ELECTRICAL & COMPUTER ENGINEERING (EEC)

College of Engineering

EEC 001 — Introduction to Electrical & Computer Engineering (2 units)

Course Description: Introduction to Electrical & Computer Engineering with focus on sub-disciplines of Electrical & Computer Engineering, engineering design, and problem solving. Microcontrollers, analog circuits, signal processing, and communications links. Application of topics to create a functional device.
Learning Activities: Lecture 1 hour(s), Laboratory 2 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 007 — Introduction to Programming & Microcontrollers (4 units)

This version has ended; see updated course, below.
Course Description: Programming computers using C/C++ languages. Software engineering and object-oriented design. Programming for hardware devices.
Learning Activities: Lecture 3 hour(s), Laboratory 2 hour(s).
Enrollment Restriction(s): Pass One restricted to Electrical Engineering majors only.
Credit Limitation(s): Only 2 units of credit for students who have previously taken ECS 036A or ECS 032A.
Grade Mode: Letter.

EEC 007 — Introduction to Programming & Microcontrollers (4 units)

Course Description: Programming computers using C/C++ languages. Software engineering and object-oriented design. Programming for hardware devices.
Learning Activities: Lecture 3 hour(s), Laboratory 2 hour(s).
Enrollment Restriction(s): Pass One restricted to Electrical Engineering majors only.
Credit Limitation(s): Only 2 units of credit for students who have previously taken ECS 036A or ECS 032A or ECS 032AV.
Grade Mode: Letter.
This course version is effective from, and including: Winter Quarter 2025.

EEC 010 — Introduction to Digital & Analog Systems (4 units)

Course Description: Interactive and practical introduction to fundamental concepts of electrical and computer engineering by implementing electronic systems, which can be digitally controlled and interrogated, with a programmable microcontroller with the ability to program the electrical connections between analog and digital components.
Learning Activities: (ECS 030 or ECS 036B or EEC 007); (ENG 017 or ENG 017); consent of instructor.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 018 — Digital Systems I (5 units)

Course Description: Introduction to digital system design including combinational logic design, sequential and asynchronous circuits, computer arithmetic, memory systems and algorithmic state machine design; computer aided design (CAD) methodologies and tools.
Prerequisite(s): ENG 017 or ENG 017V.
Learning Activities: Lecture 3 hour(s), Laboratory 4 hour(s).
Credit Limitation(s): No credit to students who have previously completed EEC 180A.
Grade Mode: Letter.

EEC 089A — Special Topics in Electromagnetics (1-5 units)

Course Description: Special topics in Electromagnetics.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 089B — Special Topics in Physical Electronics (1-5 units)

Course Description: Special topics in Physical Electronics.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 089C — Special Topics in Active & Passive Circuits (1-5 units)

Course Description: Special topics in Active & Passive Circuits.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 089D — Special Topics in Signals & Systems (1-5 units)

Course Description: Special topics in Signals & Systems.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 089E — Special Topics in Computer Systems & Software (1-5 units)

Course Description: Special topics in Computer Systems & Software.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 089F — Special Topics in Digital System Design (1-5 units)

Course Description: Special topics in Digital System Design.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 090C — Research Group Conference in Electrical & Computer Engineering (1 unit)

Course Description: Research group conferences.
Prerequisite(s): Consent of instructor. Lower division standing.
Learning Activities: Discussion 1 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Pass/No Pass only.

EEC 090X — Lower Division Seminar (1-4 units)

Course Description: Examination of a special topic in a small group setting.
Prerequisite(s): Consent of instructor.
Learning Activities: Seminar 1-4 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Letter.

EEC 092 — Internship in Electrical & Computer Engineering (1-5 units)

Course Description: Supervised work experience in Electrical & Computer Engineering.
Prerequisite(s): Lower division standing; project approval prior to period of internship.
Learning Activities: Internship 3-15 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Pass/No Pass only.

EEC 098 — Directed Group Study (1-5 units)

Course Description: Directed group study.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Grade Mode: Pass/No Pass only.

EEC 099 — Special Study for Lower Division Students (1-5 units)

Course Description: Special study for lower division students.
Learning Activities: Variable.
Grade Mode: Pass/No Pass only.

EEC 100 — Circuits II (5 units)

Course Description: Theory, application, and design of analog circuits. Methods of analysis including frequency response, SPICE simulation, and Laplace transform. Operational amplifiers and design of active filters.
Prerequisite(s): (ENG 017 C- or better or ENG 017V C- or better); (MAT 022B or MAT 027B).
Learning Activities: Laboratory 3 hour(s), Lecture 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Restricted to the following majors: Electrical Engineering, Computer Engineering, Computer Science & Engineering, Electrical Engineering/Materials Science, Biomedical Engineering, Applied Physics, graduate students in the Electrical & Computer Engineering major.
Credit Limitation(s): Students who have completed ENG 100 may receive 3.5 units of credit.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Visual Literacy (VL).

EEC 105A — EE-Emerge 1 (1 unit)

Course Description: Work in groups to conceive, design and prototype electronic exhibits to promote engineering to the public.
Learning Activities: Workshop 1 hour(s).
Enrollment Restriction(s): Pass One restricted to Electrical & Computer Engineering Junior and Sophomore-level students.
Grade Mode: Pass/No Pass only.

EEC 105B — EE-Emerge 2 (2 units)

Course Description: Work in groups to construct electronic exhibits.
Learning Activities: Workshop 2 hour(s).
Enrollment Restriction(s): Pass One restricted to Electrical & Computer Engineering Junior and Sophomore-level students.
Grade Mode: Pass/No Pass only.

EEC 105C — EE-Emerge 3 (1 unit)

Course Description: Work in groups to present electronic exhibits to the public.
Prerequisite(s): EEC 105B.
Learning Activities: Workshop 1 hour(s).
Grade Mode: Pass/No Pass only.

EEC 110A — Electronic Circuits I (4 units)

Course Description: Use and modeling of nonlinear solid-state electronic devices in basic analog and digital circuits. Introduction to the design of transistor amplifiers and logic gates.
Prerequisite(s): EEC 100; (EEC 140A (can be concurrent) or EEC 140AV (can be concurrent) or EEC 111 (can be concurrent)).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Visual Literacy (VL).

EEC 110B — Electronic Circuits II (4 units)

Course Description: Analysis and design of integrated circuits. Single-stage amplifiers, cascaded amplifier stages, differential amplifiers, current sources, frequency response, and return-ratio analysis of feedback amplifiers.
Prerequisite(s): EEC 110A.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Visual Literacy (VL).

EEC 111 — Digital Electronic Circuits (4 units)

Course Description: MOS device fundamentals, introduction to the design of CMOS logic gates, layout, circuits, and modeling. Examination of voltage transfer characteristics, and propagation delay.
Prerequisite(s): EEC 100.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Enrollment Restriction(s): Open to Computer Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 112 — Communication Electronics (4 units)

Course Description: Electronic circuits for analog and digital communication, including oscillators, mixers, tuned amplifiers, modulators, demodulators, and phase-locked loops. Circuits for amplitude modulation (AM) and frequency modulation (FM) are emphasized.
Prerequisite(s): EEC 110A; EEC 150; EEC 110B recommended.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 113 — Power Electronic Circuits (4 units)

Course Description: Electronic circuits for power applications, including linear voltage regulators, switching DC-DC converters, DC-AC converters (inverters) and AC-DC converters (rectifiers). Control loop and stability of circuits.
Prerequisite(s): EEC 110A or (EEC 111, (EEC 157A or EEC 157AV)).
Learning Activities: Lecture/Lab 4 hour(s).
Grade Mode: Letter.

