INTRODUCTION

The Bachelor of Science degree in Electrical Engineering is accredited by the Engineering Accreditation Commission of ABET, abet.org. The electrical engineering program provides students with the knowledge of basic and advanced topics in the areas of design and analysis of VLSI and electronic circuits, design and analysis of computer architecture, microprocessors, communication systems, signal processing and control systems. This program develops an ability to apply design and analysis knowledge to the practice of electrical engineering in an effective and professional manner. This knowledge can be applied to various engineering practices in aerospace, computer, electrical, electronics and other applied fields.

The Master of Science degree in Electrical Engineering provides advanced knowledge and competency in the theory and practice of electrical engineering. The program prepares students to pursue a wide range of professional engineering activities in the areas of communications systems/signal processing, computer engineering, control systems, electronics and circuit theory, and systems engineering.

The Electrical Engineering programs at CSUF provide the best qualities of teaching, scholarship and professional practice; and are committed to facilitate the education of engineering undergraduate and graduate students for their entrance in, and significant contribution to, the engineering profession. Our students are actively engaged and work in collaboration with faculty and staff to acquire and expand knowledge.

LEARNING GOALS AND STUDENT LEARNING OUTCOMES

The following learning goals and outcomes have been established for students pursuing a degree in Electrical Engineering:

Program Educational Objectives

A. Technical Growth – Graduates will be successful in modern engineering practice, integrate into the local and global workforce, and contribute to the economy of California and the nation

B. Professional Skills – Graduates will continue to demonstrate the professional skills necessary to be competent employees, assume leadership roles, and have career success and satisfaction

C. Professional Attitude and Citizenship – Graduates will become productive citizens with high ethical and professional standards, who make sound engineering or managerial decisions, and have enthusiasm for the profession and professional growth

Student Outcomes

(a) The ability to apply knowledge of mathematics, science and engineering

(b) The ability to design and conduct experiments, as well as to analyze and interpret data
The ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

The ability to function on multi-disciplinary teams.

The ability to identify, formulate and solve engineering problems.

An understanding of professional and ethical responsibility.

The ability to communicate effectively.

The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.

Recognize the need for and an ability to engage in life-long learning.

Knowledge of contemporary issues.

The ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (129 UNITS)

The requirements for the B.S. in Electrical Engineering comprise three major segments: foundation courses in mathematics and the physical sciences; general education courses in the arts, humanities, social sciences, biological sciences and other related areas; and a sequence of courses to fulfill the requirements of the Electrical Engineering degree.

Students are required to meet with their academic adviser every semester during the first year and at least once a year thereafter. Students are strongly encouraged to see their academic advisers frequently.

All courses taken in fulfillment of the requirements for the bachelor’s degree must be taken for a letter grade. MATH 150A must be completed with at least a “C” (2.0). All other mathematics and physical science courses required for the degree must be completed with at least a “C-” (1.7) to count as credit towards the degree.

Graduate courses are not open to undergraduate students without approval of the program coordinator.

2 + 2 Articulated Program with Community Colleges

The department has developed 2+2 articulation agreements with community colleges to provide students seamless transfer to the CSUF Electrical Engineering Program. This allows full-time students, taking the courses specified by the Electrical Engineering Department each semester, to graduate in two years following transfer to CSUF.

High School Preparation

Entering freshman preparation should include two years of algebra, geometry, trigonometry and one year of physics or chemistry. Students deficient in mathematics must take special preparatory courses, e.g., MATH 125, which will not carry credit for the major. (See Mathematics Section for Entry Level Mathematics test and Math-Science Qualifying Examination requirements.)

Transfer Students

Transfer students shall complete a minimum of 30 units in residence, at least 15 of which are in upper-division engineering courses. Work taken at another college or university with a “D” (1.0) may not be substituted for upper-division courses.

