ELECTRICAL AND COMPUTER ENGINEERING (E C E)

E C E 1 — COOPERATIVE EDUCATION PROGRAM
1 credit.
Work experience which combines classroom theory with practical knowledge of operations to provide students with a background upon which to base a professional career. Enroll Info: So st
Requisites: None
Course Designation: Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2019

E C E 203 — SIGNALS, INFORMATION, AND COMPUTATION
3 credits.
Introduction to the signals, information, and computational techniques in electrical engineering. Enroll Info: None
Requisites: MATH 211, 217, 221, or 275
Repeatable for Credit: No
Last Taught: Summer 2019

E C E 210 — INTRODUCTORY EXPERIENCE IN ELECTRICAL ENGINEERING
2 credits.
An introduction to electrical and electronic devices, circuits and systems including software and hardware focusing on a real-world project. Enroll Info: Advanced math competence - algebra, trigonometry or suitable placement scores
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 219 — ANALYTICAL METHODS FOR ELECTROMAGNETICS ENGINEERING
1 credit.
Reviews basic calculations in electromagnetic engineering upon which all higher level concepts and physical model construction are based. It emphasizes quantitative calculation mastery in three spatial dimensions and/or time-frequency analysis. Applies analysis tools from vector calculus and complex exponentials to the calculation and prediction of electrical system properties. Examples include calculating electric and magnetic fields, electric potentials, or electric flux from change or current sources, and calculating the amplitudes and phases of electric or magnetic fields due to time-oscillating sources. Enroll Info: MATH 234 or concurrent registration; ECE 203 or concurrent registration
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 220 — ELECTRODYNAMICS I
3 credits.
Potential theory; static and dynamic electric and magnetic fields; macroscopic theory of dielectric and magnetic materials; Maxwell's equations; boundary conditions; wave equation; introduction to transmission lines. Enroll Info: PHYSICS 202, ECE 219; ECE 230 or concurrent registration
Requisites: None
Repeatable for Credit: No
Last Taught: Summer 2019

E C E 230 — CIRCUIT ANALYSIS
4 credits.
Kirchhoff's laws, resistive circuits, equivalent circuits using Thevenin-Norton theories, small signal analysis, dc operating point, first-order circuits, second-order circuits, SPICE and circuit simulation methods, sinusoidal steady state, phasors, poles and zeros of network functions, ideal transformed linear and non-linear two-port networks. Enroll Info: MATH 222, PHYSICS 202
Requisites: None
Repeatable for Credit: No
Last Taught: Summer 2019

E C E/PHYSICS 235 — INTRODUCTION TO SOLID STATE ELECTRONICS
3 credits.
An introduction to the physical principles underlying solid-state electronic and photonic devices, including elements of quantum mechanics, crystal structure, semiconductor band theory, carrier statistics, and band diagrams. Offers examples of modern semiconductor structures. Enroll Info: Open to Fr. MATH 222 PHYSICS 202
Requisites: None
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2019

E C E/COMP SCI 252 — INTRODUCTION TO COMPUTER ENGINEERING
2 credits.
Logic components built with transistors, rudimentary Boolean algebra, basic combinational logic design, basic synchronous sequential logic design, basic computer organization and design, introductory machine- and assembly-language programming. Enroll Info: None
Requisites: None
Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 270 — CIRCUITS LABORATORY I
1 credit.
Experiments cover Kirchhoff's laws, inductors, basic operational amplifier circuits, and frequency response. Enroll Info: ECE 170; ECE 230 or con reg
Requisites: None
Repeatable for Credit: No
Last Taught: Summer 2019
E C E 271 — CIRCUITS LABORATORY II
1 credit.
Experiments cover electronic device characteristics, limitations and applications of operational amplifiers, and feedback circuits. Enroll Info: ECE 270; ECE 340 or con reg
Requisites: None
Repeatable for Credit: No
Last Taught: Summer 2019