EEC 116 — VLSI Design (4 units)

Course Description: CMOS devices, layout, circuits, and functional units; VLSI fabrication and design methodologies.
Prerequisite(s): EEC 110A or EEC 111; EEC 018 or 180A recommended.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 118 — Digital Integrated Circuits (4 units)

Course Description: Analysis and design of digital integrated circuits. Emphasis on MOS logic circuit families. Logic gate construction, voltage transfer characteristics, propagation delay, and power consumption. Regenerative circuits, sequential elements, interconnect, RAMs, ROMs, and PLAs.
Prerequisite(s): EEC 110A; (EEC 018 or EEC 180A).
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 119A — Integrated Circuit Design Project (3 units)

Course Description: Design course involving architecture, circuit design, physical design, and validation through extensive simulation of a digital or mixed-signal integrated circuit of substantial complexity under given design constraints. Team project that includes a final report.
Prerequisite(s): EEC 116 or EEC 118.
Learning Activities: Workshop 1 hour(s), Laboratory 6 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 119B — Integrated Circuit Design Project (3 units)

Course Description: Design course involving architecture, circuit design, physical design, and validation through extensive simulation of a digital or mixed-signal integrated circuit of substantial complexity under given design constraints. Team project that includes a final report.
Prerequisite(s): EEC 119A.
Learning Activities: Workshop 1 hour(s), Laboratory 6 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 130A — Electromagnetics I (4 units)

Course Description: Basics of static electric and magnetic fields and fields in materials. Work and scalar potential. Maxwell's equations in integral and differential form. Plan waves in lossless media. Lossless transmission lines.
Prerequisite(s): MAT 021D; (PHY 009C or PHY 009HD); (ENG 017 or ENG 017V).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 130B — Introductory Electromagnetics II (4 units)

Course Description: Plane wave propagation in lossy media, reflections, guided waves, simple modulated waves and dispersion, and basic antennas.
Prerequisite(s): EEC 130A.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 132A — RF & Microwaves in Wireless Communication (5 units)

Course Description: Study of Radio Frequency and Microwave theory and practice for design of wireless electronic systems. Transmission lines, microwave integrated circuits, circuit analyis of electromagnetic energy transfer systems, the scattering parameters.
Prerequisite(s): EEC 110A; EEC 130B.
Learning Activities: Lecture 3 hour(s), Laboratory 6 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 132B — RF & Microwaves in Wireless Communication (5 units)

Course Description: Passive RF and microwave device analysis, design, fabrication, and testing for wireless applications. RF and microwave filter and coupler design. Introductory analysis and design of RF and microwave transistor amplifiers.
Prerequisite(s): EEC 132A.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 132C — RF & Microwaves in Wireless Communications (5 units)

Course Description: RF and microwave amplifier theory and design, including transistor circuit models, stability considerations, noise models and low noise design. Theory and design of microwave transistor oscillators and mixers. Wireless system design and analysis.
Prerequisite(s): EEC 132B.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 133 — Electromagnetic Radiation & Antenna Analysis (4 units)

Course Description: Properties of electromagnetic radiation; analysis and design of antennas: ideal, small loop, aperture, and arrays; antenna simulations/measurements.
Prerequisite(s): EEC 130B.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 134A — RF/Microwave Systems Design (3 units)

Course Description: Board-level RF design, fabrication, and characterization of an RF/microwave system, including the antenna, RF front-end, baseband, mix-signal circuits, and digital signal processing models.
Prerequisite(s): EEC 130B or EEC 110B or EEC 150A.
Learning Activities: Workshop 3 hour(s), Laboratory 6 hour(s).
Enrollment Restriction(s): Limited to 24 students.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 134B — RF/Microwave Systems Design (3 units)

Course Description: Board-level RF design, fabrication, and characterization of an RF/microwave system, including the antenna, RF front-end, baseband, mix-signal circuits, and digital signal processing models.
Prerequisite(s): EEC 134A.
Learning Activities: Workshop 3 hour(s), Laboratory 6 hour(s).
Enrollment Restriction(s): Limited to 24 students.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 135 — Optoelectronics for High-Speed Data Networking & Computing Systems (4 units)

Course Description: Principles of optical communication systems. Planar dielectric waveguides. Optical fibers. Silicon photonics. Attenuation and dispersion in optical fibers. Optical sources, detectors, transmitters, receivers, modulators, optical amplifiers, and optical multiplexers/demultiplexers. Optics in data centers and computing systems. Design of digital optical communication links.
Prerequisite(s): EEC 130B.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 136A — Electronic Design Project (3 units)

Course Description: Optical, electronic and communication-engineering design of an opto-electronic system operating under performance and economic constraints. Measurement techniques will be designed and implemented, and the system will be characterized.
Prerequisite(s): (ECS 036B or EEC 007); EEC 018; EEC 100; (EEC 110B or EEC 180 or EEC 157A (can be concurrent) or EEC 157AV (can be concurrent)).
Learning Activities: Workshop 1 hour(s), Laboratory 6 hour(s).
Enrollment Restriction(s): Pass One restricted to major.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 136B — Electronic Design Project (3 units)

Course Description: Optical, electronic and communication-engineering design of an opto-electronic system operating under performance and economic constraints. Measurement techniques will be designed and implemented, and the system will be characterized.
Prerequisite(s): EEC 136A.
Learning Activities: Workshop 1 hour(s), Laboratory 6 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 140A — Principles of Device Physics I (4 units)

Course Description: Semiconductor device fundamentals, equilibrium and non-equilibrium statistical mechanics, conductivity, diffusion, electrons and holes, p-n and Schottky junctions, first-order metal-oxide-semiconductor (MOS) field effect transistors, bipolar junction transistor fundamentals.
Prerequisite(s): (ENG 017 (can be concurrent) or ENG 017V (can be concurrent)).; (PHY 009D or PHY 009HE).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 140AV — Principles of Device Physics I (4 units)

Course Description: Semiconductor device fundamentals, equilibrium and non-equilibrium statistical mechanics, conductivity, diffusion, electrons and holes, p-n and Schottky junctions, first-order metal-oxide-semiconductor (MOS) field effect transistors, bipolar junction transistor fundamentals.
Prerequisite(s): (ENG 017 (can be concurrent) or ENG 017V (can be concurrent)); (PHY 009D or PHY 009HE).
Learning Activities: Web Virtual Lecture 3 hour(s); Web Electronic Discussion 1 hour(s).
Enrollment Restriction(s): Pass One restricted to Electrical Engineering majors.
Grade Mode: Letter.

EEC 140B — Principles of Device Physics II (4 units)

Course Description: Electrical properties, designs, models and advanced concepts for MOS, Bipolar, and Junction Field-Effect Transistors, including scaling, minority-carrier distributions, non-ideal effects, and device fabrication methods. MESFET and heterojunction bipolar transistors (HBTs). Fundamentals of solar cells, photodetectors, LEDs and semiconductor lasers.
Prerequisite(s): EEC 140A or EEC 140AV.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 145 — Electronic Materials (4 units)

Course Description: Electronic and physical properties of materials used in electronics, ICs, optoelectronics and MEMS. Semiconductors, dielectrics, metals, optical materials, organic semiconductive, optical and nonlinear properties, as well as their synthesis and deposition methods.
Prerequisite(s): EEC 140A or EEC 140AV.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 146A — Integrated Circuits Fabrication (4 units)

Course Description: Theoretical and experimental study of basic fabrication processes for metal oxide semiconductor integrated circuits, including oxidation, photolithography, impurity diffusion, metallization, wet chemical etching, and characterization.
Prerequisite(s): EEC 140A or EEC 140AV.
Learning Activities: Lecture 2 hour(s), Laboratory 4 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 146B — Advanced Integrated Circuits Fabrication (3 units)

Course Description: Fabrication processes for CMOS VLSI. Laboratory projects examine deposition of thin films, ion implantation, process simulation, anisotropic plasma etching, sputter metallization, and C-V analysis. Topics include isolation, projection alignment, epilayer growth, thin gate oxidation, and rapid thermal annealing.
Prerequisite(s): EEC 146A.
Learning Activities: Lecture 2 hour(s), Laboratory 3 hour(s).
Enrollment Restriction(s): Restricted to Electrical, Computer, and Electrical/Materials Science majors and Electrical Engineering graduate students; non-majors accommodated when space available.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 150 — Introduction to Signals & Systems (4 units)

Course Description: Characterization and analysis of continuous-time linear systems. Fourier series and transforms with applications. Introduction to communication systems. Transfer functions and block diagrams. Elements of feedback systems. Stability of linear systems.
Prerequisite(s): EEC 100; (ENG 006 or MAT 022AL).
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 151 — Digital Signals & Systems (4 units)

Course Description: Characterization and analysis of discrete time systems. Difference equation models. Z-transform analysis methods. Frequency Analysis. Discrete and fast Fourier transforms. Digital Filtering.
Prerequisite(s): EEC 100.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 152 — Digital Signal Processing (4 units)

Course Description: Theory and practice of real-time digital signal processing. Fundamentals of real-time systems. Programmable architectures including I/O, memory, peripherals, interrupts, DMA. Interfacing issues with A/D and D/A converters to a programmable DSP. Specification driven design and implementation of simple DSP applications.
Prerequisite(s): EEC 150B; (EEC 070 or ECS 050).
Learning Activities: Lecture 2 hour(s), Laboratory 6 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 157A — Control Systems (4 units)