Mathematics and Science Courses (32)

MATH 150A Calculus (4)
MATH 150B Calculus (4)
MATH 250A Multivariate Calculus (4)
MATH 250B Introduction to Linear Algebra and Differential Equations (4)
CHEM 115 Introductory General Chemistry (4)
PHYS 225, 225L Fundamental Physics: Mechanics and Lab (4)
PHYS 226, 226L Fundamental Physics: Electricity and Magnetism and Lab (4)
PHYS 227, 227L Fundamental Physics: Waves, Optics, and Modern Physics and Lab (4)

General Education Courses

Area A: Core Competencies (9 units)
1. Oral Communication (3)
   HONR 101B, HCOM 100, 102
2. Written Communication (3)
   ENGL 101
3. Critical Thinking (3)
   HONR 101A, HCOM 235, PHIL 105, 106, PSYC 110, READ 290

Area B: Scientific Inquiry and Quantitative Reasoning (11 units)
1. Physical Science (3)
   PHYS 225
2. Life Science (3)
   BIOL 101
3. Laboratory Experience (1)
   PHYS 225L
4. Mathematics/Quantitative Reasoning (4)
   MATH 150A
5. Implications and Explorations in Mathematics and Natural Sciences
   Not applicable for engineering majors

Area C: Arts and Humanities (12 units)
1. Introduction to Arts (3)
   ART 101, 201A, 201B, 311, 312, DANC 101, MUS 100, 101
2. Introduction to the Humanities (3)
   Any lower division course in this category listed in the current class schedule
3. Explorations in the Arts and Humanities (3)
   Any upper-division course in this category listed in the current class schedule

4. Origins of the World Civilizations (3)
   HIST 110A or 110B, 210A, 210B

**Area D: Social Sciences (12 units)**

1. Introduction to the Social Sciences (3)
   EGCP/EGCE/EGEE 401

2. World Civilizations and Cultures
   Not applicable for engineering majors

3. American History, Institutions and Values (3)
   AFAM 190, AMST 201, CHIC 190, HIST 180, 190, HONR 201A

4. American Government (3)
   HONR 201B, POSC 100

5. Explorations in Social Sciences (3)
   Any upper-division course in this category listed in the current class schedule

**Area E: Lifelong Learning and Self Development (3 units)**
Not applicable for engineering majors

**Area Z: Cultural (3 units)**
At least one star (*) course in Sections C.3 and D.5

**Upper-Division Writing Requirement**
All of the following courses are required to fulfill the upper-division English writing requirement:
EGEE 303L Electronics Laboratory (1)
EGEE 310L Electronic Circuits Laboratory (1)
EGEE 313L Power Laboratory (1)
EGEE 485 Electrical Engineering Design Projects Laboratory (3)
OR EGEE 407L Digital Computer Design Lab (3)
Written work for these courses must meet professional standards. All these courses must be passed with at least a “C” (2.0).

**Required Courses in Electrical Engineering (50 units)**
CPSC 120 Introduction to Programming (3)
EGEE 203 Electric Circuits (3)
EGEE 203L Electric Circuits Lab (1)
EGEE 245 Computer Logic and Architecture (3)
EGEE 245L Computer Logic and Architecture Lab (1)
EGEE 280 Microcontrollers (3)
EGEE 281 Designing with VHDL (2)
EGEE 303 Electronics (3)
EGEE 303L Electronics Lab (1)
EGEE 308 Engineering Analysis (3)
EGEE 309 Network Analysis (3)
EGEE 310 Electronic Circuits (3)
EGEE 310L Electronic Circuits Lab (1)
EGEE 311 Field Theory and Transmission Lines (3)
EGEE 313 Introduction to Electromechanics (3)
EGEE 313L Power Laboratory (1)
EGEE 323 Engineering Probability and Statistics (3)
EGEE 401 Engineering Economics and Professionalism (3)
EGEE 407L Digital Computer Design Lab (3)
OR EGEE 485 Electrical Engineering Design Projects (3)
EGEE 409 Introduction to Linear Systems (3)

*Note:* EGEE 203, 303, 303L, 310L, 313L, 485 and 407L must be passed with at least a “C” (2.0).