E C E 303 — INTRODUCTION TO REAL-TIME DIGITAL SIGNAL PROCESSING
2 credits.
Real-Time Digital Signal Processing* emphasizes the implementation of DSP algorithms on a digital signal processor in “real-time.” Many of the signal processing algorithms that were used in ECE203 will be reviewed in Matlab and then will be implemented on a floating point signal processor in “real-time” using the C programing language. You will explore many basic digital signal processing processes in real-time. Followed by a student chosen project. You will gain the ability to create and develop your own Digital Signal Processing projects for a modern digital signal processor using an Integrated Development Environment. Lab hardware will be provided. Enroll Info: ECE 203
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 304 — ELECTRIC MACHINES LABORATORY
1 credit.
Terminal characteristics of electric machines, elements of speed control, voltage regulation, and applications in systems. Emphasis on the experimental approach to the solution of complex physical problems. Enroll Info: ECE 271; ECE 355 or con reg
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 305 — SEMICONDUCTOR PROPERTIES LABORATORY
1 credit.
Introduction to some fundamental properties of semiconductor materials and devices through the use of characterization techniques common in modern electronic industry. These concepts include: charge carriers; energy bands; space charge regions; carrier drift, diffusion and recombination; light emission; and lattice vibrations. Enroll Info: ECE 271; ECE 335 or con reg
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 306 — LINEAR ACTIVE CIRCUITS LABORATORY
1 credit.
Direct coupled and operational amplifier characteristics; applications of feedback; practical aspects. Enroll Info: ECE 271; ECE 342 or con reg
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2018

E C E 308 — NONLINEAR ELECTRONIC CIRCUITS LABORATORY
1 credit.
An experimental study of selected nonlinear electronic circuits and devices using diodes, transistors, op-amps, timers, data converters, and logic components. Enroll Info: ECE 271; ECE 342 or con reg
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2017

E C E 313 — OPTOELECTRONICS LAB
1 credit.
Light detection using photovoltaic and photoconductive detectors and phototransistors. Light generation using light emitting diodes and laser diodes. Light transmission using optical fibers. Optoisolators and optical switches. Light emitting diode and liquid crystal displays. Enroll Info: ECE 271; 340; or cons inst
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 315 — INTRODUCTORY MICROPROCESSOR LABORATORY
1 credit.
Software and hardware experiments with a microcomputer system. Assembly language programming, simple input/output interfacing, and interrupt processing in microcomputer systems. Concurrent registration in 353 is allowed if 315 is taken second half of semester. Enroll Info: None
Requisites: E C E 353
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 317 — SENSORS LABORATORY
1 credit.
A hands-on introduction to a variety of different sensor types. Labs incorporate implementation concerns involving interference, isolation, linearity, amplification, and grounding. Enroll Info: ECE 271, ECE 340 or cons inst
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 320 — ELECTRODYNAMICS II
3 credits.
Static and dynamic electromagnetic fields; forces and work in electromechanical systems; magnetic circuits; plane wave propagation; reflection of plane waves; generalized transmission line equations; current and voltage on transmission lines; impedance transformation and matching, Smith charts. Enroll Info: ECE 220; MATH 319 or 320 or concurrent registration, or consent of instructor
Requisites: None
Repeatable for Credit: No
Last Taught: Summer 2019
ECE 330 — SIGNALS AND SYSTEMS
3 credits.

Time-domain response and convolution; frequency-domain response using Fourier series, Fourier transform, Laplace transform; discrete Fourier series and transform; sampling; z-transform; relationships between time and frequency descriptions of discrete and continuous signals and systems. Enroll Info: ECE 203, ECE 230 or equivalent
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

ECE 331 — INTRODUCTION TO RANDOM SIGNAL ANALYSIS AND STATISTICS
3 credits.

Introduction to probability, random variables, and random processes. Confidence intervals, introduction to experimental design and hypothesis testing. Statistical averages, correlation, and spectral analysis for wide sense stationary processes. Random signals and noise in linear systems. Enroll Info: ECE 330
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

ECE 332 — FEEDBACK CONTROL SYSTEMS
3 credits.

Modeling of continuous systems; computer-aided solutions to systems problems; feedback control systems; stability, frequency response and transient response using root locus, frequency domain and state variable methods. Enroll Info: ECE 330
Requisites: None
Repeatable for Credit: No
Last Taught: Summer 2019

ECE 334 — STATE SPACE SYSTEMS ANALYSIS
3 credits.

Analysis of systems using matrix methods to write and solve state-variable differential equations. Additional topics include stability, controllability, observability, state feedback, observers, and dynamic output feedback. Enroll Info: MATH 320 or 340 or con reg
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2017

ECE 335 — MICROELECTRONIC DEVICES
3 credits.

