DEPARTMENT OF
ELECTRICAL AND COMPUTER
ENGINEERING

Office in Engineering Building, Room 104
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engr.colostate.edu/ece (http://www.engr.colostate.edu/ece/)

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Undergraduate
Majors

• Major in Computer Engineering (http://catalog.colostate.edu/
general-catalog/colleges/engineering/electrical-computer/computer-
engineering-major/)
  • Aerospace Systems Concentration (http://catalog.colostate.edu/
general-catalog/colleges/engineering/electrical-computer/
computer-engineering-major-aerospace-systems-concentration/)
  • Embedded and IoT Systems Concentration (http://
catalog.colostate.edu/general-catalog/colleges/engineering/electrical-computer/
computer-engineering-major-embedded-iot-systems-concentration/)
  • Networks and Data Concentration (http://catalog.colostate.edu/
general-catalog/colleges/engineering/electrical-computer/
computer-engineering-major-networks-data-concentration/)
  • VLSI and Integrated Circuits Concentration (http://
catalog.colostate.edu/general-catalog/colleges/engineering/electrical-computer/
computer-engineering-major-vlsi-integrated-circuits-concentration/)
• Major in Electrical Engineering (http://catalog.colostate.edu/
general-catalog/colleges/engineering/electrical-computer/electrical-
engineering-major/)
  • Aerospace Concentration (http://catalog.colostate.edu/
general-catalog/colleges/engineering/electrical-computer/
electrical-engineering-major-aerospace-concentration/)
  • Electrical Engineering Concentration (http://
catalog.colostate.edu/general-catalog/colleges/engineering/
electrical-computer/electrical-engineering-major-electrical-engineering-concentration/)
  • Lasers and Optical Engineering Concentration (http://
catalog.colostate.edu/general-catalog/colleges/engineering/
electrical-computer/electrical-engineering-major-lasers-optical-concentration/)
• Major in Biomedical Engineering combined with Computer Engineering (http://catalog.colostate.edu/general-catalog/colleges/
engineering/biomedical/computer-dua-degree-program/)
  • Major in Biomedical Engineering combined with Electrical Engineering, Electrical Engineering Concentration (http://
catalog.colostate.edu/general-catalog/colleges/engineering/
biomedical/(electrical-engineering-major-electrical-engineering-concentration)/
  • Major in Biomedical Engineering combined with Electrical Engineering, Lasers and Optical Engineering Concentration (http://
catalog.colostate.edu/general-catalog/colleges/engineering/
biomedical/laeers-optical-engineering-major-lasers-optical-concentration-dual-degree-
program/)

Minor

• Minor in Computer Engineering (http://catalog.colostate.edu/
general-catalog/colleges/engineering/electrical-computer/computer-
engineering-minor/)

Graduate
Graduate Programs in Electrical and Computer Engineering

Graduate programs leading to the Master of Science, Master of Engineering (Electrical Engineering and Computer Engineering specializations), and Doctor of Philosophy degrees are offered in several areas. Online Master of Engineering degrees in Electrical Engineering and Computer Engineering are also available. Students interested in graduate work should refer to the Graduate and Professional Bulletin (http://catalog.colostate.edu/general-catalog/graduate-bulletin/) and the Electrical and Computer Engineering (http://www.engr.colostate.edu/ece/) Department (http://www.engr.colostate.edu/ece/).

Certificates

• Computer Systems Engineering (http://catalog.colostate.edu/
general-catalog/colleges/engineering/electrical-computer/graduate-
certificate-computer-systems-engineering/)
• Data Engineering (http://catalog.colostate.edu/general-catalog/
colleges/engineering/electrical-computer/data-engineering-graduate-
certificate/)
• Embedded Systems (http://catalog.colostate.edu/general-catalog/
colleges/engineering/electrical-computer/graduate-certificate-
embedded-systems/)
Master's Programs

- Master of Science in Computer Engineering, Plan A (http://catalog.colostate.edu/general-catalog/colleges/engineering/electrical-computer/plan-a-computer-engineering-ms/)
- Master of Science in Computer Engineering, Plan B (http://catalog.colostate.edu/general-catalog/colleges/engineering/electrical-computer/plan-b-computer-engineering-ms/)
- Master of Science in Electrical Engineering, Plan A (http://catalog.colostate.edu/general-catalog/colleges/engineering/electrical-computer/plan-a-electrical-engineering-ms/)
- Master of Science in Electrical Engineering, Plan B (http://catalog.colostate.edu/general-catalog/colleges/engineering/electrical-computer/plan-b-electrical-engineering-ms/)
- Master of Engineering, Plan C, Computer Engineering Specialization (http://catalog.colostate.edu/general-catalog/colleges/engineering/electrical-computer/plan-c-me-computer-engineering-specialization/)
- Master of Engineering, Plan C, Electrical Engineering Specialization (http://catalog.colostate.edu/general-catalog/colleges/engineering/electrical-computer/plan-c-me-electrical-engineering-specialization/)

Ph.D.

- Ph.D. in Computer Engineering (http://catalog.colostate.edu/general-catalog/colleges/engineering/electrical-computer/phd-computer-engineering/)
- Ph.D. in Electrical Engineering (http://catalog.colostate.edu/general-catalog/colleges/engineering/electrical-computer/phd-electrical-engineering/)

Courses

Electrical and Computer Engineering (ECE)

**ECE 101 Foundations in ECE Credit: 1 (1-0-0)**

Course Description: Introduction to the field of Electrical and Computer Engineering, including exploration of the diversity of technical areas, application of the engineering method, and investigation of a range of potential careers. Hands-on application of technical concepts through completion of an Arduino-based project.

Prerequisite: None.

Registration Information: Sections may be offered: Online.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

**ECE 102 Digital Circuit Logic Credits: 4 (3-2-0)**

Course Description: Fundamentals of digital circuit logic, including Boolean algebra; Karnaugh maps; multiplexers, decoders, ROMS, PLAS, flip-flops, counters; sequential networks; and state tables.

Prerequisite: None.

Registration Information: Must register for lecture and laboratory. Sections may be offered: Online.

Term Offered: Fall, Spring.

Grade Mode: Traditional.

Special Course Fee: Yes.

**ECE 103 DC Circuit Analysis Credits: 3 (2-2-0)**

Course Description: Basic DC circuit analysis, including the use of relevant software to solve problems and analyze results from projects.

Prerequisite: MATH 159 with a minimum grade of C or MATH 160 with a minimum grade of C.

Registration Information: Must register for lecture and laboratory. Sections may be offered: Online.

Term Offered: Fall, Spring.

Grade Mode: Traditional.

Special Course Fee: Yes.

**ECE 202 Circuit Theory Applications Credits: 4 (3-3-0)**

Course Description: Basic circuit analysis techniques and applications to engineering design problems.