**Technical Electives in Electrical Engineering (14 units)**
Before enrolling in any elective course, approval of the adviser must be obtained. At least three units of design content must be included. EGEE 497 and 499 are elective courses; students must complete a study application form and submit it for approval to the supervising faculty member and the department chair prior to the semester in which the coursework is to begin.

**VLSI and Electronic Circuits**
EGEE 404, 404L, 410, 435, 442, 445, 448, 455, 465, 469

**Communication Systems and Signal Processing**
EGEE 404, 410, 420, 435, 442, 443, 460, 469, 480, 483, 483L

**Control Systems**
EGEE 404, 416, 420, 424, 425, 483

**Computer Engineering**
EGGN 403, EGEE 404, 404L, 406, 407, 412, 445, 448, 455, 465

**MASTER OF SCIENCE IN ELECTRICAL ENGINEERING (30 UNITS)**
Students must meet the CSU requirements for admission to a master’s degree program. Please consult the Graduate Admissions section in this catalog for complete information. In addition, to qualify for admission in conditionally classified standing, applicants must meet the following departmental requirements:

1. Bachelor’s degree in an engineering program accredited by the Engineering Accreditation Commission of ABET, abet.org; and

2. minimum cumulative GPA of 3.0. An undergraduate GPA of 2.5-2.99 will be considered for conditional admission (deficiency courses will be assigned by the adviser).
Students with grade deficiencies, degrees from non-ABET accredited universities or undergraduate majors other than Electrical Engineering may be considered for conditional admission. However, any deficiencies must be made up prior to advancing to classified standing and prior to beginning coursework for the master’s degree. Requirements for fulfilling deficiencies include a minimum of six units of adviser-approved coursework. Deficiencies must be completed with minimum GPA of 3.0.

Each applicant file will be reviewed by the department graduate admissions adviser. Upon admission, the applicant is required to make an appointment with the graduate program coordinator. The program coordinator will assign a faculty adviser based on the student’s areas of interest and career objectives.

Classified Standing
A student who meets the above requirements for admission to conditionally classified standing may be granted classified standing contingent upon:

1. completion of all required deficiency coursework;
2. fulfillment of the university writing requirement. Students with degrees from American universities must show proof of meeting an upper-division writing requirement, pass the EWP, or complete ENGL 301 or 360. Students who have degrees from foreign universities must pass the Examination in Writing Proficiency (EWP) or complete ENGL 301 or 360 with a grade of “C” (2.0) or better. Also refer to the Admission Requirements section of this catalog for additional international student requirements; and
3. development and approval of a study plan prior to completing nine units toward the 30-unit degree requirement.

Students must meet with a faculty adviser to set up a study plan. Classification is not granted until the study plan is approved by the faculty adviser, the department chair, and the Office of Graduate Studies. Any subsequent changes to the study plan must have prior written approval by the faculty adviser and department chair.

Study Plan
The study plan consists of adviser-approved upper-division and graduate-level coursework that must be completed with an overall grade-point average of 3.0 or better. At least half the units required for the degree must be approved graduate (500-level) courses. Each course must be passed with a minimum grade of “C” (2.0).

Required Mathematics Courses (6 units)
EGGN 403 Computer Methods in Numerical Analysis (3)
EGEE 580 Analysis of Random Signals (3)

Note: If one of the above courses has been completed, EGEE 518 will satisfy the requirement

Concentration Courses (15 units)
A student is required to select a minimum of 15 units in Electrical Engineering. These units may be 400- and 500-level courses and are selected according to the student’s area of interest. Coursework may focus on the following areas: Communications Systems/Signal Processing, Computer Engineering, Control Systems, Microelectronics and Circuit Theory, and Systems Engineering. Graduate Project, EGEE 597 (1-3), and Thesis, EGEE 598 (1-6), are considered concentration courses.

Other Courses (9 units)
Elective units should be taken in Electrical Engineering or a related engineering field and are subject to adviser approval.

Exam/Thesis/Project Option
Subject to approval by the faculty adviser, students may select one of the following options for final review by the department graduate committee:

1. satisfactory completion of a final oral comprehensive examination on coursework; OR
2. satisfactory completion of a formal project EGEE 597 (3 units) and a final oral comprehensive examination on coursework; OR
3. satisfactory completion and oral defense of a thesis EGEE 598 (3-6 units).

