ELECTRICAL AND ELECTRONIC ENGINEERING

College of Engineering and Computer Science

Program Description

Electrical Engineers design systems that generate, transmit and distribute electricity. Electronic engineers design electronic devices which perform computation, communication, or control of robots and machines. Electrical and electronic engineers work with technologies ranging from large power lines and generators to tiny integrated circuits containing billions of transistors.

The Department of Electrical and Electronic Engineering offers a Bachelor of Science (BS) in Electrical and Electronic Engineering. The Department also offers a Master of Science degree in Electrical and Electronic Engineering, with the following focus areas: control systems, power systems, communication systems, microelectronic design, and computer architecture & digital design.

Students receive a thorough grounding in mathematics and the basic sciences during their first four semesters. Engineering design and applications are stressed in the final four semesters. Prospective students are urged to discuss their plans as early as possible with their high school or community college counselor and with the Electrical and Electronic Engineering Department Chair who will advise students individually.

Degree Programs

BS in Electrical and Electronic Engineering (https://catalog.csus.edu/colleges/engineering-computer-science/engineering-electrical-electronic/bs-in-electrical-and-electronic-engineering/)

Certificate in Electric Power Systems and Engineering (https://catalog.csus.edu/colleges/engineering-computer-science/engineering-electrical-electronic/certificate-in-electric-power-systems-and-engineering/)

MS in Electrical and Electronic Engineering (https://catalog.csus.edu/colleges/engineering-computer-science/engineering-electrical-electronic/ms-in-electrical-and-electronic-engineering/)

Certificate in Mixed-Signal Integrated Circuit Design (https://catalog.csus.edu/colleges/engineering-computer-science/engineering-electrical-electronic/certificate-in-mixed-signal-integrated-circuit-design/)

Accreditation

In addition to California State University, Sacramento's full accreditation by the Western Association of Schools and Colleges, the Bachelor of Science in Electrical and Electronic Engineering is also individually accredited by ABET, Inc.

Notice to Students RE: Professional Licensure and Certification

California State University programs for professions that require licensure or certification are intended to prepare the student for California licensure and certification requirements. Admission into programs for professions that require licensure and certification does not guarantee that students will obtain a license or certificate. Licensure and certification requirements are set by agencies that are not controlled by or affiliated with the California State University and licensure and certification requirements can change at any time.

The California State University has not determined whether its programs meet other states' educational or professional requirements for licensure and certification. Students planning to pursue licensure or certification in other states are responsible for determining whether, if they complete a California State University program, they will meet their state's requirements for licensure or certification. This disclosure is made pursuant to 34 CFR §668.43(a)(5)(v)(C).

Special Features

- The BS degree in Electrical and Electronic Engineering is accredited by the Engineering Accreditation Commission (EAC) of ABET, http://www.abet.org (http://www.abet.org/)
- The major strengths of the Electrical and Electronic Engineering program lie in its faculty, whose industrial experience equips them to relate theory to practice and prepare students for the profession or for graduate study.
- The Department has outstanding laboratory facilities to provide hands-on instruction.
- A Committee of power industry leaders from throughout the State is a source of advice and assistance to the Department regarding the preparation of students for careers in power engineering.
- The EEE Department Industry Liaison Council (ILC) consists of industry professionals representing various disciplines within electrical and electronic engineering. The ILC provides feedback on program direction and our outcomes assessment efforts. The ILC is active in providing professional development opportunities for our faculty.
- The Department has a strong IEEE Student Branch. It is among the most active student chapters in the Sacramento Section of IEEE. The student branch has an elected core of officers, who plan and execute the programs of the chapter in consultation with the branch faculty advisor. The primary purpose of the student branch is to develop professional awareness among the students and provide them with opportunities to expand their leadership and communication skills.

Program Educational Objectives

The Electrical and Electronic Engineering Program has developed a set of Program Educational Objectives. These statements describe what the faculty is preparing the students to achieve within a few years after graduation:

- Core Knowledge: Our graduates will have active careers in Electrical and Electronic engineering, or be actively engaged in a related career path.
- Application of Knowledge: Our graduates will apply their knowledge and skills to solve practical engineering problems.
- Professionalism: Our graduates will demonstrate the professional skills, such as high ethical standards, effective oral and written communications, and teamwork, necessary to be productive engineers and to advance in their careers.
- Life-long Learning: Our graduates will continue to develop their skills and seek knowledge after graduation in order to adapt to advancing technology and the needs of society. This may be indicated by the graduate's pursuit of an advanced degree or other formal instruction, and/or that the graduate has developed a professional specialty.

Contact Information

Milica Marković, Department Chair
Riverside Hall, Room 3018
(916) 278-7327
Department of Electrical & Electronic Engineering (http://www.ecs.csus.edu/eee/)

Faculty

E

ELTAYEB, MOHAMMED

H

HEEDLEY, PERRY

K

KUMAR, PREETHAM

M

MARKOVIC, MILICA

MEDURI, PRAVEEN

MOGHADAM, ROHOLLAH (ROHAM)

P

PANG, JING

T

TOUPS, TRACY

Y

YAZDANI, ATOUSA

Z

ZARGHAMI, MAHYAR

EEE 64. Introduction to Logic Design. 4 Units
Prerequisite(s): CSC 15 or CSC 25 or ENGR 50
Term Typically Offered: Fall, Spring, Summer

Covers the following topics: logic gates, binary nxumber system, conversion between number systems, Boolean algebra, Karnaugh maps, combinational logic, digital logic design, flip-flops, programmable logic devices (PLDs), counters, registers, memories, state machines, designing combinational logic and state machines into PLDs, basic computer architecture. Lab emphasizes the use of software equation entry design tools, the use of a schematic entry, and the use of a logic simulation design tool. Lab assignments are design-oriented.
Cross Listed: CPE 64

EEE 64P. Peer-Assisted Learning EEE 64. 1 Unit
Corequisite(s): EEE 64
Term Typically Offered: Fall, Spring

Students concurrently enrolled in EEE 64 work through faculty-designed problems sets under the guidance of a trained student facilitator to improve their understanding of EEE 64 content. Pedagogical strategies that encourage active, engaged learning are employed to facilitate student success. Discussion, 2 hours.
Crosslisted: CPE 64P.

Credit/No Credit

EEE 64W. Introduction to Logic Design Workshop. 1 Unit
Corequisite(s): EEE 64.
Term Typically Offered: Fall, Spring

Assists students in developing a more thorough understanding of logic simulation and logic design. Focus is on problem solving and design. Activity two hours. Lecture three hours; laboratory three hours.
Cross Listed: CPE 64W; only one may be counted for credit.