Prerequisite: ECE 103 with a minimum grade of C and MATH 161 with a minimum grade of C.

Registration Information: Must register for lecture and laboratory.

Term Offered: Spring, Summer.

Grade Mode: Traditional.

Special Course Fee: Yes.

**ECE 204 Introduction to Electrical Engineering Credits: 3 (3-0-0)**

Course Description: Basic analog and digital circuits and systems; introduction to electromechanical devices.

Prerequisite: MATH 161 and PH 142.

Term Offered: Fall, Spring.

Grade Mode: Traditional.

Special Course Fee: No.

**ECE 232 Introduction to Project Practices Credit: 1 (1-0-0)**

Course Description: Development of project skills and professionalism within the electrical and computer engineering (ECE) discipline through individual and group project work guided by ECE industry leaders.

Prerequisite: ECE 202, may be taken concurrently or ECE 395B, may be taken concurrently or ECE 495B, may be taken concurrently.

Registration Information: Credit not allowed for both ECE 232 and ECE 280A1.

Term Offered: Fall, Spring.

Grade Mode: Traditional.

Special Course Fee: No.

**ECE 251 Introduction to Microcontrollers and IoT Credits: 4 (3-3-0)**

Course Description: Microprocessor organization, Internet of Things (IoT) platforms, microprocessor coding using C and assembly language, I/O techniques, real-time interfaces, and applications.

Prerequisite: ECE 102 with a minimum grade of C.

Registration Information: Must register for lecture and laboratory. Sections may be offered: Online.

Term Offered: Fall, Spring.

Grade Mode: Traditional.

Special Course Fee: Yes.

**ECE 303 Introduction to Communications Principles Credits: 3 (3-0-0)**

Also Offered As: STAT 303.

Course Description: Basic concepts in design and analysis of communication systems.

Prerequisite: MATH 340, may be taken concurrently and MATH 261 with a minimum grade of C.

Registration Information: Sections may be offered: Online. Credit not allowed for both ECE 303 and STAT 303.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.
ECE 311 Linear System Analysis I Credits: 3 (3-0-0)
Course Description: Continuous and discrete time signals and systems representations in time and frequency domain; time convolution.
Prerequisite: (ECE 202 with a minimum grade of C) and (ECE 331, may be taken concurrently and ECE 341, may be taken concurrently or CS 256, may be taken concurrently or ECE 451, may be taken concurrently or ECE 528, may be taken concurrently) and (MATH 340 with a minimum grade of C).
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 312 Linear System Analysis II Credits: 3 (3-0-0)
Course Description: Laplace and Z transforms, applications to modulation, filtering and sampling, state space representation.
Prerequisite: ECE 311 with a minimum grade of C.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 331 Electronics Principles I Credits: 4 (3-3-0)
Course Description: Discrete component semiconductor devices, characteristics and applications. Rectifier circuits, single-stage and multi-stage amplifiers.
Prerequisite: None.
Registration Information: Must register for lecture and laboratory. (ECE 202 with a minimum grade of C; ECE 311, may be taken concurrently; ECE 341, may be taken concurrently; MATH 340 with a minimum grade of C; PH 142 with a minimum grade of C) or (ECE 202 with a minimum grade of C; ECE 311, may be taken concurrently; ECE 451, may be taken concurrently; MATH 340 with a minimum grade of C; PH 142 with a minimum grade of C; or CS 356, may be taken concurrently or ECE 528, may be taken concurrently).
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: Yes.

ECE 332 Electronics Principles II Credits: 4 (3-3-0)
Course Description: Discrete and integrated-circuit amplifiers-frequency response, negative feedback.
Prerequisite: ECE 331 with a minimum grade of C.
Registration Information: Must register for lecture and laboratory.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: Yes.

ECE 340 Electromagnetics for Computer Engineering Credits: 3 (3-0-0)
Course Description: Fundamentals of electromagnetic theory for computer engineering; applications of electromagnetics in VLSI design, silicon photonics, radar, antenna, and communication; vector analysis; static electromagnetic fields; boundary conditions; time-varying electromagnetic field; Maxwell’s equations; connection between circuit theory and electromagnetics; waveguides, and fiber optics.
Prerequisite: ECE 202 with a minimum grade of C and MATH 161 with a minimum grade of C.
Registration Information: Junior standing. Sections may be offered: Online.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: Yes.

ECE 341 Electromagnetic Fields and Devices I Credits: 3 (3-0-0)
Course Description: Basic concepts of electrostatic and magnetostatic fields.
Prerequisite: PH 142 with a minimum grade of C and MATH 340 with a minimum grade of C and ECE 202 with a minimum grade of C and ECE 311, may be taken concurrently and ECE 331, may be taken concurrently.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 342 Electromagnetic Fields and Devices II Credits: 3 (3-0-0)
Course Description: Basic concepts of time varying electromagnetic fields and transmission lines.
Prerequisite: ECE 341 with a minimum grade of C.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 395A Independent Study Credits: Var[1-6] (0-0-0)
Course Description: Development and implementation of a project in an Electrical and Computer Engineering field of special interest under the supervision of a faculty member.
Prerequisite: None.
Registration Information: Contact department for registration. May be taken up to 6 times for credit.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

ECE 395B Independent Study: Open Option Project Credits: Var[1-6] (0-0-0)
Course Description: Students will work on an array of different electrical and computer engineering projects independently or under the guidance of industry mentors. Projects will be initiated by students or outside sources and will consist of small-scale service/outreach projects or market-driven projects that simulate a business environment.
Prerequisite: None.
Registration Information: Contact department for registration. May be taken up to 6 times for credit.
Terms Offered: Fall, Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

ECE 395C Independent Study: Vertically Integrated Project Credits: Var[1-6] (0-0-0)
Course Description: Explore and develop comprehensive applications of electrical and computer engineering technologies as a member of a team, especially as they relate to active research areas of CSU faculty members.
Prerequisite: None.
Registration Information: Contact department for registration. May be taken up to 6 times for credit.
Terms Offered: Fall, Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.
ECE 401 Senior Design Project I Credits: 3 (1-4-0)
Course Description: Advanced project, seminar series, formal written report, and oral presentation.
Prerequisite: None.
Registration Information: Must register for lecture and laboratory. (ECE 312 with a minimum grade of C or (PH 314 with a minimum grade of C and PH 353 with a minimum grade of C); ECE 332 with a minimum grade of C; ECE 342 with a minimum grade of C) or (ECE 311 with a minimum grade of C; 4 courses from the following: CS 356, ECE 312 with a minimum grade of C, ECE 331 with a minimum grade of C, ECE 332 with a minimum grade of C, ECE 450, ECE 451, ECE 452, ECE 456, ECE 528).
Terms Offered: Fall, Spring.
Grade Mode: Traditional.
Special Course Fee: Yes.