Guidelines for the preparation of theses and formal reports are available in the Electrical Engineering Department office and the university Graduate Studies office.

Students requesting Graduate Project (EGEE 597), Thesis (EGEE 598) or Independent Study (EGEE 599) must complete a study application form and submit it for approval to the supervising faculty member and department chair prior to the semester in which the coursework is to begin.

Advancement to Candidacy
Advancement to candidacy requires that the student file a graduation check prior to the beginning of the final semester (see class schedule for deadlines). Completion of requirements for the degree include a minimum GPA of 3.0 on all study plan coursework, successful completion of a comprehensive examination or oral defense of a thesis or project, and recommendation by the Electrical Engineering faculty and Office of Graduate Studies.

MASTER OF SCIENCE IN ELECTRICAL ENGINEERING
OPTION IN SYSTEMS ENGINEERING
Students seeking this option must meet the same requirements as the program in Electrical Engineering. In addition, students are required to include the following courses in their study plans:

EGEE 580 Analysis of Random Signals (3)
EGEE 581 Theory of Linear Systems (3)
EGEE 582 Linear Estimation Theory (3)
The remainder of the systems engineering study plan includes other engineering courses with an emphasis in a particular field, such as information systems, control theory, computer systems, civil or mechanical engineering applications. Students with a Bachelor of Science in Engineering may elect to include up to nine units from approved subjects offered by the Mihaylo College of Business Administration and Economics as a part of their study plan.

**ELECTRICAL ENGINEERING COURSES**

Courses are designated as EGEE in the class schedule.

**203 Electric Circuits (3)**
Prerequisites: PHYS 226; MATH 250A. Corequisite: CPSC 120 or EGME 205. Units: Ohm's and Kirchhoff's laws; mesh and nodal analysis; superposition; thevenin and norton theorems; RL and RC transients; phasors and steady state sinusoidal analysis; response as a function of frequency; current, voltage, and power relationships; polyphase circuits.

**203L Electric Circuits Laboratory (1)**
Pre- or corequisite: EGEE 203. Simple resistive RL and RC circuits, electrical measurement techniques, verification of basic circuit laws through hard-wired breadboarding and CAD circuit simulation. (3 hours laboratory)

**215 Solving Engineering Problems Using MATLAB (3)**
Prerequisite: CPSC 120. Formulating, solving, verifying and reporting engineering problems such as control, signal processing, and communication systems and engineering, math, and physics problems such as engineering/scientific computations and operations research using the MATLAB/SIMULINK program. (3 hours laboratory)

**245 Computer Logic and Architecture (3)**
Prerequisite: CPSC 120. Logic design and organization of the major components of a computer, analysis and synthesis of combinational and sequential logics, analysis of the arithmetic, memory control and I/O units, concepts in computer control.

**245L Computer Logic and Architecture Lab (1)**
Pre- or corequisite: EGEE 245. Computer-Aided Design (CAD) of digital logic circuits, including decoders, multiplexes, adders and subtracters, counters, shift registers and Arithmetic Logic Unit (ALU) of a computer. After verifying the CAD design through simulation, the circuits are built on a protoboard. (3 hours laboratory)

**280 Microcontrollers (3)**
(Same as EGCP 280)

**281 Designing with VHDL (2)**
(Same as EGCP 281)

**303 Electronics (3)**
Prerequisites: PHYS 227 and EGEE 203. Characteristics and elementary applications of semiconductor diodes, field-effect transistors and bipolar-junction transistors, and operational amplifiers; mid-frequency small-signal analysis and design of transistors.

**303L Electronics Laboratory (1)**
Prerequisites: EGEE 203L and ENGL 101. Corequisite: EGEE 303. Semiconductor diodes, transistors and elementary electronic circuits through hard-wired breadboarding, CAD electronic simulation and analysis. (3 hours laboratory)

**308 Engineering Analysis (3)**
(Same as EGCE/EGME 308)

**309 Network Analysis (3)**
Prerequisites: EGEE 303 and EGGN 308. Pre- or corequisite: EGEE 303L. Performance of RLC circuits; complex frequency and the s-plane; frequency response and resonance; network topology; two-port network characterization; classical filter theory.