Characteristics of semiconductors; study of physical mechanisms and circuit modeling of solid state electronic and photonic devices; principles of microelectronic processing and examples of integrated circuits. Enroll Info: ECE 220, ECE 230, and ECE/PHYSICS 235
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

ECE 340 — ELECTRONIC CIRCUITS I
3 credits.

Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

ECE 342 — ELECTRONIC CIRCUITS II
3 credits.

A second course in modeling and application of semiconductor devices and integrated circuits. Advanced transistor amplifier analysis, including feedback effects. Design for power amplifiers, op-amps, analog filters, oscillators, A/D and D/A converters, and power converters. Introduction to transistor level design of CMOS digital circuits. Enroll Info: ECE 340
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

ECE/COMP SCI 352 — DIGITAL SYSTEM FUNDAMENTALS
3 credits.

Logic components, Boolean algebra, combinational logic analysis and synthesis, synchronous and asynchronous sequential logic analysis and design, digital subsystems, computer organization and design. Enroll Info: None
Requisites: Satisfied Quantitative Reasoning (QR) A requirement and ECE/COMP SCI 252
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2019

ECE 353 — INTRODUCTION TO MICROPROCESSOR SYSTEMS
3 credits.

Introduction to architecture, operation, and application of microprocessors; microprocessor programming; address decoding; system timing; parallel, serial, and analog I/O; interrupts and direct memory access; interfacing to static and dynamic RAM; microcontrollers. Enroll Info: ECE 352, COMP SCI/ECE 354, ECE 340 or concurrent registration
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019
E C E/COMP SCI 354 — MACHINE ORGANIZATION AND PROGRAMMING
3 credits.

An introduction to fundamental structures of computer systems and the C programming language with a focus on the low-level interrelationships and impacts on performance. Topics include the virtual address space and virtual memory, the heap and dynamic memory management, the memory hierarchy and caching, assembly language and the stack, communication and interrupts/signals, compiling and assemblers/linkers. Enroll Info: None
Requisites: E C E/COMP SCI 252 and (COMP SCI 300 or 302) or graduate/professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 355 — ELECTROMECHANICAL ENERGY CONVERSION
3 credits.

Energy storage and conversion, force and emf production, coupled circuit analysis of systems with both electrical and mechanical inputs. Applications to electric motors and generators and other electromechanical transducers. Enroll Info: ECE 230, ECE 320
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2019

E C E 356 — ELECTRIC POWER PROCESSING FOR ALTERNATIVE ENERGY SYSTEMS
3 credits.

Introduction to electrical power processing technologies that are necessary to convert energy from alternative sources into useful electrical forms. Several specific alternative energy sources are examined, providing platforms for introducing basic concepts in power electronics, electric machines, and adjustable-speed drives. Enroll Info: ECE 230 or ECE 376 or equiv or cons inst
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2018

E C E 370 — ADVANCED LABORATORY
2 credits.

Experiments related to the required core material. Enroll Info: ECE 271, ECE 320, ECE 330, ECE 335, ECE 351
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 376 — ELECTRICAL AND ELECTRONIC CIRCUITS
3 credits.

DC and AC electrical circuit analysis methods, and analog and digital circuit design and analysis including operational amplifier linear circuits, digital combinational logic circuits, and computer interface circuits which combine both digital and analog devices for interfacing physical systems. Includes five laboratory sessions. Enroll Info: MATH 222 PHYSICS 202
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 377 — FUNDAMENTALS OF ELECTRICAL AND ELECTROMECHANICAL POWER CONVERSION
3 credits.

Fundamentals of electromagnetic induction and application to transformers and induction heating; Lorentz forces with a focus on the operation and control of DC and AC motors and linear actuators; electrical power conversion using power electronics for motor drives and direct power converters. Includes five laboratory sessions. Enroll Info: MATH 234, familiarity with ordinary differential equations, PHYSICS 202
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 379 — SPECIAL TOPICS IN ELECTRICAL AND COMPUTER ENGINEERING
1-4 credits.

Topics of special interest to undergrads in electrical and computer engineering. Enroll Info: So St and cons inst
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2019

E C E 399 — INDEPENDENT STUDY
1-3 credits.

Enroll Info: None
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2019

E C E 401 — ELECTRO-ACOUSTICAL ENGINEERING
3 credits.