ECE 402 Senior Design Project II Credits: 3 (1-4-0)
Course Description: Advanced project, formal report, and oral presentation.
Prerequisite: ECE 401.
Registration Information: Must register for lecture and laboratory.
Terms Offered: Fall, Spring.
Grade Mode: Traditional.
Special Course Fee: Yes.

ECE 403 Intro to Optical Techniques in Biomedical Eng Credits: 3 (3-0-0)
Also Offered As: BIOM 403.
Course Description: Engineering design principles of optical characterization techniques for biomedical systems, including optical spectroscopy and microscopy of biomolecules and tissues.
Prerequisite: CHEM 111 and PH 142 with a minimum grade of C.
Restriction: Must not be a: Freshman, Sophomore.
Registration Information: Junior standing. Sections may be offered: Online. Credit allowed for only one of the following: BIOM 403, BIOM 481A3, ECE 403, or ECE 481A3.
Term Offered: Spring (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 404 Experiments in Optical Electronics Credits: 2 (1-3-0)
Course Description: Experiments in optical electronics and lasers.
Prerequisite: None.
Registration Information: Must have concurrent registration in ECE 441. Must register for lecture and laboratory.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 411 Control Systems Credits: 3 (3-0-0)
Course Description: Control system analysis and design for linear systems: stability and performance; time and frequency domain techniques.
Prerequisite: ECE 312 with a minimum grade of C.
Registration Information: Sections may be offered: Online.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 412 Digital Control and Digital Filters Credits: 3 (3-0-0)
Course Description: FIR and IIR digital filter design, analog and digital invariance and direct digital control algorithms, hybrid systems analysis.
Prerequisite: ECE 411.
Registration Information: Sections may be offered: Online.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 421 Telecommunications I Credits: 3 (3-0-0)
Course Description: Digital communication (source coding; modulation and detection; channel coding), analog communication (modulation).
Prerequisite: (ECE 303 with a minimum grade of C or STAT 303 with a minimum grade of C) and (ECE 312 with a minimum grade of C).
Registration Information: Sections may be offered: Online.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 430 Fourier and Wavelet Analysis with Apps Credits: 3 (3-0-0)
Also Offered As: MATH 430.
Course Description: Fourier analysis and transforms, FFTs; sampling theorems, computational algorithms; wavelets; applications to communication, imaging, and compression.
Prerequisite: MATH 340 or MATH 345.
Registration Information: Credit not allowed for both ECE 430 and MATH 430.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 431 Biomedical Signal and Image Processing Credits: 3 (3-0-0)
Also Offered As: BIOM 431.
Course Description: Principles, features and mathematical processing of biomedical signals and images including interference and noise filtering and feature enhancement.
Prerequisite: (ECE 303 with a minimum grade of C or STAT 303 with a minimum grade of C) and (ECE 311 with a minimum grade of C and PH 142 with a minimum grade of C).
Registration Information: Sections may be offered: Online. Credit not allowed for both BIOM 431 and ECE 431.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 440 Antennas and Radiation Credits: 3 (3-0-0)
Course Description: Retarded potential theory, antenna arrays, long wire antennas, dipoles, aperture antennas, receiving antennas.
Prerequisite: ECE 340 with a minimum grade of C or ECE 342 with a minimum grade of C.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 441 Optical Electronics Credits: 3 (3-0-0)
Course Description: Concepts of modern physics, optical properties of atoms, light sources, lasers, optical detectors, optical cavities, and optical fiber transmission.
Prerequisite: ECE 340 with a minimum grade of C or ECE 342 with a minimum grade of C.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 442 Fourier and Wavelet Analysis with Apps Credits: 3 (3-0-0)
Course Description: Fourier analysis and transforms, FFTs; sampling theorems, computational algorithms; wavelets; applications to communication, imaging, and compression.
Prerequisite: MATH 340 or MATH 345.
Registration Information: Credit not allowed for both ECE 430 and MATH 430.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.
ECE 445 Digital Logic Synthesis Credits: 3 (3-0-0)
Course Description: Application of a top-down design methodology to optimize circuits to achieve better power, performance, timing, and area. Advanced concepts in logic optimization, simulation and testing, and synchronous and asynchronous circuits, as well as a comprehensive review of high-level hardware description languages and the extraction of gate-level circuits from these representations.
Prerequisite: ECE 102 with a minimum grade of C.
Restriction: Must not be a: Freshman, Sophomore.
Registration Information: Junior standing. Sections may be offered: Online. Credit not allowed for both ECE 445 and ECE 480A4.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 450 Digital System Design Laboratory Credit: 1 (0-3-0)
Course Description: Small digital circuits are designed and simulated using very high speed hardware description language and synthesis tools.
Prerequisite: None.
Registration Information: Must have concurrent registration in ECE 451.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 451 Digital System Design Credits: 3 (3-0-0)
Course Description: State machines with PLAs as controllers and small computers; timing and race elimination considerations; state and microprogramming implementation.
Prerequisite: ECE 102 with a minimum grade of C and ECE 202 with a minimum grade of C.
Registration Information: Concurrent registration in ECE 450.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 452 Computer Organization and Architecture Credits: 3 (3-0-0)
Course Description: CPU design; microarchitecture; data path and control path; pipelining; memory system; I/O system; program optimization by system software/hardware.
Prerequisite: CS 270 with a minimum grade of C or ECE 251 with a minimum grade of C.
Registration Information: Sections may be offered: Online.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 455 Introduction to Robot Programming/Simulation Credits: 3 (3-0-0)
Course Description: Fundamentals of simulating and programming of workcells that include robots and other articulated objects.
Prerequisite: CS 152 with a minimum grade of C or CS 162 with a minimum grade of C or CS 163 with a minimum grade of C or CS 164 with a minimum grade of C.
Registration Information: Sections may be offered: Online.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 456 Computer Networks Credits: 4 (3-3-0)
Course Description: Circuit/packet switching, protocols, LAN/MAN, TCP/IP error correction, wireless LANS, mobile networks.
Prerequisite: (CS 152 with a minimum grade of C or CS 162 with a minimum grade of C or CS 163 with a minimum grade of C or CS 164 with a minimum grade of C) and (ECE 251 with a minimum grade of C) and (ECE 303 with a minimum grade of C or STAT 303 with a minimum grade of C) and (ECE 311 with a minimum grade of C).
Registration Information: Must register for lecture and laboratory. Sections may be offered: Online.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 457 Fourier Optics Credits: 3 (3-0-0)
Course Description: Introduction to optical systems for signal and information processing with emphasis on Fourier optics.
Prerequisite: ECE 311 with a minimum grade of C and ECE 342 with a minimum grade of C.
Registration Information: Sections may be offered: Online. Credit not allowed for both ECE 457 and ECE 502.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 461 Power Systems Credits: 3 (3-0-0)
Course Description: Multi-phase power systems; power generation, transformer design, power distribution, power costs.
Prerequisite: ECE 332 with a minimum grade of C.
Registration Information: Must have concurrent registration in ECE 462.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 462 Power Systems Laboratory Credit: 1 (0-3-0)
Course Description: Set of labs designed to enhance students’ understanding of power systems.
Prerequisite: ECE 332 with a minimum grade of C.
Registration Information: Must have concurrent registration in ECE 461.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 465 Electrical Energy Generation Technologies Credits: 3 (3-0-0)
Course Description: Various electrical energy generation alternatives. Comparisons based on cost, reliability, availability and environmental impact.
Prerequisite: ECE 202 with a minimum grade of C.
Registration Information: Sections may be offered: Online.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 466 Integrated Lighting Systems Credits: 3 (3-0-0)
Course Description: Technical underpinnings of light sources, their associated heat sink fixtures and power electronics drivers.
Prerequisite: ECE 331.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.
ECE 471A  Semiconductor Physics  Credit: 1 (1-0-0)
Course Description: Fundamentals of semiconductor electron, hole states and motion: bandgap, effective mass, carrier density, Fermi level, doping, drift and diffusion.
Prerequisite: (MATH 340 or MATH 345) and (PH 142).
Registration Information: This is a partial semester course.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 471B  Semiconductor Junctions  Credit: 1 (1-0-0)
Course Description: Quantitative analysis of field, carrier and current distributions in pn and metal-semiconductor junctions.
Prerequisite: ECE 331 with a minimum grade of C and ECE 471A, may be taken concurrently.
Registration Information: This is a partial semester course.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 495A  Independent Study  Credits: Var[1-6] (0-0-0)
Course Description: Development and implementation of a project in an electrical and computer engineering field of special interest under the supervision of a faculty member.
Prerequisite: None.
Registration Information: Junior standing. Contact department for registration. May be taken up to 6 times for credit.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