**310 Electronic Circuits (3)**
Prerequisites: EGEE 303, 309. Continuation of EGEE 303, analysis and design of multistage and feedback amplifiers; frequency characteristics of amplifiers, frequency characteristics and stability of feedback amplifiers, differential amplifiers, design of IC circuit biasing, operational amplifiers and their applications.

**310L Electronic Circuits Lab (1)**
Prerequisite: EGEE 303L. Pre- or corequisite: EGEE 310. Computer-Aided Design (CAD) of electronic circuits, including multi-stage feedback amplifiers; linear and integrated circuits; ADC and DAC and wireless design projects. After verifying the CAD design through simulation, the circuits are built on a protoboard. (3 hours laboratory)

**311 Field Theory and Transmission Lines (3)**
Prerequisites: EGEE 203, PHYS 226, MATH 250B. Introduction to waves and phasors; analysis and design of transmission lines; electrostatics and magnetostatics; boundary value problems; Maxwell equations.

**313 Introduction to Electromechanics (3)**
Prerequisites: EGEE 309, 311. Electromagnetic fields and circuits; transformers, saturation effects. Simple electro-mechanical systems. Circuit models, terminal characteristics and applications of DC and AC machines.

**313L Power Laboratory (1)**
Prerequisite: EGEE 303L. Pre- or corequisite: EGEE 313. Experiments in electromagnetic fields and circuits, transformers and electromechanical systems such as AC and DC machines (3 hours laboratory)
323 Engineering Probability and Statistics (3)
Prerequisite: MATH 250A or 270B. Set theory: axiomatic foundation of probability; random variables; probability distribution and density functions; joint, conditional and marginal distributions; expected values; distribution of functions of random variables; central limit theorem; estimation.

401 Engineering Economics and Professionalism (3)
Prerequisites: MATH 150A and junior or senior standing in Engineering. Development, evaluation and presentation of design alternatives for engineering systems and projects using principles of engineering economy and cost benefit analysis. Engineering profession, professional ethics and related topics. Not available for use on graduate study plans. (Same as EGCE/EGCP 401)

404 Introduction to Microprocessors and Microcomputers (3)
Prerequisites: EGEE 245L, 280. Hardware and software concepts in microprocessors, processor family chips, system architecture, CPU, input/output devices, interrupts and DMA, memory (ROM, RAM), electrical and timing characteristics, assembly language programming.

404L Microprocessor Laboratory (1)
Prerequisite: EGEE 245L. Pre- or corequisite: EGEE 404. I/O interfacing with a microprocessor system; familiarization with the operating system, assembler, debugger and emulator; design of keyboard, LCO display, RS 232, D/A converter, A/D converter and floppy disk interfaces. (3 hours laboratory)

406 Design Applications with Microcontroller and FPGA (3)
Prerequisites: EGEE 245, 245L, 280. Digital system application design using microcontrollers, FPGAs and CPLDs including programming hardware interfacing, A/D conversion, CLB, logic arrays, interconnections, testing and simulations

407 Digital Computer Architecture and Design I (3)
Prerequisites: EGEE 245L, 280. Organization and design of major components of a digital computer, including arithmetic, memory, input, output and control units. Integration of units into a system and simulation by a computer design language.

407L Digital Computer Design Laboratory (3)
Prerequisites: EGEE 245, 303L, 407. Design and implementation of a small digital computer; adders, arithmetic unit, control unit, memory control unit, memory unit and program unit. May be taken in lieu of EGEE 485. (1 hour lecture, 6 hours laboratory).

409 Introduction to Linear Systems (3)
Prerequisite: EGEE 309. Development of time and frequency domain models for physical systems. Linearization process and representation with block diagrams and signal flow graphs; discrete-time systems and digital signals including use of Z-transforms; stability theory of continuous and discrete time systems.