Course Description: Analysis and design of feedback control systems. Examples are drawn from electrical and mechanical systems as well as other engineering fields. Mathematical modeling of systems, stability criteria, root-locus and frequency domain design methods.
Prerequisite(s): EEC 100.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 157AV — Control Systems (4 units)

Course Description: Analysis and design of feedback control systems. Examples drawn from electrical and mechanical systems as well as other engineering fields. Mathematical modeling of systems, stability criteria, root-locus and frequency domain design methods.
Prerequisite(s): EEC 100.
Learning Activities: Web Virtual Lecture 3 hour(s); Web Electronic Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 157B — Control Systems II (4 units)

Course Description: Control system design; transfer-function and state-space methods; sampled-data implementation, digital control. Laboratory includes feedback system experiments and simulation studies.
Prerequisite(s): EEC 157A or EEC 157AV.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 157BY — Control Systems II (4 units)

Course Description: Control system design; transfer-function and state-space methods; sampled-data implementation, digital control. Laboratory includes feedback system experiments and simulation studies.
Prerequisite(s): EEC 157A or EEC 157AV.
Learning Activities: Web Virtual Lecture 3 hour(s); Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE),

EEC 160 — Signal Analysis & Communications (4 units)

Course Description: Signal analysis based on Fourier methods. Fourier series and transforms; time-sampling, convolution, and filtering; spectral density; modulation: carrier-amplitude, carrier-frequency, and pulse-amplitude.
Prerequisite(s): EEC 150.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 161 — Applied Probability for Electrical & Computer Engineers (4 units)

Course Description: Axioms of probability, discrete and continuous random variables, expectation and moments. Transformation of random variables. Joint and conditional densities. Limit theorems, Markov and Poisson processes. Applications in Electrical and Computer Engineering.
Prerequisite(s): (ENG 006 or MAT 022AL); MAT 021D; MAT 022A.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 165 — Statistical & Digital Communication (4 units)

Course Description: Introduction to random process models of modulated signals and noise, and analysis of receiver performance. Analog and digitally modulated signals. Signal-to-noise ratio, probability of error, matched filters. Intersymbol interference, pulse shaping and equalization. Carrier and clock synchronization.
Prerequisite(s): EEC 160; EEC 161.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 170 — Introduction to Computer Architecture (4 units)

Course Description: Introduces basic aspects of computer architecture, including computer performance measurement, instruction set design, computer arithmetic, pipelined/non-pipelined implementation, and memory hierarchies (cache and virtual memory). Presents a simplified Reduced Instruction Set Computer using logic design methods from the prerequisite course.
Prerequisite(s): (ECS 036B or ECS 030 or ECS 034 or EEC 007); (EEC 018 or EEC 180A).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 171 — Parallel Computer Architecture (4 units)

Course Description: Organization and design of parallel processors including shared-memory multiprocessors, cache coherence, memory consistency, snooping protocols, synchronization, scalable multiprocessors, message passing protocols, distributed shared memory and interconnection networks.
Prerequisite(s): EEC 170 or ECS 154B.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 172 — Embedded Systems (4 units)

Course Description: Introduction to embedded-system hardware and software. Topics include: embedded processor and memory architecture; input/output hardware and software, including interrupts and direct memory access; interfacing with sensors and actuators; wired and wireless embedded networking.
Prerequisite(s): (EEC 170 or ECS 154A); EEC 100.
Learning Activities: Lecture 2 hour(s), Laboratory 6 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 173A — Computer Networks (4 units)

This version has ended; see updated course, below.
Course Description: Overview of computer networks, TCP/IP protocol suite, computer-networking applications and protocols, transport-layer protocols, network architectures, Internet Protocol (IP), routing, link-layer protocols, local area and wireless networks, medium access control, physical aspects of data transmission, and network-performance analysis.
Prerequisite(s): (ECS 060 or ECS 032B or ECS 036C); (ECS 132 or EEC 161 or MAT 135A or STA 131A or STA 120 or STA 032).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Pass One open to Computer Science, Computer Science Engineering and Computer Engineering Majors only.
Credit Limitation(s): Only 2 units of credit for students who have taken ECS 157.
Cross Listing: ECS 152A.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 173A — Computer Networks (4 units)

Course Description: Overview of computer networks, TCP/IP protocol suite, computer-networking applications and protocols, transport-layer protocols, network architectures, Internet Protocol (IP), routing, link-layer protocols, local area and wireless networks, medium access control, physical aspects of data transmission, and network-performance analysis.
Prerequisite(s): (ECS 032B or ECS 036C); (ECS 132 or EEC 161 or MAT 135A or STA 131A or STA 100 or STA 032, STA 035B).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Pass One open to Computer Science, Computer Science Engineering and Computer Engineering Majors only.
Credit Limitation(s): Only 2 units of credit for students who have taken ECS 157.
Cross Listing: ECS 152A.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Fall Quarter 2024.

EEC 173B — Advanced Topics in Computer Networks (4 units)

Course Description: Advanced topics in computer networks, wireless networks, multimedia networking, traffic analysis and modeling, network design and management, network simulation and performance analysis, and design projects in communication networks.
Prerequisite(s): EEC 173A or ECS 152A.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Cross Listing: ECS 152C.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 174AY — Applied Machine Learning (3 units)

Course Description: Applied machine learning (ML) and deep learning (DL) in engineering systems. Design and evaluation of components that are critical to artificial intelligence (AI) driven control systems, including but not limited to sensor fusion, feature engineering, computer vision (semantic segmentation, objection detection), ML based classification, and learning-based control systems. Team project including a final presentation and report.
Prerequisite(s): ENG 006 or MAT 022AL); (EEC 007 or ECS 036B); (EEC 161 or EEC 151 or ECS 036C).
Learning Activities: Laboratory 3 hour(s), Web Virtual Lecture 2 hour(s).
Enrollment Restriction(s): Pass One restricted to Computer Engineering and Electrical Engineering majors.
Grade Mode: Letter.

EEC 174BY — Applied Machine Learning Senior Design Projects (3 units)

Course Description: Design, development, and evaluation of components that are critical to artificial intelligence (AI) driven control systems. Team project including a final presentation and report. Example design themes include but not limited to self-driving cars, smart healthcare, and precision agriculture.
Prerequisite(s): EEC 174AY.
Learning Activities: Web Virtual Lecture 2 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.

EEC 175A — Internet of Things (3 units)

Course Description: Introduction to principles, technologies, challenges, and required expertise to build the Internet of Things (IoT) solutions. Sensing, computing, wireless communication, IP communication, and cloud processing for building an IoT solution.
Prerequisite(s): EEC 018; (EEC 111 or EEC 110A).
Learning Activities: Lecture 2 hour(s); Laboratory 3 hour(s).
Grade Mode: Letter.

EEC 175B — Internet of Things Senior Design Project (3 units)

Course Description: Propose and design a senior IoT design project, using the design principles they have studied in the prerequisite course, Internet of Things.
Prerequisite(s): EEC 175A.
Learning Activities: Lecture 1 hour(s); Laboratory 3 hour(s).
Grade Mode: Letter.

EEC 179 — Applied Machine Learning for Electrical & Computer Engineers (4 units)

Course Description: Fundamental techniques in machine learning for data preparation, preprocessing, classification, and regression. Bringing practical machine learning algorithms to the field and deploying them on real problems in hardware, mobile health, embedded systems, security, and other related topics.
Prerequisite(s): EEC 161.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 180 — Digital Systems II (5 units)

Course Description: Computer-aided design of digital systems with emphasis on hardware description languages (VHDL), logic synthesis, and field-programmable gate arrays (FPGA). May cover advanced topics in digital system design such as static timing analysis, pipelining, memory system design, testing digital circuits.
Prerequisite(s): EEC 018 or EEC 180A.
Learning Activities: Lecture 3 hour(s), Laboratory 4 hour(s).
Credit Limitation(s): No credit to students who have previously completed EEC 180B.
Grade Mode: Letter.