ECE 495B  Independent Study: Open Option Project  Credits: Var[1-6] (0-0-0)
Course Description: Students will work on an array of different electrical and computer engineering projects independently or under the guidance of industry mentors. Projects will be initiated by students or outside sources and will consist of small-scale service/outreach projects or market-driven projects that simulate a business environment.
Prerequisite: None.
Registration Information: Junior standing. Contact department for registration. May be taken up to 6 times for credit.
Terms Offered: Fall, Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

ECE 495C  Independent Study: Vertically Integrated Projects  Credits: Var[1-6] (0-0-0)
Course Description: Explore and develop comprehensive applications of electrical and computer engineering technologies as a member of a team, especially as they relate to active research areas of CSU faculty members.
Prerequisite: None.
Registration Information: Junior standing. Contact department for registration. May be taken up to 6 times for credit.
Terms Offered: Fall, Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

ECE 502  Advanced Fourier Optics  Credits: 4 (3-0-1)
Course Description: Introduction to optical systems for signal and information processing with emphasis on Fourier optics. Engineering design principles, models, and computational techniques for forward and inverse transform evaluation.
Prerequisite: ECE 311 with a minimum grade of C and ECE 342 with a minimum grade of C and MATH 340 with a minimum grade of C.
Registration Information: Junior standing. Must register for lecture and recitation. Sections may be offered: Online. Credit not allowed for both ECE 457 and ECE 502.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 503  Ultrafast Optics  Credits: 3 (3-0-0)
Course Description: Principles and theory behind ultrashort pulse generation, amplification, and manipulation.
Prerequisite: (ECE 341) and (ECE 342 or ECE 343).
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 504  Physical Optics  Credits: 3 (3-0-0)
Course Description: Classical optics from first principles; basic electromagnetic theory to wave and geometric guides.
Prerequisite: ECE 342 with a minimum grade of C.
Registration Information: Sections may be offered: Online.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 505  Nanostructures: Fundamentals and Applications  Credits: 3 (3-0-0)
Course Description: Fundamentals of quantum confinement; nanostructures optical properties; fabrication and characterization.
Prerequisite: ECE 342 and PH 353.
Registration Information: Sections may be offered: Online.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 506  Optical Interferometry and Laser Metrology  Credits: 3 (3-0-0)
Course Description: High resolution metrology techniques utilizing and interfacing of interferometric sensors using lasers and other light sources.
Prerequisite: ECE 342 and ECE 441.
Registration Information: Sections may be offered: Online.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 507  Plasma Physics and Applications  Credits: 3 (3-0-0)
Course Description: Fundamental principles and industrial applications of plasmas.
Prerequisite: ECE 342.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.
ECE 512  Digital Signal Processing  Credits: 3 (3-0-0)
Course Description: Discrete time signals and systems, digital filter design and implementation, fast algorithms, quantization effects.
Prerequisite: ECE 312 with a minimum grade of C.
Registration Information: Sections may be offered: Online.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 513  Digital Image Processing  Credits: 3 (3-0-0)
Course Description: Image acquisition and display systems, image enhancement, restoration and encoding, image analysis; real-life applications.
Prerequisite: (ECE 303 with a minimum grade of C or STAT 303 with a minimum grade of C) and (ECE 312 with a minimum grade of C).
Registration Information: Sections may be offered: Online.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 514  Applications of Random Processes  Credits: 3 (3-0-0)
Course Description: Bit-error rates, signal-to-noise power ratios, signal detection, signal estimation, Wiener filters, and applications of these concepts in electrical and computer engineering.
Prerequisite: (ECE 303 with a minimum grade of C or STAT 303 with a minimum grade of C) and (ECE 312 with a minimum grade of C).
Registration Information: Sections may be offered: Online.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 516  Information Theory  Credits: 3 (3-0-0)
Course Description: Information measures and their properties; lossless data compression; channel capacity; channel coding theorem; rate distortion theorem.
Prerequisite: (ECE 303 or STAT 303) and (ECE 421).
Registration Information: Sections may be offered: Online.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 517  Advanced Optical Imaging  Credits: 3 (3-0-0)
Also Offered As: BIOM 517.
Course Description: Engineering design principles of advanced optical imaging techniques and image formation theory.
Prerequisite: ECE 342 with a minimum grade of C or MATH 340 with a minimum grade of C or MATH 345 with a minimum grade of C.
Restriction: Must not be a: Freshman, Sophomore.
Registration Information: Junior standing. Sections may be offered: Online. Credit allowed for only one of the following: BIOM 517, BIOM 581B7, ECE 517 or ECE 581B7.
Term Offered: Fall (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 518  Biophotonics  Credits: 3 (3-0-0)
Also Offered As: BIOM 518.
Course Description: Engineering design principles of optical instrumentation for medical diagnostics. Light propagation and imaging in biological tissues.
Prerequisite: ECE 342 with a minimum grade of C or ECE 457 with a minimum grade of C or MATH 340 with a minimum grade of C or MATH 345 with a minimum grade of C.
Restriction: Must not be a: Freshman, Sophomore.
Registration Information: Junior standing. Sections may be offered: Online. Credit allowed for only one of the following: BIOM 518, BIOM 581A9, ECE 518 or ECE 581A9.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 519  Network Centric Systems  Credits: 3 (2-3-0)
Course Description: Network science concepts, fundamentals of network-centric systems, and case studies.
Prerequisite: (CS 165 with a minimum grade of C) and (ECE 303 with a minimum grade of C or ECE 312 with a minimum grade of C or ECE 421 with a minimum grade of C or ECE 456 with a minimum grade of C or MATH 369 with a minimum grade of C or STAT 303 with a minimum grade of C).
Restriction: Must not be a: Freshman, Sophomore, Junior.
Registration Information: Senior standing. Must register for lecture and laboratory. Sections may be offered: Online. Credit not allowed for both ECE 519 and ECE 581B8.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 520  Optimization Methods-Control & Communication  Credits: 3 (3-0-0)