Principles of plane and spherical sound waves; acoustical, mechanical, and electrical analogies; electroacoustic transducer materials and techniques; specific types of transducers such as microphones and loudspeakers. Enroll Info: None
Requisites: E C E 330
Repeatable for Credit: No
Last Taught: Spring 2019
ECE 411 — INTRODUCTION TO ELECTRIC DRIVE SYSTEMS
3 credits.
Basic concepts of electric drive systems. Emphasis on system analysis and application. Topics include: dc machine control, variable frequency operation of induction and synchronous machines, unbalanced operation, scaling laws, adjustable speed drives, adjustable torque drives, coupled circuit modelling of ac machines. Enroll Info: ECE 355
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

ECE 412 — POWER ELECTRONIC CIRCUITS
3 credits.
Operating characteristics of power semiconductor devices such as Bipolar Junction Transistors, IGBTs, MOSFETs and Thyristors. Fundamentals of power converter circuits including dc/dc converters, phase controlled ac/dc rectifiers and dc/ac inverters. Practical issues in the design and operation of converters. Course available on videotape. Enroll Info: ECE 342 or equiv or cons inst
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

ECE 420 — ELECTROMAGNETIC WAVE TRANSMISSION
3 credits.
Transmission lines: frequency domain analysis of radio frequency and microwave transmission circuits including power relations and graphical and computer methods. Electromagnetic waves: planar optical components, pulse dispersion, phase front considerations for optical components, conducting waveguides, dielectric waveguides. Radiation: retarded potentials, elemental dipoles, radiating antenna characterization, receiving mode. Enroll Info: ECE 320
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

ECE 427 — ELECTRIC POWER SYSTEMS
3 credits.
The electric power industry, operation of power systems, load flow, fault calculations, economic dispatch, general technical problems of electric power networks. Enroll Info: ECE 330 or equiv
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2018

ECE 431 — DIGITAL SIGNAL PROCESSING
3 credits.
Sampling continuous-time signals and reconstruction of continuous-time signals from samples; spectral analysis of signals using the discrete Fourier transform; the fast Fourier transform and fast convolution methods; z-transforms; finite and infinite impulse response filter design techniques; signal flow graphs and introduction to filter implementation. Enroll Info: ECE 330
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

ECE 432 — DIGITAL SIGNAL PROCESSING LABORATORY
3 credits.
Implementation of digital signal processing algorithms on special-purpose and general-purpose hardware. Use of assembly and high-level languages, and simulator to develop and test IIR, FIR filters and the FFT for modern DSP chips. Scaling for fixed point arithmetic. Use of high level languages to implement real time, object oriented component based DSP systems in general purpose computers. DSP applications, including data and voice communication systems. Enroll Info: ECE 431, Comp Sci 302
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2013

ECE 434 — PHOTONICS
3 credits.
Introduction to ray optics, physical optics and interference, applications of Fourier optics, absorption, dispersion, and polarization of light. Second half of the course treats light sources, including lasers (gas, solid state, and semiconductor), modulation and detection of light. Enroll Info: ECE 320, ECE 335 or con reg
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

ECE/COMP SCI/MATH 435 — INTRODUCTION TO CRYPTOGRAPHY
3 credits.
Cryptography is the art and science of transmitting digital information in a secure manner. Provides an introduction to its technical aspects. Enroll Info: None
Requisites: (MATH 320, 340, 341, or 375) or graduate/professional standing or member of the Pre-Masters Mathematics (Visiting International) Program
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Summer 2019
ECE 436 — COMMUNICATION SYSTEMS I
3 credits.
Amplitude, frequency, pulse, and pulse-code modulation. Narrow-band noise representation and signal-to-noise ratios for various modulation schemes. Pulse shaping, timing recovery, carrier synchronization, and equalization. Sampling, quantization and coding. Enroll Info: ECE 331
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2018

ECE 437 — COMMUNICATION SYSTEMS II
3 credits.
Statistical analysis of information transmission systems. Probability of error, design of receivers for digital transmission through additive white Gaussian noise channels and bandlimited channels. Spread spectrum communication systems. Channel capacity, source and error control coding. Enroll Info: ECE 331; ECE 436 or con reg
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