410 Electro-Optical Systems (3)
Prerequisite: EGEE 311. Introduction to electro-optics; optical radiation characteristics and sources; geometrical and physical optics; lasers and electro-optical modulation; quantum and thermal optical radiation detectors; detector performance analysis; electro-optical systems modeling and analysis; application examples.

412 Digital Computer Architecture and Design II (3)
Prerequisite: EGEE 307. Modern architectures of computer systems, their CPU structure, memory hierarchies and I/O processors; conventional and microprogrammed control; high-speed and pipelined ALU; cache, virtual and interleaved memories, DMA, interrupts and priority.

416 Feedback Control Systems (3)
Prerequisite: EGEE 409. Feedback control system characteristics; stability in the frequency and time domains; analysis and design of continuous-time systems using root-locus, Bode and Nyquist plots, Nichols chart and applications.

420 Introduction to Digital Filtering (3)
Prerequisite: EGEE 409. Discrete-time signals and systems; solution of difference equations; Fourier transform for a sequence; Z-transform; discrete Fourier transform; FIR and IIR realizations; design of digital filters.

424 Computer Simulation of Continuous Systems (3)
Prerequisites: CPSC 120; EGEE 215, 308. Using digital computer for simulation of physical systems modeled by ordinary differential equations; problem formulation, in-depth analysis of two integration methods, and the use of a general purpose system simulation program such as CSSL.

425 Introduction to Systems Engineering (3)
Prerequisites: EGEE 245, EGEE 323, or Computer Science 240 and MATH 338 for Computer Science majors. Introduction to systems engineering analysis and the systems approach; introduction to modeling, optimization, design and control; systems requirements analysis; analytical and computational solution methods; information processing; integrated systems.

430 Fuzzy Logic and Control (3)
Prerequisite: EGEE 409. Fuzzy logic and systems; comparison of classical sets, relations and operators with fuzzy sets, relations and operators; fuzzy arithmetic and transformations; classical predicate logic and reasoning versus fuzzy logic and approximate reasoning. Applications to rule-based systems and control systems.

435 Microwave Engineering (3)
Prerequisite: EGEE-311. Essential fundamentals for radio frequency, wireless and microwave engineering. Topics include: wave propagation in cables, waveguides and free space; impedance matching, standing wave ratios, impedance and scattering parameters.
442 Electronic Circuits (3)
   Prerequisite: EGEE 310. Power amplifiers and tuned amplifiers; RF amplifiers; modulation and detection circuits; oscillators; and operational amplifier applications.

443 Electronic Communication Systems (3)
   Prerequisites: EGEE 310 and 323 or equivalent. Principles of amplitude, angular and pulse modulation, representative communication systems, the effects of noise on system performance.

445 Digital Electronics (3)
   Prerequisites: EGEE 245, 303. RC circuits, attenuators, compensation and scope probe. Logic circuits: DTL, TTL, STTL, LSTTL and ECL. Fanout, noise-immunity, switching speed, power consumption, input-output characteristics. Design and analysis of MOS logic circuits; PMOS, NMOS and CMOS gates, flip-flops, shift registers and memory circuits.

448 Digital Systems Design with VHDL (3)
   Prerequisites: EGEE 245, 281, 303. Basic concepts and characteristics of digital systems, traditional logic design, LSI/VLSI logic design with VHDL, combinational and sequential logic, and their applications; timing and control, race conditions and noise, microcomputers, computer-aided programming, development systems, microcomputer system hardware design, input/output devices.

455 Microelectronics and Nano Devices (3)
   Prerequisites: EGEE 303, 311. Quantum mechanical principles, crystal structure, energy band, carrier transport, carrier generation and recombination, p-n junction, bipolar transistor, MOSFET, MEFET and related devices, basic microwave and optoelectronic technology, crystal growth and fabrication, introduction to nanotechnology, nano devices and technology.