Course Description: Linear and nonlinear optimization theory and methods; applications in systems, control, and communication.
Prerequisite: (MATH 229 or MATH 369) and (MATH 317).
Registration Information: Sections may be offered: Online.
Term Offered: Spring (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 521  Satellite Communication  Credits: 3 (3-0-0)
Course Description: Principles of satellite communication systems engineering.
Prerequisite: ECE 421.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.
ECE 522  Random Walks  Credits: 3 (3-0-0)
Also Offered As: MATH 522.
Course Description: Mathematical aspects of random walks and diffusion processes. Stochastic modeling of complex systems.
Prerequisite: (ECE 303 with a minimum grade of C or STAT 303 with a minimum grade of C) and (ECE 312 with a minimum grade of C or ECE 457 with a minimum grade of C or MATH 469 with a minimum grade of C).
Restriction: Must not be a: Freshman, Sophomore.
Registration Information: Junior standing. This is a partial semester course. Credit allowed for only one of the following: ECE 522, ECE 681A2, and MATH 522.
Term Offered: Fall (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 523  Electronic Properties of Materials  Credits: 3 (3-0-0)
Also Offered As: MSE 523.
Course Description: Introduction to the electronic properties of materials, including band structures, quantum mechanics and optical characteristics.
Prerequisite: MATH 340 or MATH 345.
Restriction: Must not be a: Freshman, Sophomore, Junior.
Registration Information: Senior standing. Credit allowed for only one of the following: ECE 523, ECE 580B7, ECE 580B8, ECE 580C2, MSE 523, MSE 580B7, MSE 580B8, MSE 580C2.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 526  Biological Physics  Credits: 3 (3-0-0)
Also Offered As: BIOM 526.
Course Description: Mathematical and physical modeling of biological systems. Mass transport in cellular environments. Electrical/mechanical properties of biomolecules.
Prerequisite: (MATH 340 or MATH 345) and (PH 122 or PH 142).
Registration Information: Credit not allowed for both BIOM 526 and ECE 526. Sections may be offered: Online. Credit allowed for only one of the following: BIOM 526, BIOM 581B3, ECE 526, or ECE 581B3.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 527A  Biosensing: Cells as Circuits  Credit: 1 (1-0-0)
Also Offered As: BIOM 527A.
Course Description: Treatment of biological cells as circuits and their electrical time-dependent function and frequency-dependent impedance. Topics include the Hodgkin–Huxley circuit model, diffusion equation, and modeling action potential propagation.
Prerequisite: (BIOM 101 or LIFE 102) and (CHEM 111) and (MATH 340 or MATH 345) and (PH 142).
Registration Information: Junior standing. This is a partial semester course. Credit allowed for only one of the following: BIOM 527A, BIOM 581B1, ECE 527A, or ECE 581B1.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 527B  Biosensing: Signal and Noise in Biosensors  Credit: 1 (1-0-0)
Also Offered As: BIOM 527B.
Course Description: Quantitative treatment of concepts of noise, interference and signal including noise types and spectra, filtering, and limitations imposed by noise. Example applications to Biosensors.
Prerequisite: (MATH 340, may be taken concurrently or MATH 345, may be taken concurrently) and (PH 142).
Registration Information: Junior standing. This is a partial semester course. Credit allowed for only one of the following: BIOM 527B, BIOM 581B2, ECE 527B, or ECE 581B2.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 527C  Biosensing: Sensor Circuit Fundamentals  Credit: 1 (1-0-0)
Also Offered As: BIOM 527C.
Course Description: Introduction to circuit concepts used in sensors, including review of basic circuit elements of resistors, capacitors, and MOS (Metal-Oxide-Semiconductor transistors) elements. Fundamentals of the application of MOS circuits for signal conditioning and amplification and how sensor's backend signal processing is carried out after the sensor signal transduction stage.
Prerequisite: (BIOM 101 or LIFE 102) and (MATH 340, may be taken concurrently or MATH 345, may be taken concurrently) and (PH 142).
Registration Information: Junior standing. This is a partial semester course. Credit allowed for only one of the following: BIOM 527C, BIOM 581B3, ECE 527C, or ECE 581B3.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 527D  Biosensing: Electrochemical Sensors  Credit: 1 (1-0-0)
Also Offered As: BIOM 527D.
Course Description: Introduction to the electrochemistry, and applications of electrochemical methods, used for detection of certain classes of chemicals and molecules.
Prerequisite: (BIOM 101 or LIFE 102) and (CHEM 111) and (MATH 255 or MATH 261) and (PH 142).
Registration Information: Junior standing. This is a partial semester course. Credit allowed for only one of the following: BIOM 527D, BIOM 581B5, ECE 527D, or ECE 581B5.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 527E  Biosensing: Affinity Sensors  Credit: 1 (1-0-0)
Also Offered As: BIOM 527E.
Course Description: Fundamentals of affinity sensor application and design, including optical and electrical approaches and technologies.
Prerequisite: (BIOM 101 or LIFE 102) and (CHEM 111) and (MATH 340, may be taken concurrently or MATH 345, may be taken concurrently) and (PH 142).
Registration Information: Junior standing. This is a partial semester course. Credit allowed for only one of the following: BIOM 527E, BIOM 581B4, ECE 527E, or ECE 581B4.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.
ECE 527F  Biosensing: Biophotonic Sensors Using Refractive Index  Credit: 1 (0-0-0)
Also Offered As: BIOM 527F.
Course Description: Operating principles of optical biosensors based on changes in refractive index, such as thin films, ring-resonators, Mach-Zehnder interferometers, and other evanescent wave sensors. Basic supporting optical concepts, including thin-film interference, optical waveguides and evanescent waves.
Prerequisite: (BIOM 527E or ECE 527E) and (MATH 340, may be taken concurrently or MATH 345, may be taken concurrently) and (PH 142).
Registration Information: Junior standing. This is a partial semester course. Credit allowed for only one of the following: BIOM 527F, BIOM 581B6, ECE 527F, or ECE 581B6.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 528  Embedded Systems and Machine Learning  Credits: 4 (3-2-0)
Also Offered As: CS 528.
Course Description: Machine learning for embedded computing systems; hardware/software optimizations for machine learning; hardware accelerators for deep learning; data reuse and sharing techniques; memory and network design for machine learning acceleration; anomaly detection and adversarial learning; advanced applications of machine learning in embedded applications.