Credit/No Credit

EEE 101. Introduction to Printed Circuit Board Design. 3 Units
Prerequisite(s): PHYS 11C
Term Typically Offered: Fall, Spring

Introduction to Printed Circuit Board (PCB) design techniques including library component creation, schematic capture, layout, routing, signal integrity analysis, IEEE/IPC rules & standards, materials, manufacturing processes, and physical properties of a PCB. Industry standard electrical computer-aided design (ECAD) software tools will be used.

EEE 108. Electronics I. 3 Units
Prerequisite(s): EEE 117.
Corequisite(s): EEE 108L.
Term Typically Offered: Fall, Spring

Introduction to electronics, ideal OP-AMPS, BJTs, FETs, DC biasing, VI characteristics, single stage amplifiers, low frequency small signal models, power supplies and voltage regulation. PSPICE required.

EEE 108L. Electronics I Laboratory. 1 Unit
Prerequisite(s): EEE 117, EEE 117L
Corequisite(s): EEE 108
Term Typically Offered: Fall, Spring

Characteristics and applications of semiconductor devices including diodes, BJTs and FETs, and analog integrated circuits including opamps. Introduction to circuit simulation using professional computer-aided design (CAD) software. Laboratory three hours.

EEE 109. Electronics II. 4 Units
Prerequisite(s): EEE 108, EEE 108L, EEE 117, EEE 117L; and)GWAR Certification before Fall 09, or WPJ score of 70+, or at least a C- in ENGL 109M or ENGL 109W).
Term Typically Offered: Fall, Spring

Differential and multistage amplifiers, high frequency models (BJTs and FETs), feedback and sensitivity, power amplifiers, oscillators and waveform shaping circuits. Advanced use of PSPICE. Lecture three hours; laboratory three hours.

EEE 110. Advanced Analog Integrated Circuits. 3 Units
Prerequisite(s): EEE 109 or consent of instructor.
Term Typically Offered: Fall only

The use of operational amplifiers in circuit designs for applications such as filtering, switched capacitor design, sample and hold design, instrumentation amplifiers, and voltage reference circuitry will be explored, as well as topics in Feedback Theory.

EEE 111. Advanced Analog Integrated Circuits Laboratory. 1 Unit
Prerequisite(s): EEE 109; either EEE 110 or EEE 230. EEE 110 or EEE 230 may be taken concurrently.
Term Typically Offered: Fall only

Circuit design, mask design, and simulation of integrated circuitry. Use of CAD software to prepare design for fabrication. Individual and group design projects. Laboratory three hours.

EEE 117. Network Analysis. 3 Units
Prerequisite(s): ENGR 17, MATH 45, and PHYS 11C
Corequisite(s): EEE 117L.
Term Typically Offered: Fall, Spring

Review of sinusoidal steady state, phasors, complex power, three phase power, mutual inductance, series and parallel resonance. Introduction to application of Laplace transforms in network analysis, transfer functions, Bode plots, Fourier series, two-port circuits.

EEE 117L. Networks Analysis Laboratory. 1 Unit
Corequisite(s): EEE 117.
Term Typically Offered: Fall, Spring

Introduces fundamental laboratory techniques while demonstrating the concepts introduced in the EEE 117 lecture. The computer simulation language PSPICE is introduced and applied. Laboratory three hours.

EEE 120. Electronic Instrumentation. 4 Units
Prerequisite(s): EEE 108, EEE 117; EEE 108 may be taken concurrently.
Term Typically Offered: Fall, Spring

Fundamental principles of sensors and instrumentation systems, together with their electrical implementation, such as biasing and signal conditioning circuits. Temperature, force, pressure, and mechanical sensors. Optical sensors, including a brief introduction to light sources and detectors. Applications to biomedical engineering and industrial control. Lecture three hours; laboratory three hours.

EEE 122. Applied Digital Signal Processing. 3 Units
Prerequisite(s): EEE 117, EEE 180.
Term Typically Offered: Fall only

Application of digital signal processing to biomedical signals. Origin and characteristics of biomedical signals and contaminations. Preparation of biomedical signals for processing, including sensors, amplification, filtering, sampling, and quantization. Time-domain processing, including peak and zero-crossing detection, time interval measurement, peak height, and moving average estimates of mean and root mean square value. Frequency domain processing, including filtering to separate biomedical signal components and spectrum estimation. Joint time-frequency analysis.

EEE 130. Electromechanical Conversion. 3 Units
Prerequisite(s): EEE 117 and EEE 161
Corequisite(s): EEE 131
Term Typically Offered: Fall, Spring

Magnetic circuits and principles of electromechanical energy conversion, Transformers, Rotating Magnetic Fields, Asynchronous AC machines, Synchronous AC machines, DC machines, Introduction to special machines, Introduction to power electronic drives.

EEE 131. Electromechanics Laboratory. 1 Unit
Prerequisite(s): EEE 117 and WPJ score of 70+, or at least a C- in ENGL 109M or ENGL 109W).
Corequisite(s): EEE 130
Term Typically Offered: Fall, Spring

Direct current motor and generator characteristics, three phase synchronous motor and synchronous generator characteristics, single phase power transformer short circuit and no-load tests, frequency changer tests and tests on DC and AC machine models, potential and current transformers. This course requires safety training.

EEE 135. Renewable Electrical Energy Sources and Grid Integration. 3 Units
Prerequisite(s): EEE 141 or EEE 130.
Term Typically Offered: Spring only

The study of existing sources of renewable electric energy such as wind, solar, geothermal, hydro, tidal, wave power, and biomass. Emphasis on wind and solar energy sources and their integration into the electric power grid. Various energy storage methods to accommodate the intermittent nature of these resources. Economic constraints, environmental benefits and institutional regulations.

EEE 136. Smart Electric Power Grid. 3 Units
Prerequisite(s): EEE 141
Term Typically Offered: Spring only

Smart grid to enhance reliability, security, robustness and efficiency of transmission and distribution systems. Integration of renewable energy sources and distributed generation. Energy storage systems. Advanced metering infrastructure, home-area networks, micro-grids, real-time pricing, plug-in hybrid vehicles, demand response, load curve sharing. Control, monitoring and protection grid; SCADA systems. Voltage and load frequency control to ensure balance. Enabling active participation of consumer. Anticipating and responding to system disturbance in self healing manner. Providing power quality for digital systems needs.

EEE 137. Applications of Power Electronics in Power Systems. 3 Units
Prerequisite(s): EEE 141
Term Typically Offered: Spring only

Analysis methods for power electronics. Power electronic devices and their control methodologies. Electric machinery drives and flexible alternating current transmission systems (FACTS) devices simulation of cases relevant to applications of power electronics in power systems.