ECE/MEE 439 — INTRODUCTION TO ROBOTICS
3 credits.
Hands-on introduction to key concepts and tools underpinning robotic systems in use and development today. Intended to give students the tools to understand robotic systems, to explore robotics for their own purposes, and to pursue advanced study in the field. Students are expected to have familiarity with a high level programming language such as Python (recommended), MATLAB, Java or Julia. Enroll Info: None
Requisites: Senior or graduate standing
Repeatable for Credit: No
Last Taught: Fall 2018

ECE 445 — SEMICONDUCTOR PHYSICS AND DEVICES
3 credits.
Physics and properties of semiconductors, p-n junctions, metal-semiconductor contacts, homojunction and heterojunction bipolar transistor and physics, metal-oxide-semiconductor and heterostructure field-effect transistor and physics, thin-film resistors, memory devices, quantum devices. Enroll Info: ECE 335
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

ECE 447 — APPLIED COMMUNICATIONS SYSTEMS
3 credits.
Analysis with design problems of electronic communications circuits. Emphasis on the nonlinear effects of large-signal operation of active devices. Complete design of r.f. oscillator, amplifier, and mixer circuits. Enroll Info: ECE 340, ECE 420 recommended
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

ECE 453 — EMBEDDED MICROPROCESSOR SYSTEM DESIGN
4 credits.
Hardware and software design for modern microprocessor-based embedded systems; study of the design process; emphasis on major team design project. Enroll Info: ECE 315 353
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

ECE 454 — MOBILE COMPUTING LABORATORY
4 credits.
End-to-end project management; teamwork; fundamentals of disciplined development practices; introduction to mobile computing platforms and systems; design, implementation, and deployment of mobile systems and applications. Enroll Info: Computer Engineering Sr st or cons inst
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

ECE/BME 462 — MEDICAL INSTRUMENTATION
3 credits.
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

ECE/BME 463 — COMPUTERS IN MEDICINE
3 credits.
Study of microprocessor-based medical instrumentation. Emphasis on real-time analysis of electrocardiograms. Labs and programming project involve design of biomedical digital signal processing algorithms. Enroll Info: ECE 330, Comp Sci 302
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

ECE 466 — ELECTRONICS OF SOLIDS
3 credits.
Electronic, optical and thermal properties of crystalline solids. Energy-momentum dispersion of fundamental particles and excitations in solids leading to microscopic theories of conductivity, polarizability and permeability. Influence of materials characteristics on the performance of electronic and photonic devices. Enroll Info: ECE 335, 305, or consent of instructor
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2012
E C E 489 — HONORS IN RESEARCH
1-3 credits.

Undergraduate honors research projects supervised by faculty members. Not available for graduate credit. Enroll Info: None
Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2019

E C E 491 — SENIOR DESIGN PROJECT
3 credits.

Engineering design projects supervised by faculty members. Not available for graduate credit. Enroll Info: Sr st cons inst
Requisites: Consent of instructor
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 504 — ELECTRIC MACHINE & DRIVE SYSTEM LABORATORY
2-3 credits.

Steady state and dynamic performance of electric machines in combination with power electronic converters. Parameter measurement, performance evaluation, design of experimental procedures for problem solving, use of digital data acquisition systems and signal processing equipment in system evaluation. Enroll Info: ECE 304 and 411 or con reg 411 and cons inst
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2018

E C E/COMP SCI 506 — SOFTWARE ENGINEERING
3 credits.

Ideas and techniques for designing, developing, and modifying large software systems. Topics include software engineering processes; requirements and specifications; project team organization and management; software architectures; design patterns; testing and debugging; and cost and quality metrics and estimation. Students will work in large teams on a substantial programming project. Enroll Info: None
Requisites: (COMP SCI 367 or 400) and (COMP SCI 407, 536, 537, 545, 559, 564, 570, 679 or E C E/COMP SCI 552) or graduate/professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 511 — THEORY AND CONTROL OF SYNCHRONOUS MACHINES
3 credits.

The idealized three phase synchronous machine time domain model including saliency, time invariant form using Park’s transformation, sudden short circuits and other transient conditions, reduced order models, excitation system and turbine/governor control, dynamics of multiple machine systems, transient stability and subsynchronous resonance. Enroll Info: ECE 355, ECE 427, or cons inst
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2016

E C E 512 — POWER ELECTRONICS LABORATORY
3 credits.