Prerequisite: CS 270 with a minimum grade of C or ECE 251 with a minimum grade of C.
Restriction: Must not be a: Freshman, Sophomore.
Registration Information: Junior standing. Must register for lecture and laboratory. Sections may be offered: Online. Credit allowed for only one of the following: CS 528, CS 581C1, ECE 528, or ECE 581C1.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 532  Dynamics of Complex Engineering Systems  Credits: 3 (3-0-0)
Also Offered As: SYSE 532.
Course Description: Higher-level behavior and issues that emerge from interaction between components in complex socio-technical systems.
Prerequisite: ECE 501, may be taken concurrently or ENGR 501, may be taken concurrently or SYSE 501, may be taken concurrently.
Registration Information: Sections may be offered: Online. Credit allowed for only one of the following: ECE 532, ENGR 532, or SYSE 532.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 534  Analog Integrated Circuit Design  Credits: 3 (3-0-0)
Course Description: Design methods for state-of-the-art analog integrated circuits including CMOS op-amps, comparators, and phase-locked loops.
Prerequisite: ECE 332 with a minimum grade of C.
Registration Information: Must have concurrent registration in ECE 535. Sections may be offered: Online.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 535  Analog Integrated Circuit Laboratory  Credit: 1 (0-0-0)
Course Description: Analog integrated circuits are designed and simulated using modern software tools.
Prerequisite: None.
Registration Information: Must have concurrent registration in ECE 534. Sections may be offered: Online.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 536  RF Integrated Circuit Design  Credits: 3 (3-0-0)
Course Description: Design of state-of-the-art ICs for RF applications including CMOS low-noise amplifiers, voltage-controlled oscillators, mixers and power amplifiers.
Prerequisite: ECE 332.
Registration Information: Sections may be offered: Online.
Term Offered: Fall (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 537  Biomedical Signal Processing  Credits: 3 (3-0-0)
Also Offered As: BIOM 537.
Course Description: Modeling and classification of biosignals (e.g. EEG, ECG, EMG), covering adaptive filtering, wavelets, support vector machines, neural networks, and handling problems with overfitting of noisy data.
Prerequisite: ECE 303 or ECE 311 or MATH 340 or STAT 303.
Registration Information: Sections may be offered: Online. Credit not allowed for both BIOM 537 and ECE 537.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 538  Design/Analysis of Analog Digital Interface  Credits: 4 (3-3-0)
Course Description: Topics of interface circuit designs analog and digital interfaces. Basic concept of designing and analyzing analog and digital interface circuits.
Prerequisite: ECE 312 with a minimum grade of C and ECE 332 with a minimum grade of C and ECE 451 with a minimum grade of C.
Registration Information: Must register for lecture and laboratory.
Terms Offered: Fall, Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 540  Computational Electromagnetics  Credits: 3 (3-0-0)
Course Description: Computational techniques for practical applications in electromagnetic fields, devices, scattering, propagation, and radiation.
Prerequisite: ECE 340 with a minimum grade of C or ECE 342 with a minimum grade of C.
Restriction: Must not be a: Freshman, Sophomore.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.
ECE 541 Applied Electromagnetics  Credits: 3 (3-0-0)
Course Description: High- and low-frequency electromagnetics, wave propagation, radiation, and scattering, wireless and guided-wave systems, bioelectromagnetics.
Prerequisite: ECE 340 with a minimum grade of C or ECE 342 with a minimum grade of C.
Restriction: Must not be a: Freshman, Sophomore.
Registration Information: Credit not allowed for both ECE 541 and ECE 580B5.
Term Offered: Fall (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 549 Radar Systems and Design  Credits: 3 (3-0-0)
Course Description: Fundamental ideas of radar operation and basic design of various radar types including current topics.
Prerequisite: ECE 340 with a minimum grade of C or ECE 342 with a minimum grade of C.
Registration Information: Sections may be offered: Online.
Term Offered: Spring (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 554 Computer Architecture  Credits: 3 (3-0-0)
Course Description: Fundamentals of computer design, multiprocessors and thread-level parallelism, storage systems, and interconnection networks and clusters.
Prerequisite: ECE 452 or CS 470.
Registration Information: Sections may be offered: Online.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 555 Advanced Robotics—Redundancy & Optimization  Credits: 3 (3-0-0)
Course Description: Advanced analysis, design, and control of kinematically redundant articulated objects, including both robotic and biological systems.
Prerequisite: ECE 455 and MATH 369.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 556 AI for Radar and Remote Sensing  Credits: 3 (3-0-0)
Course Description: Radar and remote sensing using techniques from artificial intelligence (AI) and data science, with applications to areas such as precipitation observation, identification, classification, estimation, and prediction.
Prerequisite: (CS 152 with a minimum grade of C or CS 162 with a minimum grade of C or CS 163 with a minimum grade of C or CS 164 with a minimum grade of C) and (ECE 303 with a minimum grade of C or STAT 303 with a minimum grade of C) and (MATH 369 with a minimum grade of C) or (ECE 303 with a minimum grade of C or STAT 303 with a minimum grade of C) and (MATH 369 with a minimum grade of C).
Restriction: Must not be a: Freshman, Sophomore.
Registration Information: Junior standing. Sections may be offered: Online. Credit not allowed for both ECE 556 and ECE 580C3.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 557 Manycore System Design Using Machine Learning  Credits: 3 (3-0-0)
Course Description: Fundamentals of manycore system design and electronic design automation (EDA). Design problems created by increased complexity and specialization of modern manycore systems and an exploration of traditional solutions, their deficiencies, and how machine learning can be utilized to address these problems.
Prerequisite: (PH 141) and (ECE 303 with a minimum grade of C or MATH 369 with a minimum grade of C) or (CS 163 with a minimum grade of C) or (CS 164 with a minimum grade of C).
Restriction: Must not be a: Freshman, Sophomore.
Registration Information: Junior standing. Sections may be offered: Online. Credit not allowed for both ECE 557 and ECE 580B9.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.