EEE 141. Power System Analysis I. 3 Units
Prerequisite(s): EEE 117
Term Typically Offered: Fall, Spring

Introduction to modern electric power systems, fundamentals of AC and DC systems, power definitions, per-unit analysis, steady-state analysis of power systems, models of power system components such as transformers, generators, motors, power electronic converters and loads.

EEE 142. Power System Analysis II. 3 Units
Prerequisite(s): EEE 141, EEE 161, and EEE 184 (EEE 184 may be taken concurrently).
Term Typically Offered: Fall, Spring

Transmission line parameters and modeling, power flow analysis, analysis of power systems under faulted conditions, introduction to economic operation of power systems, introduction to power system stability and control.

EEE 143. Power System Laboratory. 1 Unit
Prerequisite(s): EEE 142 (EEE 142 maybe taken concurrently), received WPJ score
Term Typically Offered: Fall, Spring

Simulation and measurements on single-phase and three phase circuits, power generation, paralleling, and integration of multiple generation systems, transmission line operations including voltage regulation and line compensation.

EEE 144. Electric Power Distribution. 3 Units
Prerequisite(s): EEE 141.
Term Typically Offered: Fall only

Operation and design of utility and industrial distribution systems including distribution system planning; load characteristics; application of distribution transformers; design of subtransmission lines, distribution substations, primary systems, secondary systems; application of capacitors; voltage regulation and reliability.

EEE 145. Power System Relay Protection and Laboratory. 4 Units
Prerequisite(s): EEE 141
Term Typically Offered: Fall only

Principles of protective relaying (classical and modern), current and voltage transformers, setting and testing or relaying elements, including differential, impedance, over/under current, voltage, and frequency relay types and/or elements, and their applications in protection of power system elements, including lines, generators, transformers, motors, and buses. Lecture 3 hours; laboratory 3 hours.

EEE 146. Power Electronics. 3 Units
Prerequisite(s): EEE 108.
Term Typically Offered: Fall, Spring

Introduction to solid state device applications in power control. Modeling and review of thyristors, controlled rectifiers, DC-DC converters, and DC to AC inverters. Brief introduction to control of DC drives. Strong design emphasis. Control of power electronics systems, UPS systems, power supplies.

EEE 147. Power System Operation and Control Laboratory. 1 Unit
Prerequisite(s): EEE 142.
Term Typically Offered: Fall, Spring

Computer simulation methods to describe power system behavior under steady state and dynamic conditions. Experiments conducted using MATLAB and Simulink for load flow in distribution lines, optimal power dispatch, synchronous machine transient behavior under short circuit conditions, transient stability, voltage and reactive power control, classical and modern load frequency control. Laboratory three hours.

EEE 148. Power Electronics Laboratory. 1 Unit
Prerequisite(s): EEE 146; may be taken concurrently.
Term Typically Offered: Fall, Spring

Solid state applications in power control. Diodes, rectifiers (single state and three phase), thrustors. Principle of phase controlled rectification, single phase and three phase converters. Power factor improvement. Three phase Pulse Width Modulation (PWM). AC voltage controllers. SPICE modeling. Strong design emphasis. EMTP modeling. LabView graphics simulation. Microprocessor control of power electronics systems. UPS systems, power supplies, power quality monitoring.

EEE 161. Applied Electromagnetics. 4 Units
Prerequisite(s): MATH 32, MATH 45, PHYS 11C, and ENGR 17.
Term Typically Offered: Fall, Spring

Review of vector calculus. Electrostatic fields from lines, surface and volume charges by Coulomb's law, Gauss' law, Laplace's and Poisson's equations. Capacitance. Magnetostatic field calculations using Biot-Savart's law and Ampere's law. Inductance. Forces on moving charges. Magnetic materials. Electric and magnetic energy in fields. Faraday's law. Ideal transformer. Moving conductor in time-varying magnetic field. Displacement current. Charge-current continuity relation. Transmission line analysis, characteristic impedance, reflection coefficient and standing wave concepts. Smith Chart, matching problems. Lecture three hours, lab three hours.

EEE 162. Applied Wave Propagation. 3 Units
Prerequisite(s): EEE 117, EEE 161.
Term Typically Offered: Fall, Spring

Review of distributed circuit theory and the Smith chart. Impedance matching using series or shunt lumped and distributed circuits or near-quarterwave-matching sections. Noise temperature and noise figure. Scattering coefficient characterization of two-ports. Stability circles for high frequency transistors. Constant gain and noise figure circles. Basic antenna theory. Illustrated by their use for cell phones and other wireless systems.

EEE 163. Traveling Waves Laboratory. 1 Unit
Prerequisite(s): EEE 117, EEE 162 (EEE 162 may be taken concurrently), and (WPJ score of 70+, or at least a C- in ENGL 109M/W)
Term Typically Offered: Fall only

Selected experiments in the transmission and reflection of waves in coaxial lines and waveguides. Antenna impedance and pattern measurements. Laboratory three hours.

EEE 165. Introduction To Optical Engineering. 3 Units
Prerequisite(s): EEE 161, EEE 180, EEE 185; EEE 185 may be taken concurrently.
Term Typically Offered: Fall, Spring

Generation, propagation and detection of light. Fresnel equations, Snells law, diffraction, polarization and interference. Operating principles of LEDs, lasers, photodiodes and optical fibers. Introduction to optical communications systems, integrated optical devices, and optical instrumentation.

EEE 166. Physical Electronics. 3 Units
Prerequisite(s): EEE 108 and CHEM 1E or CHEM 1A
Term Typically Offered: Spring only

Semiconductor physics, atomic models and crystal structures. Quantum theory, energy bands, motion of charge carriers, minority/majority carrier profiles and pn junctions. Manufacturing processes for and operating characteristics of diodes, bipolar transistors and field effect devices.

EEE 167. Electro-Optical Engineering Lab. 1 Unit
Prerequisite(s): EEE 161, EEE 180, EEE 165; EEE 165 may be taken concurrently, and (WPJ score of 70+, or at least a C- in ENGL 109 M/W)
Term Typically Offered: Fall, Spring

Provides senior level undergraduates with hands-on experience in optical engineering and design. Experiments involving laser characteristics, spectral radiometry, diffraction, polarization, modulation of light, holography and spatial filtering will be performed. Laboratory three hours.

EEE 174. Introduction to Microprocessors. 4 Units
Prerequisite(s): Junior status, EEE 64.
Term Typically Offered: Fall, Spring, Summer

Topics include: microcomputer systems, microprocessor architecture, machine and assembly language programming, timing operations, bus arbitration and exception processing logic, addressing modes, parallel and serial ports, memory, assemblers and development systems. The lab uses development systems and target systems in the Computer Engineering laboratory to assemble, link, test and debug and run various assignments. Lecture three hours; laboratory three hours.