This laboratory introduces the student to measurement and simulation of important operating characteristics of power electronic circuits and power semiconductor devices. Emphasis is on devices, circuits, gating methods and power quality. Enroll Info: ECE 412 or consent required
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2019

E C E/COMP SCI/I SY E 524 — INTRODUCTION TO OPTIMIZATION
3 credits.

Introduction to mathematical optimization from a modeling and solution perspective. Formulation of applications as discrete and continuous optimization problems and equilibrium models. Survey and appropriate usage of basic algorithms, data and software tools, including modeling languages and subroutine libraries. Enroll Info: None
Requisites: (COMP SCI 200, 300, 301, 302, or 310) and (MATH 320, 340, 341, or 375) or graduate/professional standing
Course Designation: Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Summer 2019

E C E/N E/PHYSICS 525 — INTRODUCTION TO PLASMAS
3 credits.

Basic description of plasmas: collective phenomena and sheaths, collisional processes, single particle motions, fluid models, equilibria, waves, electromagnetic properties, instabilities, and introduction to kinetic theory and nonlinear processes. Examples from fusion, astrophysical and materials processing processing plasmas. Enroll Info: One crse in electromagnetic fields beyond elem physics
Requisites: None
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019
ECE/N/N 527 — PLASMA CONFINEMENT AND HEATING
3 credits.

Principles of magnetic confinement and heating of plasmas for controlled thermonuclear fusion: magnetic field structures, single particle orbits, equilibrium, stability, collisions, transport, heating, modeling and diagnostics. Discussion of current leading confinement concepts: tokamaks, tandem mirrors, stellarators, reversed field pinches, etc. Enroll Info: None
Requisites: PHYSICS/E C E/N E 525 or graduate/professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

ECE/N E 528 — PLASMA PROCESSING AND TECHNOLOGY
3 credits.

Introduction to basic understanding and techniques. Plasma processing of materials for semiconductors, polymers, plasma spray coatings, ion implantation, etching, arcs, extractive metallurgy and welding. Plasma and materials diagnostics. Enroll Info: PHYSICS 322 or ECE 320 or equiv or cons inst
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

ECE/COMP SCI/M E 532 — MATRIX METHODS IN MACHINE LEARNING
3 credits.

An introduction to machine learning that focuses on matrix methods and features real-world applications ranging from classification and clustering to denoising and data analysis. Mathematical topics covered include: linear equations, regression, regularization, the singular value decomposition, and iterative algorithms. Machine learning topics include: the lasso, support vector machines, kernel methods, clustering, dictionary learning, neural networks, and deep learning. In addition to the formal course requisites, students are expected to have had exposure to numerical computing (e.g. Matlab, Python, Julia, R). Appropriate for graduate students or advanced undergraduates. Enroll Info: None
Requisites: MATH 222 and (ECE 203, COMP SCI 200, 300 or 302) or graduate/professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2019

ECE/COMP SCI 533 — IMAGE PROCESSING
3 credits.

Mathematical representation of continuous and digital images; models of image degradation; picture enhancement, restoration, segmentation, and coding; pattern recognition, tomography. Enroll Info: None
Requisites: ECE 330 and (MATH 320 or 340) or graduate/professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

ECE 536 — INTEGRATED OPTICS AND OPTOELECTRONICS
3 credits.

This course introduces the student to the physical principles, design concepts, and technological consequences of passive, electro-optic, and optic-electronic guided wave devices. Enroll Info: ECE 320, 335, ECE 434 or 420 or cons inst
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2018

ECE 537 — COMMUNICATION NETWORKS
3 credits.

Study of communication networks with focus on performance analysis. Layered network structure. Basic protocol functions such as addressing, multiplexing, routing, forwarding, flow control, error control, and congestion response. Overview of transport, network, and link layer protocol standards. Introduction to wireless and mobile networks. Enroll Info: ECE 203, Comp Sci 367
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

ECE/COMP SCI/M E 539 — INTRODUCTION TO ARTIFICIAL NEURAL NETWORK AND FUZZY SYSTEMS
3 credits.