EEC 181A — Digital Systems Design Project (3 units)

Course Description: Digital-system and computer-engineering design course involving architecture, design, implementation and testing of a prototype application-specific processor under given design constraints. Team project includes a final presentation and report.
Prerequisite(s): (EEC 180 or EEC 180B); EEC 170.
Learning Activities: Workshop 1 hour(s), Laboratory 6 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 181B — Digital Systems Design Project (3 units)

Course Description: Digital-system and computer-engineering design course involving architecture, design, implementation and testing of a prototype application-specific processor under given design constraints. Team project includes a final presentation and report.
Prerequisite(s): EEC 181A.
Learning Activities: Workshop 1 hour(s), Laboratory 6 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 183 — Testing & Verification of Digital Systems (5 units)

Course Description: Computer aided-testing and design verification techniques for digital systems; physical fault testing; simulation-based design verification; formal verification; timing analysis.
Prerequisite(s): EEC 170; EEC 180B.
Learning Activities: Lecture 3 hour(s), Laboratory 4 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189A — Special Topics in Electrical Engineering & Computer Science: Computer Science (1-5 units)

Course Description: Special topics in Computer Science.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189B — Special Topics in Electrical Engineering & Computer Science: Programming Systems (1-5 units)

Course Description: Special topics in Programming Systems.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189C — Special Topics in Electrical Engineering & Computer Science: Digital Systems (1-5 units)

Course Description: Special topics in Digital Systems.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189D — Special Topics in Electrical Engineering & Computer Science: Communications (1-5 units)

Course Description: Special topics in Communications.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189E — Special Topics in Electrical Engineering & Computer Science: Signal Transmission (1-5 units)

Course Description: Special topics in Signal Transmission.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189F — Special Topics in Electrical Engineering & Computer Science: Digital Communication (1-5 units)

Course Description: Special topics in Digital Communication.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189G — Special Topics in Electrical Engineering & Computer Science: Control Systems (1-5 units)

Course Description: Special topics in Control Systems.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189H — Special Topics in Electrical Engineering & Computer Science: Robotics (1-5 units)

Course Description: Special topics in Robotics.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189I — Special Topics in Electrical Engineering & Computer Science: Signal Processing (1-5 units)

Course Description: Special topics in Signal Processing.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189J — Special Topics in Electrical Engineering & Computer Science: Image Processing (1-5 units)

Course Description: Special topics in Image Processing.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189K — Special Topics in Electrical Engineering & Computer Science: High-Frequency Phenomena & Devices (1-5 units)

Course Description: Special topics in High-Frequency Phenomena & Devices.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189L — Special Topics in ECS: Solid-State Devices & Physical Electronics (1-5 units)

Course Description: Special topics in Solid-State Devices & Physical Electronics.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189M — Special Topics in Electrical Engineering & Computer Science: Systems Theory (1-5 units)

Course Description: Special topics in Systems Theory.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189N — Special Topics in Electrical Engineering & Computer Science: Active & Passive Circuits (1-5 units)

Course Description: Special topics in Active & Passive Circuits.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189O — Special Topics in Electrical Engineering & Computer Science: Integrated Circuits (1-5 units)

Course Description: Special topics in Integrated Circuits.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189P — Special Topics in Electrical Engineering & Computer Science: Computer Software (1-5 units)

Course Description: Special topics in Computer Software.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189Q — Special Topics in Electrical Engineering & Computer Science: Computer Engineering (1-5 units)

Course Description: Special topics in Computer Engineering.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189R — Special Topics in Electrical Engineering & Computer Science: Microprocessing (1-5 units)

Course Description: Special topics in Microprocessing.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189S — Special Topics in Electrical Engineering & Computer Science: Electronics (1-5 units)

Course Description: Special topics in Electronics.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189T — Special Topics in Electrical Engineering & Computer Science: Electromagnetics (1-5 units)

Course Description: Special topics in Electromagnetics.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189U — Special Topics in Electrical Engineering & Computer Science: Opto-Electronics (1-5 units)

Course Description: Special topics in Opto-Electronics.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture, Laboratory, Lecture/Lab.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 189W — Special Topics in Electrical Engineering & Computer Science: Computer Networks (1-5 units)

Course Description: Special topics in Computer Networks.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 190C — Research Group Conferences in Electrical & Computer Engineering (1 unit)

Course Description: Research group conferences.
Prerequisite(s): Consent of instructor. Upper division standing in Electrical and Computer Engineering.
Learning Activities: Discussion 1 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Pass/No Pass only.
General Education: Science & Engineering (SE).

EEC 192 — Internship in Electrical & Computer Engineering (1-6 units)

Course Description: Supervised work experience in electrical and computer engineering.
Prerequisite(s): Consent of instructor. Completion of a minimum of 84 units; project approval before period of internship.
Learning Activities: Internship 3-18 hour(s).
Repeat Credit: May be repeated when project differs.
Grade Mode: Pass/No Pass only.
General Education: Science & Engineering (SE).

EEC 193A — Senior Design Project (3 units)

Course Description: Team design project for seniors in Electrical or Computer Engineering. Project involves analysis, design, implementation and evaluation of an Electrical Engineering or Computer Engineering system. Project is supervised by a faculty member.
Prerequisite(s): EEC 196 (can be concurrent); and consent of instructor.
Learning Activities: Workshop 1 hour(s), Laboratory 6 hour(s).
Enrollment Restriction(s): Restricted to senior standing in Electrical or Computer Engineering.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 193B — Senior Design Project (3 units)

Course Description: Team design project for seniors in Electrical Engineering or Computer Engineering. Project involves analysis, design, implementation and evaluation of an Electrical Engineering or Computer Engineering system. Project supervised by a faculty member.
Prerequisite(s): EEC 193A.
Learning Activities: Workshop 1 hour(s), Laboratory 6 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 195A — Autonomous Vehicle Design Project (3 units)

Course Description: Design and construct an autonomous race car. Work in groups to design, build and test speed control circuits, track sensing circuits, and a steering control loop.
Prerequisite(s): (ECS 036A or EEC 007); EEC 018; (EEC 110B or EEC 157A (can be concurrent) or EEC 157AV (can be concurrent) or ECS 036B).
Learning Activities: Workshop 1 hour(s), Laboratory 6 hour(s).
Enrollment Restriction(s): Pass One restricted to major.
Repeat Credit: May be repeated.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 195B — Autonomous Vehicle Design Project (3 units)

Course Description: Design and construct an autonomous race car. Students work in groups to design, build and test speed control circuits, track sensing circuits, and a steering control loop.
Prerequisite(s): EEC 195A.
Learning Activities: Workshop 1 hour(s), Laboratory 6 hour(s).
Enrollment Restriction(s): May be repeated.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 196 — Issues in Engineering Design (1 unit)

Course Description: Covers various electrical and computer engineering standards and realistic design constraints including economic, manufacturability, sustainability, ethical, health & safety, environmental, social, and political.
Prerequisite(s): Senior standing in Electrical or Computer Engineering.
Learning Activities: Seminar 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

EEC 197T — Tutoring in Electrical & Computer Engineering (1-3 units)

Course Description: Tutoring in Electrical & Computer Engineering courses, especially introductory circuits. For upper division undergraduate students who will provide tutorial assistance.
Prerequisite(s): Consent of instructor. Upper division standing.
Learning Activities: Discussion 1 hour(s), Discussion/Laboratory 2-8 hour(s).
Grade Mode: Pass/No Pass only.

EEC 198 — Directed Group Study (1-5 units)

Course Description: Directed group study.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Repeat Credit: May be repeated 3 time(s).
Grade Mode: Pass/No Pass only.
General Education: Science & Engineering (SE).

EEC 199 — Special Study for Advanced Undergraduates (1-5 units)

Course Description: Special study for advanced undergraduates.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Grade Mode: Pass/No Pass only.

EEC 200 — Navigating Graduate School (1 unit)

Course Description: Practical and non-technical skills necessary for first-year students in the Electrical & Computer Engineering Graduate Group. Mentorship, time management, research ethics, science communication, intellectual property.
Prerequisite(s): First-year Electrical Computer Engineering graduate student, Electrical Computer Engineering transfer student, or instructor approval.
Learning Activities: Lecture 1 hour(s).
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 201 — Digital Signal Processing (4 units)

Course Description: Theory and design of digital filters. Classification of digital filters, linear phase systems, all-pass functions, FIR and IIR filter design methods and optimality measures, numerically robust structures for digital filters.
Prerequisite(s): EEC 150B; STA 120 or MAT 131 or MAT 167 recommended.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 205 — Computational Methods in Biomedical Imaging (4 units)

Course Description: Analytic tomographic reconstruction from projections in 2D and 3D; model-based image reconstruction methods; maximum likelihood and Bayesian methods; applications to CT, PET, and SPECT.
Prerequisite(s): (BIM 105 or STA 120); (BIM 108 or EEC 150A).
Learning Activities: Lecture 4 hour(s).
Cross Listing: BIM 252.
Grade Mode: Letter.

EEC 206 — Digital Image Processing (4 units)

Course Description: Two-dimensional systems theory, image perception, sampling and quantization, transform theory and applications, enhancement, filtering and restoration, image analysis, and image processing systems.
Prerequisite(s): EEC 150B.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.