ECE 560  Foundations of Fine-Grain Parallelism  Credits: 4 (3-2-0)
Also Offered As: CS 560.
Prerequisite: CS 451.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 561  Hardware/Software Design of Embedded Systems  Credits: 4 (3-3-0)
Also Offered As: CS 561.
Course Description: Embedded systems design including system level modeling, design space exploration, hardware-software partitioning, high level synthesis.
Prerequisite: CS 270 or CS 470 or ECE 251 or ECE 452.
Registration Information: Must register for lecture and laboratory. Credit not allowed for both CS 561 and ECE 561. Sections may be offered: Online.
Term Offered: Spring (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 562  Power Electronics I  Credits: 3 (3-0-0)
Course Description: Switch mode and resonant converters, control using switch averaged dynamic models, modeling of all circuit components including sources, loads, and switches.
Prerequisite: ECE 332 with a minimum grade of C.
Registration Information: Sections may be offered: Online.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 565  Electrical Power Engineering  Credits: 3 (3-0-0)
Also Offered As: ENGR 565.
Course Description: Analysis of power systems in terms of current, voltage, and active/reactive power; introduction of computer-aided tools for power systems.
Prerequisite: (ECE 332 with a minimum grade of C) and (ECE 340 with a minimum grade of C or ECE 342 with a minimum grade of C).
Restriction: Must not be a: Freshman, Sophomore.
Registration Information: Sections may be offered: Online. Credit not allowed for both ECE 565 and ENGR 565.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 566  Grid Integration of Wind Energy Systems  Credits: 3 (3-0-0)
Course Description: Aspects of integration of wind energy conversion systems (WECS) to electric power transmission grids.
Prerequisite: ECE 461 and ECE 462 or ECE 565.
Restriction: Must not be a: Freshman, Sophomore.
Registration Information: Sections may be offered: Online. Credit not allowed for both ECE 566 and ENGR 566.
Term Offered: Spring (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 569  Micro-Electro-Mechanical Devices  Credits: 3 (3-0-0)
Also Offered As: MECH 569.
Course Description: Micro-electro-mechanical processes and applications in sensors, optics, and structures.
Prerequisite: ECE 331 with a minimum grade of C or MECH 344 with a minimum grade of C.
Registration Information: Credit not allowed for both ECE 569 and MECH 569. Sections may be offered: Online.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 571  VLSI System Design  Credits: 3 (3-0-0)
Course Description: Design of integrated circuits at the system level including cell design, digital systems, parallel architecture, systolic arrays.
Prerequisite: ECE 451.
Registration Information: Must have concurrent registration in ECE 575.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 572  Semiconductor Transistors  Credit: 1 (1-0-0)
Course Description: Quantitative analysis of electric field, carrier and current distributions in MOSFETs and bipolar junction transistors; scaling, non-idealities.
Prerequisite: (ECE 331 with a minimum grade of C) and (ECE 415, may be taken concurrently or ECE 471B).
Registration Information: This is a partial semester course.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 573  Semiconductor Optoelectronics Laboratory  Credits: 3 (1-4-0)
Course Description: Experimental characterization techniques for semiconductor optoelectronic devices and design and testing of related electronic circuits.
Prerequisite: ECE 471B.
Registration Information: Must register for lecture and laboratory.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 574  Optical Properties in Solids  Credits: 3 (3-0-0)
Course Description: Light propagation and interaction with materials; linear and non-linear optical properties.
Prerequisite: ECE 441 with a minimum grade of C.
Registration Information: Sections may be offered: Online.
Term Offered: Spring (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 575  Experiments in VLSI System Design I  Credit: 1 (0-3-0)
Course Description: Set of labs designed to enhance students’ understanding of the materials in ECE 571.
Prerequisite: ECE 451.
Registration Information: Must have concurrent registration in ECE 571.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
<th>Term Offered</th>
<th>Registration Information</th>
<th>Restriction</th>
<th>Prerequisite</th>
<th>Course Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 578</td>
<td>Satellite Data Analysis</td>
<td>3</td>
<td>(3-0-0)</td>
<td>S/U Sat/Unsat Only</td>
<td>Traditional</td>
<td>ECE 312 or ECE 456</td>
<td>Broad exposure to a variety of traditional and modern statistical methods for filtering and analyzing satellite data and imagery. Topics include fundamentals in statistics, time-series analysis, filter design, image processing techniques, spatial analysis of data fields such as principal component analysis, cluster analysis, etc. Solve common data analysis problems in satellite remote sensing.</td>
</tr>
<tr>
<td>ECE 579</td>
<td>Global Navigation Satellite Systems</td>
<td>3</td>
<td>(3-0-0)</td>
<td>Traditional</td>
<td>Graduate</td>
<td>ECE 312 or ECE 456</td>
<td>Provides a fundamental understanding of Global Navigation Satellite Systems (GNSS), including GNSS satellite constellations, satellite orbits, ground monitoring stations functions, GNSS receivers, GNSS measurement errors and correction techniques, recent advancements in GPS and other international GNSS, and applications of GNSS. Learn to use a variety of GNSS receivers to collect data, to compute receiver position, velocity, and time, and to analyze GNSS data.</td>
</tr>
<tr>
<td>ECE 587</td>
<td>Internship</td>
<td>Var[1-6]</td>
<td>(0-0-0)</td>
<td>Traditional</td>
<td>Graduate</td>
<td>ECE 312 or ECE 456</td>
<td>Internship experience in Electrical or Computer Engineering.</td>
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<tr>
<td>ECE 604</td>
<td>Nonlinear Optics</td>
<td>3</td>
<td>(3-0-0)</td>
<td>Traditional</td>
<td>Graduate</td>
<td>ECE 312 or ECE 456</td>
<td>Principles of nonlinear optics, symmetry properties, multiple order nonlinear phenomenon, and nonlinear spectroscopy.</td>
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<tr>
<td>ECE 611</td>
<td>Nonlinear Control Systems</td>
<td>3</td>
<td>(3-0-0)</td>
<td>Traditional</td>
<td>Graduate</td>
<td>ECE 312 or ECE 456</td>
<td>Controller analysis and design for nonlinear systems.</td>
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<tr>
<td>ECE 612</td>
<td>Robust Control Systems</td>
<td>3</td>
<td>(3-0-0)</td>
<td>Traditional</td>
<td>Graduate</td>
<td>ECE 312 or ECE 456</td>
<td>Introduction to modern robust control theory techniques for analysis and design of large-scale uncertain multivariable systems.</td>
