECE 4928 Senior Project II (2)**

This is the completion phase of the project. Students will present a project report to the entire class, explaining the nature of the work, the finished product, and its relationship to the field. Students will demonstrate proficiency in critical thinking, information literacy, written communication, and quantitative reasoning in their written project report. Additionally, students will demonstrate an understanding of their academic pursuits by reflecting on their studies of the arts, humanities, natural sciences, behavioral sciences, and social sciences. Prerequisite: ECE 4910 and completion of at least 90 units. Prerequisite or Co-requisite: Completion of or concurrent enrollment in all GE course requirements for engineering majors. (GE Capstone)

**ECE 4960 Leadership in Engineering (1-2)**

Leadership in computer and electrical engineering related activities that meet campus and/or community needs. Offered on a credit, no-credit basis only. Course is repeatable. Course credits cannot be used as elective credit towards the major requirements, but can be used as additional university units. Prerequisite: Permission of the instructor

**ECE 4970 Service Learning in Engineering (1-2)**

Service learning in computer and electrical engineering related activities that meet campus and/or community needs. Students will design and/or implement a service learning project in consultation with their faculty supervisor and, if applicable, community partners. Offered on a credit, no-credit basis only. Course is repeatable. Course credits cannot be used as elective credit towards the major requirements, but can be used as additional university units. Prerequisite: Permission of the instructor

**ECE 4980 Teaching in Engineering (1-2)**

Experience supporting teaching activities in department courses, providing tutoring in the department tutoring center, leading problem solving sessions, and/or supporting other instructional activities in the department. Offered on a credit, no-credit basis only. Course is repeatable. Course credits cannot be used as elective credit towards the major requirements, but can be used as additional university units. Prerequisite: Permission of the instructor