EEC 210 — MOS Analog Circuit Design (4 units)

Course Description: Analysis and design of MOS amplifiers, bias circuits, voltage references and other analog circuits. Stability and compensation of feedback amplifiers. Introduction to noise analysis in MOS circuits.
Prerequisite(s): EEC 110B; (EEC 140A B or better or EEC 140AV B or better).
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

EEC 211 — Advanced Analog Circuit Design (4 units)

Course Description: Noise and distortion in electronic circuits and systems. Application to communication circuits. Specific applications include mixers, low-noise amplifiers, power amplifiers, phase-locked loops, oscillators and receiver architectures.
Prerequisite(s): EEC 210; STA 131A EEC 112 recommended.
Learning Activities: Lecture 3 hour(s), Project (Term Project).
Grade Mode: Letter.

EEC 212 — Analog MOS IC Design for Signal Processing (4 units)

Course Description: Analysis and design of analog MOS integrated circuits. Passive components, Single-ended and fully differential op amps, Sampled-data and continuous-time filters.
Prerequisite(s): EEC 210.
Learning Activities: Lecture 3 hour(s), Extensive Problem Solving.
Grade Mode: Letter.

EEC 213 — Data-Conversion Techniques & Circuits (4 units)

Course Description: Digital-to-analog and analog-to-digital conversion; component characteristics and matching; sample-and-hold, comparator, amplifier, and reference circuits.
Prerequisite(s): EEC 210.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

EEC 214 — Integrated Circuit Design for Power Electronics (4 units)

Course Description: IC design for power electronics. Linear and switching regulation. Integrated power management. DC/DC and AC/DC conversion. Applications in portable electronics and wireless sensors.
Prerequisite(s): EEC 210.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 215 — Circuits for Digital Communications (4 units)

Course Description: Analog, digital, and mixed-signal CMOS implementations of communication-circuit blocks: gain control, adaptive equalizers, sampling detectors, clock recovery.
Prerequisite(s): EEC 150B; EEC 210 (can be concurrent); EEC 165, EEC 166, or EEC 265 recommended.
Learning Activities: Lecture 3 hour(s), Project (Term Project).
Grade Mode: Letter.

EEC 216 — Low Power Digital Integrated Circuit Design (4 units)

Course Description: Integrated circuit design for low power and energy consumption. Low power architectures, logic styles and circuit design. Variable supply and threshold voltages. Leakage management. Power estimation. Energy sources, power electronics, and energy recovery. Applications in portable electronics and sensors. Thermodynamic limits.
Prerequisite(s): EEC 118.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

EEC 221 — Radio Frequency & Microwave Filter Design (4 units)

Course Description: Design of radio frequency and microwave filters including filter specification and approximation theory. Passive LC filter design covers doubly-terminated reactance two-port synthesis and coupling matrix based synthesis. Active filter design includes sensitivity, op-amp building blocks, and cascade filter design.
Prerequisite(s): EEC 132A; or consent of instructor.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 222 — RF IC Design (4 units)

Course Description: Radio frequency (RF) solid-state devices, RF device modeling and design rules; non-linear RF circuit design techniques; use of non-linear computer-aided (CAD) tools; RF power amplifier design.
Prerequisite(s): EEC 210.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 223 — RF Integrated Circuits for Wireless Communications (4 units)

Course Description: Integrated RF front end circuit design of receivers and synthesizers for wireless communications, such as LNA, mixers, PLL; noise and linearity analysis and specifications; theory and working mechanism of synthesizers and phase noise analysis.
Prerequisite(s): EEC 132A; EEC 112.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

EEC 224 — Terahertz & mm-Wave Integrated Circuit Design (4 units)

Course Description: Fundamental theory of RF transmitter and receiver, including noise analysis, transceiver architectures, and antenna arrays. Fundamental limitations, theory and design of amplifiers, oscillators and signal sources at THz and mm-wave frequencies.
Prerequisite(s): EEC 132A; EEC 112; or consent of instructor.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

EEC 228 — Advanced Microwave Circuit & Device Design Techniques (4 units)

Course Description: Theory, design, fabrication, analysis of advanced microwave circuits and devices. Wideband transformers, stripline/microstripline broadband couplers. Lumped and distributed filter synthesis. Broadband matching theory applied to microwave devices. Wideband and low noise FET/HEMT amplifiers. Advanced microwave oscillator theory. Phase noise analysis.
Prerequisite(s): EEC 132B.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.

EEC 229 — RF-MEMS & Adaptive Wireless Frontends (4 units)

Course Description: Focuses on the modeling, design, fabrication, and characterization of RF-MEMS while providing a thorough introduction to the technology with an emphasis on how it will benefit the design of adaptive RF/microwave wireless systems.
Prerequisite(s): EEC 130A.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 230 — Electromagnetics (4 units)

Course Description: Maxwell's equations, plane waves, reflection and refraction, complex waves, waveguides, resonant cavities, and basic antennas.
Prerequisite(s): EEC 130B.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 231A — Plasma Physics & Controlled Fusion I (4 units)

Course Description: Equilibrium plasma properties; single particle motion; fluid equations; waves & instabilities in a fluid plasma; plasma kinetic theory & transport coefficients; linear & nonlinear Vlasov theory; fluctuations, correlations & radiation; inertial & magnetic confinement systems in controlled fusion.
Learning Activities: Lecture 4 hour(s).
Enrollment Restriction(s): Graduate Standing in Engineering or Consent of Instructor.
Grade Mode: Letter.

EEC 231B — Plasma Physics & Controlled Fusion II (4 units)

Course Description: Equilibrium plasma properties; single particle motion; fluid equations; waves & instabilities in a fluid plasma; plasma kinetic theory & transport coefficients; linear & nonlinear Vlasov theory; fluctuations, correlations & radiation; inertial & magnetic confinement systems in controlled fusion.
Prerequisite(s): EEC 231A; or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 231C — Plasma Physics & Controlled Fusion III (4 units)

Course Description: Equilibrium plasma properties; single particle motion; fluid equations; waves & instabilities in a fluid plasma; plasma kinetic theory & transport coefficients; linear & nonlinear Vlasov theory; fluctuations, correlations & radiation; inertial & magnetic confinement systems in controlled fusion.
Prerequisite(s): EEC 231B; or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 232A — Advanced Applied Electromagnetics I (4 units)

Course Description: The exact formulation of applied electromagnetic problems using Green's functions. Applications of these techniques to transmission circuits.
Prerequisite(s): EEC 132B or EEC 230.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 232B — Advanced Applied Electromagnetics II (4 units)

Course Description: An advanced treatment of electromagnetics with applications to passive microwave devices and antennas.
Prerequisite(s): EEC 132B.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.

EEC 233 — High Speed Signal Integrity (4 units)

Starting Summer Session 1 2025, this course is no longer offered.
Course Description: Design and analysis of interconnects in high-speed circuits and sub-systems; understanding of high-speed signal propagation and signal integrity concepts; electromagnetic modeling tools and experimental techniques.
Prerequisite(s): EEC 130B.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 234A — Physics & Technology of Microwave Vacuum Electron Beam Devices I (4 units)

Course Description: Physics & technology of electron beam emission, flow and transport, electron gun design, space charge waves & klystrons with applications to accelerator systems, RF power sources for radar & communication systems, thermionic energy conversion, and electric space propulsion. Recent advances in materials & manufacturing technologies are also reviewed.
Prerequisite(s): B.S. degree in physics or engineering or the equivalent background or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 234AV — Physics & Technology of Microwave Vacuum Electron Beam Devices I (4 units)

Course Description: Physics & technology of electron beam emission, flow and transport, electron gun design, space charge waves & klystrons with applications to accelerator systems, RF power sources for radar & communication systems, thermionic energy conversion, and electric space propulsion. Recent advances in materials & manufacturing technologies also reviewed.
Prerequisite(s): B.S. degree in physics or engineering or the equivalent background or consent of instructor.
Learning Activities: Web Virtual Lecture 3 hour(s), Web Electronic Discussion 1 hour(s).
Grade Mode: Letter.

EEC 234B — Physics & Technology of Microwave Vacuum Electron Beam Devices II (4 units)

This version has ended; see updated course, below.
Course Description: Theory, modeling, & experimental design of traveling wave tubes, backward wave oscillators, and extended interaction oscillators employed in satellite commutations, plasma imaging, and underground imaging systems.
Prerequisite(s): EEC 234A; or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 234B — Physics & Technology of Microwave Vacuum Electron Beam Devices II (4 units)

Course Description: Theory, modeling, & experimental design of traveling wave tubes, backward wave oscillators, and extended interaction oscillators employed in satellite commutations, plasma imaging, and underground imaging systems.
Prerequisite(s): EEC 234A or EEC 324AV; or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.
This course version is effective from, and including: Fall Quarter 2024.