456 Introduction to Logic Design in Nanotechnology (3)
   (Same as EGCP 456)

460 Introduction to Cellular Mobile Communications Systems (3)
   Prerequisite: EGEE 443. Introduction to wireless mobile telecommunications, description and analysis of cellular radio systems, co-channel interference reduction, channel capacity and digital cellular systems

461 Low Power Digital IC Design (3)
   (Same as EGCP 461)

465 Introduction to VLSI Design (3)
   Prerequisites: EGEE 245, 303. Computer-aided design of VLSI circuits. MOS device structure, design rules, layout examples, CMOS standard cells. Speed power trade off, scaling, device and circuit simulation. VLSI design software tools. Routing method system design, Design Project. Chip fabrication through MOSIS service, testing.

469 Antennas for Wireless Communications (3)
   Prerequisite: EGEE 311. Aspects of antenna theory and design; radiation from dipoles, loops, apertures, microstrip antennas and antenna arrays.

480 Optical Engineering and Communications (3)
   Prerequisites: EGEE 311, PHYS 227. Optics review, lightwave fundamentals, integrated optic waveguides, first design of fiber optic system, analog and digital modulation, digital fiber optic system design, baseband coding, digital video transmission in optical fiber, optical emitters and receivers, coherent optical communication, measurements in fiber optic telecommunication.

483 Introduction to Global Positioning Systems (GPS) (3)

483L Global Positioning System Lab (2)
   Corequisite: EGEE 483. Use and description of Novatel, Magelen, Ahstek, Collins and Tribel receivers. Computation of GPS and GEO stationary satellite positions from ephemeris data available on almanac. Errors such as selective availability, ionospheric, tropospheric, satellite and receiver will be calculated and compensated in the data. (1 hour lecture, 3 hours laboratory)

485 Electrical Engineering Design Projects Laboratory (3)
   Prerequisites: EGEE 280, 310L, 323. Practical aspects of design and project construction. Instructor-approved design project in electrical engineering, inter-disciplinary projects. Use of CAD program for schematic capture and simulation. Construction of final hardware according to the design specification. Performance evaluation and demonstration of project. (1 hour lecture, 6 hours laboratory).

497 Senior Project (1-3)
   Prerequisites: consent of adviser and instructor. Directed independent design project.

499 Independent Study (1-3)
   Prerequisite: approval of study plan by adviser. Specialized topics in engineering selected in consultation with and completed under the supervision of the instructor. May be repeated for credit.

503 Information Theory and Coding (3)
   Prerequisite: EGEE 323. Information measures, probabilistic studies of the transmission and encoding of information, Shannon's fundamental theorems, coding for noisy channels.
504A Linear Network Synthesis (3)

507 Detection Theory (3)

510 Optics and Electromagnetics in Communications (3)
Prerequisite: EGEE 480. Plane-wave propagation and reflection from multiple layers; two- and three-dimensional boundary value problems; waveguides and resonant cavities; radiation from apertures and antennas; electromagnetic properties of materials, gases and plasmas; significant coverage of engineering applications.

518 Digital Signal Processing (3)
Prerequisite: EGEE 420. Discrete Fourier transform; fast Fourier transform; Chirp Z-transform; discrete time random signals; floating-point arithmetic; quantization; finite word length effect in digital filters; spectral analysis and power spectrum estimation.

519A Parallel and Multiprocessing (3)
Prerequisite: EGEE 412. Parallel and multiprocessing systems, including hypercubes, shared distributive memory architectures, array and pipelines processors, communication protocols, routing algorithms and hands-on parallel programming experience on CSUF Hypercube System.

519B Computer Networks and the Internet (3)
Prerequisite: EGEE 412. Computer networking with LAN, WAN to the Internet including ATM, Ethernet, wireless and Bluetooth technology, design of communication protocols, transmission media, security and control.

522 Spread Spectrum Communications (3)

523A VLSI and Nano Technology and Devices (3)
Prerequisite: EGEE 455 or equivalent. Silicon crystal, PN junction physics, oxide and interface physics, wafer fabrication technology; oxidation, diffusion, ion-implantation, epitaxy, photolithography, thin films process. Layout design principle for integrated circuits. Nano-electronic devices and technology.