</tr>
<tr>
<td>ECE 614</td>
<td>Principles of Digital Communications</td>
<td>3</td>
<td>(3-0-0)</td>
<td>Traditional</td>
<td>Graduate</td>
<td>ECE 312 or ECE 456</td>
<td>Information theory, optimal receiver design, waveform coding, error correcting coding.</td>
</tr>
<tr>
<td>ECE 621</td>
<td>Estimation and Filtering Theory</td>
<td>3</td>
<td>(3-0-0)</td>
<td>Traditional</td>
<td>Graduate</td>
<td>ECE 312 or ECE 456</td>
<td>Linear and Nonlinear parameter and state estimation methods; Optimal Kalman state estimation and applications.</td>
</tr>
<tr>
<td>ECE 641</td>
<td>Electromagnetics</td>
<td>3</td>
<td>(3-0-0)</td>
<td>Traditional</td>
<td>Graduate</td>
<td>ECE 312 or ECE 456</td>
<td>Fundamental principles of short wavelength electromagnetic radiation.</td>
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<tr>
<td>ECE 642</td>
<td>Time Harmonic Electromagnetics</td>
<td>3</td>
<td>(3-0-0)</td>
<td>Traditional</td>
<td>Graduate</td>
<td>ECE 312 or ECE 456</td>
<td>Maxwell's equations, radiation, boundary value problem, dyadic Green's functions, scattering theory.</td>
</tr>
<tr>
<td>ECE 650</td>
<td>Extreme Ultraviolet and Soft X-Ray Radiation</td>
<td>3</td>
<td>(3-0-0)</td>
<td>Traditional</td>
<td>Graduate</td>
<td>ECE 312 or ECE 456</td>
<td>Fundamental principles of short wavelength electromagnetic radiation.</td>
</tr>
<tr>
<td>ECE 652</td>
<td>Estimation and Filtering Theory</td>
<td>3</td>
<td>(3-0-0)</td>
<td>Traditional</td>
<td>Graduate</td>
<td>ECE 312 or ECE 456</td>
<td>Linear and Nonlinear parameter and state estimation methods; Optimal Kalman state estimation and applications.</td>
</tr>
</tbody>
</table>
ECE 653  Detection Theory  Credits: 3 (3-0-0)
Course Description: Neyman-Pearson and Bayes detectors and
properties, matched filter and matched subspace detectors, distributed
detection, and applications.
Prerequisite: ECE 652.
Restriction: Must be a: Graduate, Professional.
Registration Information: Credit not allowed for both ECE 651 and ECE 653.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 656  Machine Learning and Adaptive Systems  Credits: 3 (3-0-0)
Course Description: Adaptive system theory, statistical pattern
recognition, supervised and unsupervised learning, support vector
machines, manifold learning, applications.
Prerequisite: ECE 512.
Restriction: Must be a: Graduate, Professional.
Registration Information: Sections may be offered: Online.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 658  Internet Engineering  Credits: 4 (3-3-0)
Also Offered As: CS 658.
Course Description: Link technologies, multiple access, hardware and
software for internetworks routing, switching flow control, multicast,
performance, and applications.
Prerequisite: ECE 456 or CS 457.
Restriction: Must be a: Graduate, Professional.
Registration Information: Must register for lecture and laboratory.
Sections may be offered: Online. Credit not allowed for both ECE 658 and CS 658.
Term Offered: Fall (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 661  Advanced Topics in Embedded Systems  Credits: 4 (3-3-0)
Course Description: Embedded systems design: networks on chip, novel
memory architectures, synthesis algorithms, optimization for low power,
fault tolerance, security.
Prerequisite: (ECE 452) and (ECE 561 or CS 561).
Restriction: Must be a: Graduate, Professional.
Registration Information: Must register for lecture and laboratory.
Sections may be offered: Online.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 666  Topics in Robotics  Credits: 3 (3-0-0)
Course Description: Recent advances in robotics, automation, and
intelligent systems.
Prerequisite: ECE 455.
Restriction: Must be a: Graduate, Professional.
Term Offered: Spring (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 670B  Topics in Architecture/Systems: Performance Evaluation and
Modeling  Credits: Var[1-4] (0-0-0)
Also Offered As: CS 670B.
Course Description:
Prerequisite: ECE 554 or CS 570.
Restriction: Must be a: Graduate, Professional.
Registration Information: Credit not allowed for both CS 670B and
ECE 670B.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 670C  Topics in Architecture/Systems: Distributed Systems  Credits:
Var[1-4] (0-0-0)
Also Offered As: CS 670C.
Course Description:
Prerequisite: ECE 554 or CS 570.
Restriction: Must be a: Graduate, Professional.
Registration Information: Credit not allowed for both CS 670C and
ECE 670C.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 670D  Topics in Architecture/Systems: Architecture of Advanced
Systems  Credits: Var[1-4] (0-0-0)
Also Offered As: CS 670D.
Course Description:
Prerequisite: ECE 554 or CS 570.
Restriction: Must be a: Graduate, Professional.
Registration Information: Credit not allowed for both CS 670D and
ECE 670D.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 673  Thin Film Growth  Credits: 3 (3-0-0)
Course Description: Microstructures of physically vapor-deposited
films; thin-film morphological development; atomistic processes of
condensation, nucleation, and growth.
Prerequisite: CHEM 474 or CHEM 476 or MECH 337 or PH 361 or PH 531.
Restriction: Must be a: Graduate, Professional.
Registration Information: Sections may be offered: Online.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 695  Independent Study  Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

ECE 697  Group Study  Credits: Var[1-6] (0-0-0)
Also Offered As: ENGR 697.
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Registration Information: Credit not allowed for both ECE 697 and
ENGR 697.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Traditional.
Special Course Fee: No.
ECE 699  Thesis  Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

ECE 742  Topics in Electromagnetics  Credits: 3 (3-0-0)
Course Description: Applications of wave propagation and scattering to microwave radar, Doppler radar, meteorological radar applications.
Prerequisite: ECE 641.
Restriction: Must be a: Graduate, Professional.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 752  Topics in Signal Processing  Credits: 3 (3-0-0)
Course Description: Adaptive filtering, spectral estimation, sonar/radar signal processing, and detection/classification schemes.
Prerequisite: (ECE 512) and (ECE 514 or STAT 525).
Restriction: Must be a: Graduate, Professional.
Grade Mode: Traditional.
Special Course Fee: No.

ECE 777  X-Ray Lasers  Credits: 3 (3-0-0)
Course Description: Fundamentals, design, and implementation of soft X-ray lasers and X-ray optics.
Prerequisite: ECE 546.
Restriction: Must be a: Graduate, Professional.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

ECE 795  Independent Study  Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

ECE 799  Dissertation  Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.