EEC 234BV — Physics & Technology of Microwave Vacuum Electron Beam Devices II (4 units)

Course Description: Theory, modeling, & experimental design of traveling wave tubes, backward wave oscillators, and extended interaction oscillators employed in satellite commutations, plasma imaging, and underground imaging systems.
Prerequisite(s): EEC 234A or EEC 234AV recommended; or consent of instructor.
Learning Activities: Web Virtual Lecture 3 hour(s), Web Electronic Discussion 1 hour(s).
Grade Mode: Letter.

EEC 234C — Physics & Technology of Microwave Vacuum Electron Beam Devices III (4 units)

This version has ended; see updated course, below.
Course Description: Physics & technology of gyrotrons, gyro-amplifiers, free electron lasers, magnetrons, cross-field amplifiers, and relativistic devices employed in plasma fusion reactors, microwave heating, and high power microwave applications.
Prerequisite(s): EEC 234B; or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 234C — Physics & Technology of Microwave Vacuum Electron Beam Devices III (4 units)

Course Description: Physics & technology of gyrotrons, gyro-amplifiers, free electron lasers, magnetrons, cross-field amplifiers, and relativistic devices employed in plasma fusion reactors, microwave heating, and high power microwave applications.
Prerequisite(s): EEC 234B or EEC 234BV; or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.
This course version is effective from, and including: Winter Quarter 2025.

EEC 234CV — Physics and Technology of Microwave Vacuum Electron Beam Devices III (4 units)

Course Description: Physics & technology of gyrotrons, gyro-amplifiers, free electron lasers, magnetrons, cross-field amplifiers, and relativistic devices employed in plasma fusion reactors, microwave heating, and high power microwave applications.
Prerequisite(s): EEC 234B or EEC 234BV; or consent of instructor.
Learning Activities: Web Virtual Lecture 3 hour(s), Web Electronic Discussion 1 hour(s).
Grade Mode: Letter.

EEC 235 — Photonics (4 units)

Course Description: Optical propagation of electromagnetic waves and beams in photonic components and the design of such devices using numerical techniques.
Prerequisite(s): EEC 130B; EEC 230 recommended.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

EEC 236 — Nonlinear Optical Applications (3 units)

Course Description: Nonlinear optical interactions in optical communication, optical information processing and integrated optics. Basic concepts underlying optical nonlinear interactions in materials and guided media.
Prerequisite(s): EEC 130B; EEC 230 (can be concurrent).
Learning Activities: Lecture 3 hour(s).
Credit Limitation(s): Not open for credit to students who have completed EEC 233.
Grade Mode: Letter.

EEC 237A — Lasers (3 units)

Course Description: Theoretical and practical description of lasers. Theory of population inversion, amplification and oscillation using semiclassical oscillator model and rate equations. Description and design of real laser system.
Prerequisite(s): EEC 235; EEC 130B; or the equivalent of EEC 130B.
Learning Activities: Lecture 3 hour(s).
Credit Limitation(s): Not open for credit to students who have completed EEC 226A.
Grade Mode: Letter.

EEC 237B — Laser Physics II (4 units)

Course Description: Oscillation threshold. Coupled cavity/atomic rate equations, Linear pulse propagation; dispersion, broadening, compression. Nonlinear pulse propagation. Energy extraction. Optical beams, resonators, eigenmodes, axial/transverse modes. Paraxial ray optics, resonator stability, ABCD matrices. Laser dynamics; transients, spiking, Q-switching, active and passive modelocking.
Prerequisite(s): EEC 237A or EAD 265A.
Learning Activities: Lecture 3 hour(s), Extensive Problem Solving.
Credit Limitation(s): Not open for credit to students who have completed EEC 226B.
Grade Mode: Letter.

EEC 238 — Semiconductor Lasers & Photonic Integration (4 units)

Course Description: Understanding of fundamental optical transitions in semiconductors and quantum-confined systems are applied to diode & unipolar lasers and selected photonic devices. The importance of radiative and non-radiative recombination, simulated emission, excitons in quantum wells, and strained quantum layers are considered. Photonic integrated circuits based on active (with optical gain) and passive (without optical gain).
Prerequisite(s): EEC 140A or EEC 140AV.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 239A — Optical Communication Technologies for High-Speed Data Networking (4 units)

Course Description: Enabling technologies for optical fiber communication and data center networks. Physical layer issues for component and system technologies in high-speed data optical communications. High-capacity data multiplexing technologies including wavelength-division-multiplexing, time-division-multiplexing, and advanced coherent modulation. Optical signal transmission, optical amplification, and optical switching for telecom and data center networks.
Prerequisite(s): EEC 130B.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 239B — High-Capacity Optical Data Systems & Networks (4 units)

Course Description: High-capacity optical data systems and networks, built-on modern optical communication technologies. Technologies behind data center networking, software defined networking, and RF-optical networking. Physical layer issues in light of networking architectures and protocols. Optical communications systems design and integration. Systems technologies and higher-level network architecture, case studies. WDM, TDM, and EON networking, optical and wireless access technologies based on PON and ROF.
Prerequisite(s): EEC 239A.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 240 — Semiconductor Device Physics (4 units)

Course Description: Physical principles, characteristics and models of various semiconductor materials and devices, including: P-N junction, metal- semiconductor diodes, junction, and insulated-gate field effect transistors. Elements of basic design exercises to explore circuit design, RF phenomenon, optoelectronics, solid-state devices, materials, and large-scale integration.
Prerequisite(s): EEC 140B.
Learning Activities: Lecture 3 hour(s); Project.
Grade Mode: Letter.

EEC 241 — Introduction to Molecular Electronics (4 units)

Starting Summer Session 1 2025, this course is no longer offered.
Course Description: Examines molecules for electronic devices and sensors. Covers: electronic states of molecules, charge transport in nanoscale systems, and fabrication and measurement of molecular-scale devices. Specific Topics: Hartree-Fock & Density Functional Theory, Landauer formalism, coulomb blockade, tunneling and hopping transport.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

EEC 242 — Advanced Nanostructured Devices (4 units)

Course Description: Physics of nano-structured materials and device operation. Overview of new devices enabled by nanotechnology; fabrication and characterization methods; applications of nano-structures and devices.
Prerequisite(s): EEC 130A; (EEC 140A or EEC 140AV).
Learning Activities: Lecture 4 hour(s); Project.
Grade Mode: Letter.

EEC 243 — Optical Imaging & Microscopy (4 units)

Course Description: Theory and techniques of optical imaging & microscopy. Fourier optics; light propagation & light detection; imaging contrast mechanisms; optical & microscopy techniques.
Prerequisite(s): PHY 009B; EEC130AB recommended.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 244 — Introduction to Neuroengineering (4 units)

Course Description: Survey of neuroengineering field from engineering and biological perspectives; micro-/nano-fabrication technology; optical and electrical techniques to monitor and modulate neural activity; computational tools and control systems; prosthetics and human machine interfaces; human performance and rehabilitation; cognitive neuroengineering; neuroethics; extensive proposal development to merge aforementioned themes into a multidisciplinary project.
Prerequisite(s): Graduate standing; or consent of instructor.
Learning Activities: Lecture 2 hour(s); Discussion 1 hour(s); Extensive Writing.
Grade Mode: Letter.

EEC 245 — Micro- & Nano-Technology in Life Sciences (4 units)

Course Description: Survey of biodevice design from engineering and biological perspectives; micro-/nano-fabrication techniques; surface science and mass transport; essential biological processes and models; proposal development skills on merging aforementioned themes.
Prerequisite(s): Graduate standing or consent of instructor.
Learning Activities: Lecture/Discussion 4 hour(s).
Cross Listing: ECH 245, EMS 245, MAE 245.
Grade Mode: Letter.

EEC 246 — Advanced Projects in IC Fabrication (4 units)

Course Description: Individualized projects in the fabrication of analog or digital integrated electronic or optoelectronic circuits.
Prerequisite(s): EEC 146B.
Learning Activities: Discussion 1 hour(s), Laboratory 9 hour(s).
Grade Mode: Letter.