523B CMOS VLSI Design (3)
Prerequisites: EGEE 465 and EGEE 448 or equivalent. Surface physics of MOS system, MOS device physics. Short channel effect; hot carrier effect, subthreshold conduction. CMOS fabrication process. Layout design rules. Scaling design and analysis of CMOS circuits. Standard cell method. CAD design and SPICE simulation.

526 Digital Control Systems (3)
Prerequisite: EGEE 416. Analysis, design and implementation of digital control systems; Z-transform methods; frequency domain and state-space approach for discrete-time systems.

527 Fault Diagnosis and Fault-Tolerant Design (3)
Prerequisite: EGEE 307. Fault diagnosis and fault-tolerant design of digital systems; fault diagnosis test for combinational and sequential circuits, reliability calculations, multiple hardware redundancy, error detection and correcting codes, software redundancy and fault-tolerant computing.

529 Principles of Neural Systems (3)

531 Phase-Locked and Frequency Feedback Systems (3)
Prerequisite: EGEE 580 or consent of instructor. Theory of noise and linear systems, FM feedback principles. Theory and design of phase-locked loops and their applications in communication and control.

537 Satellite Communications (3)
Prerequisite: EGEE 443. Satellite systems, link analysis, propagation effects, SNR/CNR calculations, modulation schemes, TDMA, FDMA, CDMA techniques.

557 Microprogramming and Embedded Microprocessors (3)
Prerequisites: EGEE 412, EGEE 448. Introduction to microprogramming concepts and applications to the control unit of a computer, microprogrammable control, arithmetic-logic unit, implementation of an embedded process on FPGA and interfacing with external memories.

558A Microprocessors and Systems Applications I (3)
Prerequisites: EGEE 404, 404L. Microprocessors and microcomputers, their related software systems, system design with microprocessors, applications in peripheral controllers, communication devices and multiprocessing systems.
558B Microprocessors and Systems Applications II (3)
Prerequisite: EGEE 558A. Advanced microprocessor architecture and their applications to microcomputer networking; RISC VS CISC architectures, communication protocol, distributed-operating system, and local area networks.

559 Introduction to Robotics (3)
Prerequisite: EGEE 416 or consent of instructor. Science of robotics from an electrical engineering standpoint, including modeling, task planning, control, sensing and robot intelligence.

580 Analysis of Random Signals (3)
Prerequisites: EGEE 323 and 409 or equivalent. Random processes pertinent to communications, controls and other physical applications, Markov sequences and processes, the orthogonality principle.

581 Theory of Linear Systems (3)
Prerequisites: EGEE 416, EGGN 403. State space analysis, linear spaces, stability of systems; numerical methods of linear systems analysis and design.

582 Linear Estimation Theory (3)
Prerequisites: EGEE 580, 581. Mathematical models of continuous-time and discrete-time stochastic processes; the Kalman filter, smoothing and suboptimal filtering computational studies.

585 Optimization Techniques in Systems Engineering (3)
Prerequisite: EGGN 403 or MATH 340 for Computer Science majors. Calculus of variations, optimization of functions of several variables, Lagrange multipliers, gradient techniques, linear programming, and the simplex method, nonlinear and dynamic programming.

587 Operational Analysis Techniques in Systems Engineering (3)
Prerequisite: EGEE 323 or MATH 338 for Computer Science majors. Operational research models; applications of probability theory to reliability, quality control, waiting line theory, Markov chains; Monte Carlo methods.

597 Project (1-3)
Prerequisite: consent of adviser. Classified graduate students only. Unless approved by the department chair, EGEE 597 cannot be taken if EGEE 598 or 599 is already taken.

598 Thesis (1-6)
Prerequisite: consent of adviser. Classified graduate students only. Unless approved by the department chair, EGEE 598 cannot be taken if EGEE 597 is already taken.

599 Independent Graduate Research (1-3)
Prerequisite: consent of adviser. May be repeated for credit. Unless approved by the department chair, EGEE 599 cannot be taken if EGEE 597 is already taken.