EEE 178. Introduction to Machine Vision. 3 Units
Prerequisite(s): EEE 180 or ME 172, or instructor approval.
Term Typically Offered: Spring only

Fundamental digital image processing and machine vision concepts and their application to the fields of robotics and automation. Topics include: digital image processing, image formation, two dimensional transforms, boundary descriptors, motion, camera calibration, vision for robot control, 3-D vision, and hardware architectures to support vision.

EEE 180. Signals & Systems. 3 Units
Prerequisite(s): ENGR 17, MATH 45, EEE 117; EEE 117 may be taken concurrently.
Term Typically Offered: Fall, Spring

Rigorous development of the fundamental relationships governing time-domain and frequency-domain analysis of linear continuous-time and discrete-time systems. Topics include Fourier, Laplace and z-transforms, sampling theorem, modulation, system stability, and digital filters.

EEE 181. Introduction to Digital Signal Processing. 3 Units
Prerequisite(s): EEE 64, EEE 180.
Term Typically Offered: Spring only

Focuses on the application of linear systems theory to design and analysis of digital signal processing systems. Discrete systems, the z transform, and discrete Fourier transform are reviewed. Design of infinite impulse response filters, finite impulse response filters, and digital spectral analysis systems is presented. Computer simulation is used to study the performance of filters and spectral analysis systems. Signal processing architectures are introduced.

EEE 182. Digital Signal Processing Lab. 1 Unit
Prerequisite(s): EEE 180, EEE 181; EEE 181 may be taken concurrently.
Term Typically Offered: Spring only

Provides senior level undergraduate students with experience in the software/hardware design of discrete-time systems, and modern DSP techniques. Laboratory projects will include the following: spectral analysis of analog and digital signals, design of sampling and quantizer circuits, design and realization of IIR and FIR Digital Filters. Hardware projects will include acquisition, analysis, and filtering of speech, biomedical and video signals using Digital Signal Processors (DSPs).

EEE 183. Digital and Wireless Communication System Design. 3 Units
Prerequisite(s): EEE 161, EEE 180; EEE 185 may be taken concurrently.
Term Typically Offered: Fall only

Review of fundamentals, probability, information, distortion by channel, sampling, pulse code modulation, companding, link power calculation, noise figure, pseudo noise. Matched filter detection of binary signals, bit error rate, inter-symbol interference, zero-forcing equalizers. Effects of additive white Gaussian noise in pulse code modulation, spread spectrum in multiple access, cellular radio and other wireless applications. Procedure for making design trade offs will be discussed.

EEE 184. Introduction to Feedback Systems. 3 Units
Prerequisite(s): EEE 180.
Term Typically Offered: Fall, Spring

Dynamic system modeling by transfer function and state-space methods using differential equation, time-response and frequency-response methods. Determination of steady-state errors due to step, ramp and parabolic inputs and disturbances for closed-loop systems. Mapping of block diagrams and state-space representations to signal flow graphs (SFG) as well as finding the transfer function of the system represented by the SFG by Mason's Rule. Closed-loop system stability is examined via poles and eigenvalues and by using the Routh-Hurwitz criterion. Introduction to observability and controllability of systems. Design of compensators for feedback systems using root-locus, frequency response and state-space methods. Introduction to digital control. Computer simulation methods such as MATLAB and SIMULINK are used to support the above subjects.

EEE 185. Modern Communication Systems. 3 Units
Prerequisite(s): EEE 180, ENGR 120; ENGR 120 may be taken concurrently.
Term Typically Offered: Fall, Spring

Review of signal and system analysis, sampling theorem and Nyquist's criteria for pulse shaping, signal distortion over a channel, study of digital and analog communication systems, line coding, signal to noise ratios, performance comparison of various communication systems.

EEE 186. Communication Systems Laboratory. 1 Unit
Prerequisite(s): EEE 117 (EEE 185 may be taken concurrently), and (GWAR Certification before Fall 09, or WPJ score of 70+, or at least a C- in ENGL 109M or ENGL 109W).
Term Typically Offered: Fall, Spring

Experimental study of modulation and demodulation in AM, FM, and digital communication systems, A/D and D/A conversion, measurement of power spectra, noise characterization in frequency domain.

EEE 187. Robotics. 4 Units
Prerequisite(s): EEE 180 or equivalent, or instructor permission.
Term Typically Offered: Fall only

Lecture introduces principles of robotics and design of robot systems. Includes robot architectures, sensing position/velocity, digital circuit noise, actuator and path control, robot coordinate systems, kinematics, differential motion, computer vision/architectures, and artificial intelligence. Laboratory will apply lecture theory in design experiments utilizing five degree-of-freedom robots, an industrial robot, and vision systems.

EEE 188. Digital Control System. 3 Units
Prerequisite(s): EEE 180, WPJ score of 70+, or at least a C- in ENGL 109 M/W.
Term Typically Offered: Spring only

Intended to present treatment of the classical digital control with an introduction to modern digital control system in the state space. Z-transform as applied to discrete-time systems with transformation from the s-plane to the z-plane. Analyzes digital control systems using Nyquist and Bode plots and root-locus. Stability analysis of digital systems using Jury test, Routh Criterion, Nyquist and Bode plots. Design using root-locus and Bode plots introduced. Introduction to state-space and pole assignment. Finite-word length effects. MATLAB applications.

EEE 189. Controls Laboratory. 1 Unit
Prerequisite(s): EEE 184 (EEE 184 may be taken concurrently), and (WPJ score of 70+, or at least a C- in ENGL 109M or ENGL 109W).
Term Typically Offered: Spring only

Study, simulation and design of linear feedback control systems using digital control methods such as MATLAB and SIMULINK. Practical examples of analysis and compensation for closed loop systems.

EEE 192A. Electrical Power Design Project I. 2 Units
Prerequisite(s): EEE 141, EEE 142, EEE 143; (EEE 142 and EEE 143 may be taken concurrently). WPJ score of 70+, or at least a C- in ENGL 109M or ENGL 109W.
General Education Area/Graduation Requirement: Physical Science (5-A)
Term Typically Offered: Fall, Spring

Concentrates on the planning, research and design aspects of electric power systems, including generation, transmission and distribution systems. Emphasis is placed on design philosophies, problem definition, research, project planning, written and oral communication skills, teamwork, development of specifications and effective utilization of available resources. Lecture one hour; laboratory three hours.