EEC 247 — Advanced Semiconductor Devices (4 units)

Starting Summer Session 1 2025, this course is no longer offered.
Course Description: Semiconductor devices, including MOSFETs, heterojunction transistors, light-emitting diodes, lasers, sensors, detectors, power and high-voltage transistors, MEMS resonators, organic semiconductors and photovoltaics. All material is from recent literature, encouraging students to utilize search methods and critically assess the latest research.
Prerequisite(s): Graduate standing in Engineering.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

EEC 248 — Photovoltaics & Solar Cells (3 units)

Course Description: Physics and application of photovoltaics and solar cells, including design, fabrication technology, and grid incorporation. Mono and microcrystalline silicon devices; thin-film technologies, heterojunction and organic-semiconductor technologies. Collectors, electrical inverters and infrastructure issues. Challenges and concerns.
Prerequisite(s): EEC 140B; or consent of instructor, or equivalent.
Learning Activities: Lecture 3 hour(s).
Cross Listing: EMS 246.
Grade Mode: Letter.

EEC 249 — Nanofabrication (4 units)

Course Description: Theory and practice of nanofabrication (top-down and bottom-up approaches), used for producing integrated circuits, electronic devices, sensors, and microstructures. Process development and characterization.
Prerequisite(s): Graduate standing in Engineering.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 250 — Linear Systems & Signals (4 units)

Course Description: Mathematical description of systems. Selected topics in linear algebra. Solution of the state equations and an analysis of stability, controllability, observability, realizations, state feedback and state estimation. Discrete-time signals and systems, and the Z-transform.
Prerequisite(s): EEC 150A.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 251 — Nonlinear Systems (4 units)

Course Description: Nonlinear differential equations, second-order systems, approximation methods, bifurcations, Lyapunov stability, absolute stability, Popov criterion, circle criterion, sliding-mode control, feedback linearization techniques.
Prerequisite(s): EEC 250.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 252 — Multivariable Control System Design (4 units)

Course Description: Review of single-loop feedback design. Stability, performance and robustness of multi-input multi-output control systems. H-infinity design. Frequency response methods. Optimization-based design. Algebraic design methods for uncertain systems.
Prerequisite(s): EEC 250.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 254 — Optimization (3 units)

This version has ended; see updated course, below.
Course Description: Modeling optimization problems in engineering design and other applications; optimality conditions; unconstrained optimization (gradient, Newton, conjugate gradient and quasi-Newton methods); duality and Lagrangian relaxation constrained optimization. (Primal method and an introduction to penalty and augmented Lagrangian methods.)
Prerequisite(s): MAT 022A; Knowledge of FORTRAN or C.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.

EEC 254 — Optimization (4 units)

Course Description: Understanding, analyzing, and solving constrained convex optimization problems arising in cutting-edge engineering and science fields, including machine learning, signal processing, networks, control, transportation, and circuit design. Convexity theory and the algorithmic approaches for convex optimization problem.
Prerequisite(s): MAT 022A; or consent of instructor; working knowledge in Linear Algebra and Multivariate Calculus, knowledge of Python or Matlab.
Learning Activities: Discussion/Laboratory 3 hour(s).
Grade Mode: Letter.
This course version is effective from, and including: Summer Session 1 2025.

EEC 255 — Robotic Systems (3 units)

Course Description: Introduction to robotic systems. Mechanical manipulators, kinematics, manipulator positioning and path planning. Dynamics of manipulators. Robot motion programming and control algorithm design.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.

EEC 256 — Reinforcement Learning (4 units)

Course Description: Reinforcement Learning (RL) is the subset of machine learning, the core of artificial intelligence. Topics include fundamentals of RL, bandit problems, Markov decision processes, and dynamic programming.
Prerequisite(s): EEC 260; or the equivalent.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 260 — Random Signals & Noise (4 units)

Course Description: Random processes as probabilistic models for signals and noise. Probability and random variables, Convergence and limit theorems, Specification of random processes, Markov Chains, Wiener process and white Gaussian noise, Poisson process and shot noise, Processing and frequency analysis of random signals.
Prerequisite(s): EEC 150A; EEC 161.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 261 — Signal Processing for Communications (4 units)

Course Description: Signal processing in wireless and wireline communication systems. Characterization and distortion of wireless and wireline channels. Channel equalization and maximum likelihood sequence estimation. Channel precoding and pre-equalization. OFDM and transmit diversity. Array processing.
Prerequisite(s): EEC 165; EEC 260; or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 262 — Multi-access Communications Theory (4 units)

Course Description: Maximum stable throughput of Poisson collision channels. Classic collision resolution algorithms. Carrier sensing multiple access and its performance analysis. System stability analysis. Joint design of the physical/medium access control layers. Capacity region of multi-access channels. Multi-access with correlated sources.
Prerequisite(s): (EEC 173A or ECS 152A); STA 120; or equivalent of STA 120.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

EEC 263 — Optimal & Adaptive Filtering (4 units)

Course Description: Geometric formulation of least-squares estimation problems. Theory and applications of optimum Wiener and Kalman filtering. MAP and maximum likelihood estimation of hidden Markov models, Viterbi algorithm. Adaptive filtering algorithms, properties and applications.
Prerequisite(s): EEC 260.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 264 — Estimation & Detection of Signals in Noise (4 units)

Course Description: Introduction to parameter estimation and detections of signals in noise. Bayes and Neyman-Pearson likelihood-ratio tests for signal detection. Maximum-likelihood parameter estimation. Detection of known and Gaussian signals in white or colored noise. Applications to communications, radar, signal processing.
Prerequisite(s): EEC 260.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 265 — Principles of Digital Communications (4 units)

Course Description: Introduction to digital communications. Coding for analog sources. Characterization of signals and systems. Modulation and demodulation for the additive Gaussian channel. Digital signaling over bandwidth-constrained linear filter channels and over fading multipath channels. Spread spectrum signals.
Prerequisite(s): EEC 165; EEC 260; or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 266 — Information Theory & Coding (4 units)

Course Description: Topics include Entropy, Relatively Entropy, Mutual Information; Asymptotic Equipartition Property; Entropy Rates of Stochastic Process; Data Compression; Channel Capacity; Differential Entropy; Gaussian Channel; Rate Distortion Theory; Network Information Theory.
Prerequisite(s): EEC 161.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

EEC 267 — Mobile Communications (4 units)

Course Description: Time-varying multi-path fading channel models and receiver performance in fading channels; multiple access techniques and multiple access receivers design and performance; optimum design and the capacity of wireless channels.
Prerequisite(s): EEC 260; EEC 265 (can be concurrent).
Learning Activities: Lecture/Lab 3 hour(s).
Grade Mode: Letter.

EEC 269A — Error Correcting Codes: Algebraic Approach (4 units)

Course Description: Introduction to theory and practice of block codes, linear block codes, cyclic codes, decoding algorithms, and coding techniques.
Prerequisite(s): MAT 022A.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 269B — Error Correcting Codes II (3 units)

This version has ended; see updated course, below.
Course Description: Introduction to convolutional codes, turbo codes, trellis and block coded modulation codes,soft-decision decoding algorithms, the Viterbi algorithm,reliability-based decoding, trellis-based decoding, multistage decoding.
Prerequisite(s): EEC 165; EEC 269A.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.

EEC 269B — Error Correcting Codes: Probabilistic Approach (4 units)
Course Description: Probabilistic approach to construct and decode error-correcting codes, coded communication systems, low-density parity-check (LDPC) codes, polar codes, fountain codes, decoding algorithms.
Prerequisite(s): ENG 006; EEC 161.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.
This course version is effective from, and including: Winter Quarter 2025.

EEC 270 — Computer Architecture (4 units)

Course Description: Introduction to modern techniques for high-performance single and multiple processor systems. Topics include advanced pipeline design, advanced memory hierarchy design, optimizing pipeline and memory use, and memory sharing among multiprocessors. Case studies of recent single and multiple processor systems.
Prerequisite(s): EEC 170 or ECS 154B.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

EEC 272 — High-Performance Computer Architecture (4 units)

Course Description: Designing and analysis of high performance computer architecture with emphasis on vector processing, on-chip interconnect networks, chip-level multiprocessors, memory and storage subsystem design and impact of technological advances on computer architecture.
Prerequisite(s): EEC 270 or ECS 201A.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 273 — Networking Architecture & Resource Management (4 units)

Course Description: Design & implementation principles of networking architecture and protocols. Internet, data center, and telephony case studies. Topics: Internet data & control planes; application & services; resource management; Quality of Service (QoS) provisioning; traffic engineering; performance evaluation, software-defined networks, & future research issues.
Prerequisite(s): ECS 152A or EEC 173A.
Learning Activities: Lecture 3 hour(s), Project.
Enrollment Restriction(s): Pass One and Pass Two only open to Graduate Students in Computer Science and Electrical & Computer Engineering.
Grade Mode: Letter.