EEE 192B. Electrical Power Design Project II. 2 Units
Prerequisite(s): EEE 142, EEE 143, and EEE192A.
General Education Area/Graduation Requirement: Physical Science (5-A)
Term Typically Offered: Fall, Spring

Continuation of EEE 192A. Students are expected to continue the power engineering design project begun the previous semester in EEE 192A. Final results of the project report will be presented orally to the class and invited faculty in a publicized seminar. Lecture one hour; laboratory three hours.

EEE 193A. Product Design Project I. 2 Units
Prerequisite(s): EEE 108, EEE 109, EEE 161, EEE 174, EEE 180 (EEE 109 may be taken concurrently), GE Area A and (WPJ score of 70+, or at least a C- in ENGL 109M or ENGL 109W).
General Education Area/Graduation Requirement: Physical Science (5-A)
Term Typically Offered: Fall, Spring

Concentrates on the planning and design of electrical and electronic engineering devices, systems and software. Emphasis is placed on design philosophies, problem definition, project planning and budgeting, written and oral communication skills, teamwork, development of specifications, utilization of computer aided design systems, and effective utilization of available resources. Lecture one hour; laboratory three hours.

EEE 193B. Product Design Project II. 2 Units
Prerequisite(s): EEE 193A.
General Education Area/Graduation Requirement: Physical Science (5-A)
Term Typically Offered: Fall, Spring

Concentrates on design projects begun by the previous semester design teams in EEE 193A. The hardware will be completed, tested for the meeting of specifications and other requirements, and redesigned if necessary. Required software will be written, debugged and incorporated in a written report. The final results of the team project will be presented orally to the class and invited faculty in a publicized seminar. Lecture one hour; laboratory three hours.

EEE 194. Career Development in Electrical and Electronic Engineering. 1 Unit
Prerequisite(s): EEE 192A or EEE 193A, may be taken concurrently.
Term Typically Offered: Fall, Spring

Designed for Electrical and Electronic Engineering students making career decisions. Instruction will include effective career planning strategies and techniques including skill assessments, employment search strategy, goal setting, time management, interview techniques and resume writing. Lecture one hour.
Note: Units earned cannot be used to satisfy major requirements.

Credit/No Credit

EEE 195. Fieldwork in Electrical and Electronic Engineering. 1 - 3 Units
Term Typically Offered: Fall, Spring

Supervised work experience in Electrical and Electronic Engineering with public agencies or firms in the industry. Requires approval of a petition by the supervising faculty member and Department Chair.
Note: May be repeated for credit.

Credit/No Credit

EEE 195A. Professional Practice. 1 - 12 Units
Prerequisite(s): Instructor permission.
Term Typically Offered: Fall, Spring

Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report.
Note: Units earned cannot be used to satisfy major requirements.

Credit/No Credit

EEE 195B. Professional Practice. 1 - 12 Units
Prerequisite(s): Instructor permission.
Term Typically Offered: Fall, Spring

Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report.
Note: Units earned cannot be used to satisfy major requirements.

Credit/No Credit

EEE 195C. Professional Practice. 1 - 12 Units
Prerequisite(s): Instructor permission.
Term Typically Offered: Fall, Spring

Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report.
Note: Units earned cannot be used to satisfy major requirements.

Credit/No Credit

EEE 195D. Professional Practice. 1 - 12 Units
Prerequisite(s): Instructor permission.
Term Typically Offered: Fall, Spring

Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report.
Note: Units earned cannot be used to satisfy major requirements.

Credit/No Credit

EEE 196A. PCB Design Fundamentals. 1 Unit
Prerequisite(s): EEE 102, CPE 102 or EEE 108.
Term Typically Offered: Fall, Spring

Printed circuit board (PCB) design fundamentals including library component creation, schematic capture, layout, routing, signal integrity and transmission line analysis, IEEE/IPC rules and standards, materials, manufacturing processes, and other physical properties of a PCB.

EEE 196I. Electric Vehicle Design: Electrical and Control Concepts. 3 Units
Prerequisite(s): EEE 117 or equivalent
Term Typically Offered: Fall only

Comprehensive overview of electric vehicle design. Topics include system level requirements, component level requirements, energy storage systems (battery pack design), charging, power electronics, control systems, safety, standards, and industry codes.

EEE 199. Special Problems. 1 - 3 Units
Prerequisite(s): Instructor permission.
Term Typically Offered: Fall, Spring

Individual projects or directed reading.
Note: Open only to students who appear qualified for independent work. Approval of the faculty sponsor and the academic advisor must be obtained before registering. May be repeated for credit.

EEE 201. Research Methodology. 2 Units
Prerequisite(s): Graduate standing or instructor permission.
Term Typically Offered: Fall, Spring

Immersion in the discourse of Computer Engineering: genres, literacies, stylistic conventions, research methodology. Collective and individual study of selected issues and problems relating to fields of study in the Computer Engineering. Orientation to the requirements for the master's degree culminating experience.
Note: Must be taken in the first semester of the graduate program. Crosslisted: EEE 201.

EEE 211. Microwave Engineering. 3 Units
Prerequisite(s): EEE 161; EEE 108 or instructor permission.
Term Typically Offered: Fall, Spring

High-frequency passive electronic circuit design, specifically S-parameters, impedance matching, microstrip lines, filters, couplers and antennas.

EEE 212. Modern Antenna Design. 3 Units
Prerequisite(s): EEE 161.
Term Typically Offered: Fall, Spring

Antenna analysis, design, simulation, manufacturing and measurements. Antenna properties. Classification of antennas. Microstrip patch and printed circuit antennas. Dipole antennas. Aperture antennas. Antenna arrays. Antenna measurements. Simulations using full-3D electromagnetic software.

EEE 213. Microwave Devices and Circuits. 3 Units
Prerequisite(s): EEE 162.
Term Typically Offered: Fall, Spring

Theory and application of electromagnetic radiation at microwave frequencies; study of microwave impedance and power measurement and characteristics of microwave circuit components, and electronic devices.

EEE 214. Computer Aided Design for Microwave Circuits. 3 Units
Prerequisite(s): EEE 211 or instructor permission.
Term Typically Offered: Fall, Spring

Introduction to design methodology of the basic building blocks of communication systems. Use of solid state devices in communications and microwave technology. Implementation of transmitter and receiver architectures. Impedance matching, S-parameters and small-signal, large-signal device operation. Design of transmitter and receiver components using a professional software tool. Design and simulations of gain and low noise amplifiers, detectors, mixers, power amplifiers and oscillators. Tradeoffs involved in the design of a complete transmitter and a receiver.

EEE 215. Lasers. 3 Units
Prerequisite(s): EEE 180 and EEE 161 or instructor permission.
Term Typically Offered: Fall, Spring

Review of electromagnetic theory. Ray tracing in an optical system, Gaussian beam propagation. Resonant optical cavities, study of excitation and lasing mechanisms in gas and semiconductor lasers. General characteristics and design of CW, Q switched and traveling wave lasers.

EEE 221. Machine Vision. 3 Units
Term Typically Offered: Spring only

Introduces the student to fundamental digital imaging processing concepts and their application to the fields of robotics, automation, and signal processing. Topics include: digital image filters, two dimensional transforms, boundary descriptors, Hough transform, automated visual inspection techniques, vision for robot control, 3-D vision, and hardware architectures to support vision.

EEE 222. Electronic Neural Networks. 3 Units
Term Typically Offered: Spring only – even years

Current neural network architectures and electronic implementation of neural networks are presented. Basics of fuzzy logic is covered. Application software will be used to simulate training. Testing of various neural net architectures. Learning strategies such as back-propagation, Kohonen, Hopfield and Hamming algorithms will be explored. A final project requires the student to design, train and test a neural network for electronic implementation that solves a specific practical problem.

EEE 225. Advanced Robot Control. 3 Units
Prerequisite(s): EEE 184 or equivalent.
Term Typically Offered: Fall only

Introduction to robot kinematics and dynamics followed by a comprehensive treatment of robot control. Topics include: independent joint control, multivariable control, force control, feedback linearization, real-time parameter estimation, and model-reference adaptive control.

EEE 230. Analog and Mixed Signal Integrated Circuit Design. 3 Units
Prerequisite(s): EEE 109 or instructor permission.
Term Typically Offered: Fall, Spring

Covers core topics and circuits important for analog and mixed-signal integrated circuits. Topics include: device structures and models, single-stage and differential amplifiers, current mirrors and active loads, operational amplifier design, stability and compensation, fully-differential circuits and common-mode feedback, noise in integrated circuits and the impact of IC processes on analog performance.

EEE 231. Advanced Analog and Mixed Signal Integrated Circuit Design. 3 Units
Prerequisite(s): EEE 230 or consent of the instructor.
Term Typically Offered: Fall only

A companion course to EEE 230, covers additional topics important in analog and mixed-signal integrated circuit design. Topics include traditional issues such as device matching and analog layout techniques, as well as important building blocks such as bandgap references and bias circuits. Also included are current-mode techniques such as high-speed current-mode logic (CML), and an introduction to noise in integrated circuits. Circuit and layout projects are assigned using CAD software.

EEE 232. Key Mixed-Signal Integrated Circuit Building Blocks. 3 Units
Prerequisite(s): EEE 230 or consent of instructor.
Term Typically Offered: Spring only

Covers key mixed-signal integrated circuit building blocks most often used in modern ICs. Topics covered include data converter fundamentals, comparators, and important circuit architectures for Analog-to-Digital Converters (ADCs), Digital-to-Analog Converters (DACs), and Phase-Locked Loops (PLLs).

EEE 234. Digital Integrated Circuit Design. 3 Units
Prerequisite(s): EEE 230 or instructor permission.
Term Typically Offered: Fall, Spring

The background and techniques needed to design and layout digital circuits at the transistor level for mixed-signal integrated circuits are covered. Topics include the design, layout and characterization of digital logic gates at the transistor level, typical CMOS process flows, device models and physics, and chip level considerations.

EEE 235. Mixed-Signal IC Design Laboratory. 1 Unit
Prerequisite(s): EEE 230 or consent of the instructor.
Term Typically Offered: Fall only

Methods to develop successful mixed-signal integrated circuits using an industrial design methodology and computer-aided design tools. Proven design techniques presented; hands-on experience gained through each student designing their own integrated circuit. Communications skills developed through periodic presentations, including reviews for the circuit architecture, design and layout.

EEE 236. Advanced Semiconductor Devices. 3 Units
Term Typically Offered: Spring only

Semiconductor device modeling, including the application of the continuity equation and Poissons equation to abrupt and graded p/n junctions, semiconductor/metal contacts, junction field effect transistors (JFET), metal-oxide-semiconductor transistors (MOSFET), and bipolar junction transistors (BJT). Special topics include compound semiconductor devices and heterostructures.

EEE 238. Advanced VLSI Design-For-Test I. 3 Units
Prerequisite(s): CPE 151 and CPE 166.
Term Typically Offered: Fall only

Focus on integrated circuit design-for-test-techniques; semiconductor reliablity factors and screening; semiconductor fabrication processes, device physics and related performance limitations; quantifying cost/quality tradeoffs; IC manufacturing flows and high-accuracy parametric test methods.

EEE 239. Advanced VLSI Design-For-Test II. 3 Units
Prerequisite(s): EEE 238.
Term Typically Offered: Fall, Spring

Advanced topics in VLSI testing and Design-For-Test applications. Memory-specific test methodology and special features of memory designs employed in high volume manufacturing for improved testability, yield, and reliability. VLSI failure modes, their detection and prevention. Application of trim, redundancy, wear-leveling, and error correction.

EEE 241. Linear Systems Analysis. 3 Units
Prerequisite(s): EEE 180 or equivalent.
Term Typically Offered: Spring only – odd years

Analyzes linear systems in the state-space. System realization and modeling, solutions of linear systems, stability including the method of Lyapunov, controllability and observability, state feedback and observers for both continuous and discrete-time systems. Familiarity with MATLAB is required.

EEE 242. Statistical Signal Processing. **3 Units**
Prerequisite(s): ENGR 120, EEE 180
Term Typically Offered: Fall, Spring

Introduces the student to modern statistical approaches for solving electronic system noise problems. A few of the topics covered are: Stochastic processes, Wiener and Kalman filters, linear prediction, lattice predictors and singular-value decomposition.
Note: The knowledge of ENGR 120 and EEE 180 or equivalent courses is recommended to take this course.

EEE 243. Applied Stochastic Processes. **3 Units**
Prerequisite(s): ENGR 120.
Term Typically Offered: Fall, Spring

Introduction to sequence of random variables and multivariable distributions; models of stochastic processes; stationary stochastic processes and their applications; Markov processes, Markov chains, continuous Markov chains; renewal processes; birth-death processes; time-series applications in stochastic processes in filtering, reliability and forecasting, prediction and control.

EEE 244. Electrical Engineering Computational Methods and Applications. **3 Units**
Prerequisite(s): EEE 180.
Term Typically Offered: Fall, Spring

Computational methods for solving problems in engineering analysis. Topics include variational methods, finite-difference analysis, optimization methods, and matrix methods. Focuses predominantly on applications of the methods, and students are required to solve real-world, engineering problems on the computer.