EEC 275 — Introduction to Hardware Security (4 units)

Course Description: Hardware Security. Cryptographic processing and the analysis of its overhead, physical attacks, side-channel attacks and counter measures, physically unclonable functions, hardware-based random number generators, watermarking of Intellectual Property blocks, field-programmable gate array security, printed circuit board security, passive and active metering for prevention of piracy, and access control.
Prerequisite(s): EEC 018 or EEC 118; or equivalent.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.

EEC 279 — Modern Parallel Computing (4 units)

Course Description: Exploration of the architecture of modern parallel computers, their programming models, and their programming systems.
Prerequisite(s): Prior experience in C/C++ required; experience with other computer architecture, computer graphics, algorithms, and data structures are also useful; all assignments use C/C++.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

EEC 281 — VLSI Digital Signal Processing (4 units)

Course Description: Digital signal processors, building blocks, and algorithms. Design and implementation of processor algorithms, architectures, control, functional units, and circuit topologies for increased performance and reduced circuit size and power dissipation.
Prerequisite(s): EEC 150B; EEC 170; (EEC 180 or EEC 180B); or consent of instructor.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

EEC 283 — Advanced Design Verification of Digital Systems (4 units)

Course Description: Design verification techniques for digital systems; simulation-based design verification techniques; formal verification techniques, including equivalence checking, model checking, and theorem proving; timing analysis and verification; application of design cerification techniques to microprocessors.
Prerequisite(s): EEC 170; (EEC 018 or EEC 180A).
Learning Activities: Lecture 3 hour(s), Project 1 hour(s).
Grade Mode: Letter.

EEC 284 — Design & Optimization of Embedded Computing Systems (4 units)

Course Description: Introduction to design and optimization of digital computing systems for embedded applications. Topics include combinatorial optimization techniques, performance and energy optimization in embedded systems, compilation and architecture-specific mapping, programmable and reconfigurable platforms; design automation and algorithmic improvements to design process.
Prerequisite(s): EEC 170; (EEC 180 or EEC 180B); or consent of instructor. ECS 122A recommended.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

EEC 286 — Introduction to Digital System Testing (4 units)

Course Description: Review of several current techniques used to detect physical faults in both combinational and sequential circuits. Topics include fault modeling, fault simulation, test generation, compression techniques, and testing architectures.
Prerequisite(s): EEC 018.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

EEC 289A — Special Topics in Electrical & Computer Engineering: Computer Science (1-5 units)

Course Description: Special topics in Computer Science.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289B — Special Topics in Electrical & Computer Engineering: Programming Systems (1-5 units)

Course Description: Special topics in Programming Systems.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289C — Special Topics in Electrical & Computer Engineering: Digital Systems (1-5 units)

Course Description: Special topics in Digital Systems.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289D — Special Topics in Electrical & Computer Engineering: Digital Systems (1-5 units)

Course Description: Special topics in Digital Systems.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289E — Special Topics in Electrical & Computer Engineering: Signal Transmission (1-5 units)

Course Description: Special topics in Signal Transmission.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289F — Special Topics in Electrical & Computer Engineering: Digital Communication (1-5 units)

Course Description: Special topics in Digital Communication.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289G — Special Topics in Electrical & Computer Engineering: Control Systems (1-5 units)

Course Description: Special topics in Control Systems.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289H — Special Topics in Electrical & Computer Engineering: Robotics (1-5 units)

Course Description: Special topics in Robotics.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289I — Special Topics in Electrical & Computer Engineering: Signal Processing (1-5 units)

Course Description: Special topics in Signal Processing.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289J — Special Topics in Electrical & Computer Engineering: Image Processing (1-5 units)

Course Description: Special topics in Image Processing.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289K — Special Topics in Electrical & Computer Engineering: High Frequency Phenomena & Devices (1-5 units)

Course Description: Special topics in High Frequency Phenomena & Devices.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289L — Special Topics in Electrical & Computer Engineering: Solid-State Devices & Physical Electronics (1-5 units)

Course Description: Special topics in Solid-State Devices & Physical Electronics.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289M — Special Topics in Electrical & Computer Engineering: Systems Theory (1-5 units)

Course Description: Special topics in Systems Theory.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289N — Special Topics in Electrical & Computer Engineering: Active & Passive Circuits (1-5 units)

Course Description: Special topics in Active & Passive Circuits.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289O — Special Topics in Electrical & Computer Engineering: Integrated Circuits (1-5 units)

Course Description: Special topics in Integrated Circuits.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289P — Special Topics in Electrical & Computer Engineering: Computer Software (1-5 units)

Course Description: Special topics in Computer Software.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289Q — Special Topics in Electrical & Computer Engineering: Computer Engineering (1-5 units)

Course Description: Special topics in Computer Engineering.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289R — Special Topics in Electrical & Computer Engineering: Microprocessing (1-5 units)

Course Description: Special topics in Microprocessing.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289S — Special Topics in Electrical & Computer Engineering: Electronics (1-5 units)

Course Description: Special topics in Electronics.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289T — Special Topics in Electrical & Computer Engineering: Electromagnetics (1-5 units)

Course Description: Special topics in Electromagnetics.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289U — Special Topics in Electrical & Computer Engineering: Optoelectronics (1-5 units)

Course Description: Special topics in Optoelectronics.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 289W — Special Topics in Electrical Engineering & Computer Science: Computer Networks (1-5 units)

Course Description: Special topics in Computer Networks.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Lab 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

EEC 290 — Seminar in Electrical & Computer Engineering (1 unit)

Course Description: Discussion and presentation of current research and development in Electrical & Computer Engineering.
Learning Activities: Seminar 1 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 290C — Graduate Research Group Conference in Electrical & Computer Engineering (1 unit)

Course Description: Research problems, progress, and techniques in electrical and computer engineering.
Prerequisite(s): Consent of instructor.
Learning Activities: Discussion 1 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 290P — Capstone Project For MS Plan II (4 units)

Course Description: Conducting research projects in electrical and computer engineering. Communicating research results in written reports and oral presentations. Systemic project implementation to answer a comprehensive scientific or technical question in the area of electrical and computer engineering.
Prerequisite(s): Consent of instructor.
Learning Activities: Term Paper, Lecture 1 hour(s), Extensive Problem Solving.
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 291 — Solid-State Circuit Research Laboratory Seminar (1 unit)

Course Description: Lectures on solid-state circuit and system design by various visiting experts in the field.
Prerequisite(s): Graduate standing.
Learning Activities: Seminar 1 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 292 — Seminar in Solid-State Technology (1 unit)

Course Description: Lectures on solid-state technology by various visiting experts in the field.
Prerequisite(s): Graduate standing.
Learning Activities: Seminar 1 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 293 — Computer Engineering Research Seminar (1 unit)

Course Description: Lectures, tutorials and seminars on topics in computer engineering.
Prerequisite(s): Graduate standing or consent of instructor.
Learning Activities: Seminar 1 hour(s).
Repeat Credit: May be repeated 4 time(s).
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 294 — Communications, Signal & Image Processing Seminar (1 unit)

Course Description: Communications, signal and image processing, video engineering and computer vision.
Prerequisite(s): Graduate standing.
Learning Activities: Seminar 1 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 295 — Systems, Control & Robotics Seminar (1 unit)

Course Description: Seminars on current research in systems and control by faculty and visiting experts. Technical presentations and lectures on current topics in robotics research and robotics technology.
Prerequisite(s): Graduate standing.
Learning Activities: Seminar 1 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 296 — Photonics Research Seminar (1 unit)

Course Description: Lectures on photonics and related areas by faculty and visiting experts.
Prerequisite(s): Graduate standing.
Learning Activities: Seminar 1 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 298 — Group Study (1-5 units)

Course Description: Group study.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 299 — Research (1-12 units)

Course Description: Research.
Learning Activities: Variable.
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 390 — The Teaching of Electrical Engineering (1 unit)

Course Description: Participation as a teaching assistant or associate-in in a designated engineering course. Methods of leading discussion groups or laboratory sections, writing and grading quizzes, use of laboratory equipment, and grading laboratory reports.
Prerequisite(s): Meet qualifications for teaching assistant and/or associate-in in Electrical Engineering.
Learning Activities: Discussion 1 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Satisfactory/Unsatisfactory only.

EEC 396 — Teaching Assistant Training Practicum (1-4 units)

Course Description: Teaching Assistant training.
Prerequisite(s): Graduate standing.
Learning Activities: Variable.
Repeat Credit: May be repeated.
Grade Mode: Pass/No Pass only.