EEE 245. Advanced Digital Signal Processing. **3 Units**
Prerequisite(s): ENGR 50, ENGR 120, EEE 181; or instructor permission
Term Typically Offered: Fall, Spring

Advanced signal processing topics include: multirate signal processing, adaptive filter design and analysis, spatial filtering and the application of FIR filter theory to beamforming. Applications of digital signal processing in communication systems, radar systems, and imaging systems are covered.

EEE 246. Advanced Digital Control. **3 Units**
Prerequisite(s): EEE 241.
Term Typically Offered: Spring only – even years

Review of digital control methods using transform techniques. State-variable representation and design of digital control systems, state-space compensators and tracking systems, polynomial equations approach, LQR and LQG discrete-time control and identification, and introduction to adaptive self-turning regulators.

EEE 249. Advanced Topics in Control and Systems. **3 Units**
Term Typically Offered: Spring only – even years

Topics from recent advances in control, systems and robotics control selected from IEEE Journals and related professional publications. May be taken twice for credit.

EEE 250. Modern Power Transmission Systems. **3 Units**
Prerequisite(s): EEE 142 or equivalent.
Term Typically Offered: Fall, Spring

Characteristics of modern power transmission systems, Transmission line parameters, Steady-state, Dynamic and Transient behavior of AC/DC transmission systems, Flexible AC Transmission Systems (FACTS), High-Voltage Direct Current (HVDC) systems, Analysis of faulted transmission systems and AC/DC hybrid grids.

EEE 251. Power System Economics and Dispatch. **3 Units**
Prerequisite(s): EEE 141 or equivalent.
Term Typically Offered: Fall only

Study of a number of engineering and economic matters involved in planning, operating, and controlling power generation and transmission systems in electric utilities. Effects of hydro and nuclear plants on system economics. Economic and environmental constraints. Theoretical developments and computer methods in determining economic operation of interconnected power systems with emphasis on digital computers.

EEE 252. Power System Reliability and Planning. **3 Units**
Prerequisite(s): EEE 142 or equivalent.
Term Typically Offered: Spring only

Power system economics, generation, transmission and distribution reliability. Production costing and generation planning, transmission planning.

EEE 253. Control and Stability of Power Systems. **3 Units**
Prerequisite(s): EEE graduate standing.
Term Typically Offered: Fall only

The fundamental concepts of control and stability in power systems. Topics include: power systems dynamics and linearized models, small and large disturbances, voltage and frequency stability. Introduction to power systems dynamic simulation for stability studies using CAD tools.

EEE 254. Large Interconnected Power Systems. **3 Units**
Prerequisite(s): EEE 142.
Term Typically Offered: Spring only

Computer control, optimization and organization of large power systems. Loan and frequency control, voltage control, large load flow and contingency studies. Introduction to state estimation and load forecasting.

EEE 255. Future Power Systems and Smart Grids. **3 Units**
Prerequisite(s): EEE 141, EEE 146, EEE 180, and EEE 250 or instructor permission.
Term Typically Offered: Spring only

Future power systems from component and system perspectives. Smart grids, micro-grids, and interactive power systems using renewable resources and energy storage elements. National standards for certification of distributed generation involving machine-based and inverter-based technologies. Essential elements of advanced sensing, communications and information technology and their roles in adaptive automation, control, protection, and security.

EEE 256. Advanced Power Systems Protection. 3 Units
Prerequisite(s): EEE 141; EEE 145 or instructor permission.
Term Typically Offered: Fall, Spring

Advanced concepts and schemes used in power system protection including the various protective schemes used for transmission lines, transformers, machines, and other elements of a large interconnected power system. Concepts in digital and microprocessor based relay design and analysis of typical protection subsystems, in conjunction with the protection of the power system as a whole.

EEE 257. Wind Energy Electrical Conversion Systems. 3 Units
Prerequisite(s): Fully classified graduate standing in EEE or instructor permission
Term Typically Offered: Fall only

Fundamentals of current technologies and methods in wind energy conversion systems, including turbines, generators and converters as well as control and integration of these devices in power grids. Topics include: power conversion, grid converters for wind systems, system integration, methods for power, voltage and frequency control, and wind farms simulation and aggregation methods.

EEE 259. Advanced Topics in Power Systems. 3 Units
Prerequisite(s): EEE 142.
Term Typically Offered: Spring only

Topics from recent advances in Electrical Power Engineering selected from IEEE Journal on "Power Systems" and "Power Systems Delivery." May be taken twice for credit.

EEE 260. Digital Communications. 3 Units
Prerequisite(s): EEE 185, or instructor permission.
Term Typically Offered: Fall only

This course introduces the fundamental principles and design of digital communication systems. Main topics to be covered include representation of digitally modulated signals, signal spectral characteristics, optimum demodulation and detection methods in AWGN channels, and evaluation of the error-rate performance in AWGN channels.

EEE 261. Information Theory, Coding, and Detection. 3 Units
Prerequisite(s): ENGR 120 and EEE 185; or instructor permission.
Term Typically Offered: Spring only

The concepts of source, channel, rate of transmission of information. Entropy and mutual information. The noiseless coding theorem. Mutual information; typical sequences and their applications. Noisy channels, the coding theorem for finite-state zero memory channels. Channel capacity. Error bounds. Source encoding.

EEE 262. Wireless Communications Systems. 3 Units
Prerequisite(s): EEE 185 or instructor permission.
Term Typically Offered: Fall only

Wireless communication techniques, systems and standards. Topics include cellular systems, RF transmission and analog/digital modulation techniques. Modern techniques such as multiple access and spread spectrum systems. Channel coding and diversity will also be included.

EEE 264. Advanced Topics in Wireless Communications. 3 Units
Prerequisite(s): EEE 262 or instructor permission.
Term Typically Offered: Fall only

Advanced theoretical and practical aspects of modern wireless communications. Specific topics include: advanced cellular concepts, modern small-scale and large-scale propagation models, complex equalization and diversity system design, 3G (third generation) wireless networks, Bluetooth and Personal Area Networks (PANs), GPRS (General Packet Radio Service) and wireless measurement techniques.

EEE 265. Optoelectronic Engineering. 4 Units
Prerequisite(s): Graduate standing or instructor permission.
Term Typically Offered: Fall, Spring

Generation, propagation and detection of light. Fresnel equations, Snell's law, diffraction, polarization, and interference. Operating principles of LEDs, lasers, photodiodes, optical fibers, photovoltaic devices. Introduction to optical communications systems and optical instrumentation.
Note: EEE 265 and EEE 165 may not be both taken for graduate credit.

EEE 266. Modern Digital Communication Systems. 3 Units
Prerequisite(s): EEE 260 or instructor permission
Term Typically Offered: Spring only

This course introduces the fundamentals of digital communications over band-limited channels. Topics covered include inter-symbol interference, performance analysis of digital transmission schemes over fading channels, and diversity techniques. Other topics include overview of MIMO communication systems and diversity multiplexing trade-offs in multi-antenna systems.

EEE 267. Fiber Optic Communications. 3 Units
Prerequisite(s): EEE 185 or instructor permission.
Term Typically Offered: Fall, Spring

Fundamentals of modern lightwave communication systems, sources detectors and optical fibers. Study of dispersion in Step Index, Graded Index and Single Mode Optical Fibers. Intensity Modulated Direct Detection systems (IMDD) and Coherent Fiber Optic Systems (COFOCS). Performance evaluation and design considerations. Wavelength division multiplexing, Local Area Networks, optical amplifiers and photonic switching.

EEE 268. Telecommunication Networks. 3 Units
Prerequisite(s): EEE 185 or instructor permission.
Term Typically Offered: Spring only

This course discusses the architecture of current and next generation telecommunication networks. Main topics to be covered include introduction to modern telecommunication networks, multi-access channels, media access control, resource allocation, performance analysis of transmission techniques, and ad-hoc wireless networks. Emphasis will be on the datalink and physical layers of the communication network.

EEE 270. Advanced Topics in Logic Design. 4 Units
Prerequisite(s): EEE Graduate Student Standing.
Term Typically Offered: Fall, Spring

Synchronous and asynchronous state machines. Timing issues in high-speed digital design. Design of a complex system using VHDL and Verilog Hardware Description Languages in a CAD environment. Automation toolsets to synthesize projects containing a hierarchy of modules into Field Programmable Gate Arrays (FPGAs). Simulations using CAD tools to verify the design before implementation on rapid prototyping boards in the lab. Lecture 3 hours; laboratory 3 hours.

EEE 272. High Speed Digital System Design. 3 Units
Prerequisite(s): EEE 161, fully classified graduate standing and instructor permission.
Term Typically Offered: Fall, Spring

Theoretical topics and practical applications relating to high speed digital systems. Review of basic transmission line theory, crosstalk, impact of PCB traces, vias, and connectors on signal integrity, return current paths, simultaneous switching noise, high frequency power delivery, high speed timing budgets, high speed bus design methodologies, radiated emissions, and system noise.

EEE 273. Hierarchical Digital Design Methodology. 3 Units
Prerequisite(s): EEE 64 or equivalent.
Term Typically Offered: Spring only

Hierarchical digital design course that includes: State machine design, Programmable Logic Devices, digital simulation techniques, digital interface, design with ASIC (Application Specific Integrated Circuits), programmable Gate Arrays, and designing with Gas high speed logic devices. Problems with EMI, RFI and EMC will be presented along with design guidelines. Lecture three hours.
Cross Listed: CSC 273; only one may be counted for credit.

EEE 274. Advanced Timing Analysis. 3 Units
Prerequisite(s): EEE 273, CSC 273, CPE 273 or instructor permission.
Term Typically Offered: Fall, Spring

Timing analysis of Application Specific Integrated Circuit (ASIC) designs: Topics include ASIC design methodology, static timing analysis, timing design constraints, design reports, clock timing issues, timing exceptions, operating conditions, hierarchical analysis, analyzing designs with asynchronous logic, performance measurement and power issues.
Cross-listed: CPE 274; only one may be counted for credit.

EEE 280. Advanced Computer Architecture. 3 Units
Prerequisite(s): CSC 205 or instructor permission.
Term Typically Offered: Fall, Spring

Introduces computer classification schemes, structures of uni- and multi-processor systems, parallelism in uniprocessor systems, design and performance analysis of pipelined and array processors; survey and analysis of interconnection networks and parallel memory organizations; programming issues of multiprocessor systems; and fault tolerant computing and design for testability.
Cross Listed: CSC 280; only one may be counted for credit.

EEE 285. Micro-Computer System Design I. 3 Units
Prerequisite(s): EEE 174 or CPE 185.
Term Typically Offered: Fall, Spring

Focuses on: design of the microprocessor based computer system, study of bus structures, interrupt schemes, memory interfacing, timing, bus arbitration, system architecture, data communications, introduction to multiprocessor systems, and software development.

EEE 286. Microcomputer System Design II. 3 Units
Prerequisite(s): EEE 285 or CPE 186.
Term Typically Offered: Fall, Spring

Includes PCI and PCI express bus specifications/architecture, PCI bridges transaction ordering, PCI express transactions and handshaking protocols, electromagnetic interference, methods of eliminating interference, shielding grounding, balancing, filtering, isolation, separation, orientation, cancellation techniques and cable design. Involves design projects and research presentations on PCI and PCI Express Bridge.

EEE 296C. Transients in Power Systems. 3 Units
Prerequisite(s): EEE 130 and EEE 141
Term Typically Offered: Fall, Spring

Transients in electric power systems due to shunt capacitor switching, voltage flicker and nonlinear loads such as electric arc furnaces. Lightning surges and their effect on the power system health and operation. Transformer inrush currents and motor starting. The knowledge of EEE 130 and EEE 141 or equivalent courses is required for taking this course.
Credit/No Credit

EEE 296N. Radio Frequency Integrated Circuit Design. 3 Units
Prerequisite(s): EEE 230 or consent of the instructor.
Term Typically Offered: Spring only

Transistor-level analysis and design of radio frequency integrated circuits (RFICs) for wireless connectivity and radio communication. High-frequency device modeling, major architectures for designing transmitters and receivers, low-noise amplifiers, mixers, oscillators and frequency synthesizers, and radio frequency power amplifiers as well as design considerations of noise, linearity, distortion, and filtering in RFICs.

EEE 296T. Digital Speech Processing. 3 Units
Prerequisite(s): EEE 181 or instructor permission.
Term Typically Offered: Fall, Spring

The objective of this course is to cover the digital processing of speech signals. Topics include speech production and perception, speech processing in the time frequency domains. Short-time energy and Short-time Fourier analysis, homomorphic and linear predictive coding methods. Also covered are speech coding, basic introduction of text-to-speech synthesis and speech recognition.
Cross listed: CPE 296T.

EEE 299. Special Problems. 1 - 3 Units
Prerequisite(s): Instructor permission.
Term Typically Offered: Fall, Spring

Open to qualified students who wish to pursue problems of their own choice. Projects must have approval and supervision of a faculty advisor.

EEE 500. Culminating Experience. 5 Units

Prerequisite(s): Advanced to candidacy and approval of the graduate coordinator.

Term Typically Offered: Fall, Spring

Completion of a thesis, project or comprehensive examination. Credit given upon successful completion of one of the following plans: Plan A: Master's Thesis, 5 units; Plan B: Master's Project, 2 units; or Plan C: Comprehensive Examination, 0 units.