Theory and applications of artificial neural networks and fuzzy logic: multi-layer perceptron, self-organization map, radial basis network, Hopfield network, recurrent network, fuzzy set theory, fuzzy logic control, adaptive fuzzy neural network, genetic algorithm, and evolution computing. Applications to control, pattern recognition, nonlinear system modeling, speech and image processing. Enroll Info: None
Requisites: COMP SCI 200, 301, 302, or 310 or graduate/professional standing
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2018
E C E 541 — ANALOG MOS INTEGRATED CIRCUIT DESIGN
3 credits.
Analysis, design and applications of modern analog circuits using integrated bipolar and field-effect transistor technologies. Provides the student with a working knowledge of the basic circuits used in modern analog integrated circuits and techniques for analysis and design. Enroll Info: ECE 342 or ECE 340 cons inst
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

E C E 542 — INTRODUCTION TO MICROELECTROMECHANICAL SYSTEMS
3 credits.
Introduction to MEMS technology, devices and systems. Fundamentals of MEMS in fabrication, process integration, material mechanics of MEMS structures, sensors and actuators. Main topics in MEMS - microfluidics, optical MEMS, RF MEMS, BioMEMS, packaging, and CAD. Enroll Info: ECE 335 or 340, or cons inst
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

E C E 545 — ADVANCED MICROWAVE MEASUREMENTS FOR COMMUNICATIONS
3 credits.
Measurements at VHF and microwave frequencies; characteristics of microwave generators, amplifiers, passive devices and detection systems; measurement of frequency, noise and simple antenna patterns; time domain reflectometry, swept frequency network and spectrum analyzer techniques; lecture and lab. Enroll Info: ECE 301, ECE 444 or cons inst
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2014

E C E/PHYSICS 546 — LASERS
2-3 credits.
General principles of laser operation; laser oscillation conditions; optical resonators; methods of pumping lasers, gas discharge lasers, e-beam pumped lasers, solid state lasers, chemical lasers, and dye lasers; gain measurements with lasers; applications of lasers. Enroll Info: PHYSICS 322 or ECE 420 or equiv; PHYSICS 545, or 449 or 531
Requisites: None
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2015

E C E 547 — ADVANCED COMMUNICATIONS CIRCUIT DESIGN
3 credits.
Principles underlying the design of r.f. and microwave communications circuits. Analysis and design of wideband nonlinear power amplifiers, S-parameter techniques for r.f. active circuit design, computer aided design techniques, r.f. integrated circuits, fundamentals of low noise r.f. design. Enroll Info: ECE 447, ECE 420 or cons reg, or cons inst
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2018

E C E 548 — INTEGRATED CIRCUIT DESIGN
3 credits.
Bipolar and MOS devices in monolithic circuits. Device physics, fabrication technology. IC-design for linear and nonlinear circuitry. Enroll Info: ECE 335
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2018

E C E 549 — INTEGRATED CIRCUIT FABRICATION LABORATORY
3 credits.
Monolithic integrated circuit fabrication; mask making, photolithography, oxidation, diffusion, junction evaluation, metallization, packaging, and testing. Enroll Info: ECE 548 or cons inst
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 551 — DIGITAL SYSTEM DESIGN AND SYNTHESIS
3 credits.
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E/COMP SCI 552 — INTRODUCTION TO COMPUTER ARCHITECTURE
3 credits.
The design of computer systems and components. Processor design, instruction set design, and addressing; control structures and microprogramming; memory management, caches, and memory hierarchies; and interrupts and I/O structures. E C E 551 or knowledge of Verilog is recommended. Enroll Info: None
Requisites: (E C E/COMP SCI 352 and E C E/COMP SCI 354) or graduate/professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2019
E C E 553 — TESTING AND TESTABLE DESIGN OF DIGITAL SYSTEMS
3 credits.
Faults and fault modeling, test equipment, test generation for combinational and sequential circuits, fault simulation, memory and microprocessor testing, design for testability, built-in self-test techniques, and fault location. Enroll Info: COMP SCI/E C E 352; Comp Sci 367; ECE 353 or cons inst
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2014

E C E 554 — DIGITAL ENGINEERING LABORATORY
4 credits.
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 555 — DIGITAL CIRCUITS AND COMPONENTS
3 credits.
Principles and characterization of logic circuits. Design and analysis techniques for applied logic circuits. Transmission lines in digital applications. Families of circuit logic currently in use and their characteristics. Enroll Info: ECE 340; COMP SCI/E C E 352
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2018

E C E 556 — DESIGN AUTOMATION OF DIGITAL SYSTEMS
3 credits.
Use of digital computers to simulate, partition, place and interconnect digital electronic systems. Enroll Info: COMP SCI/E C E 352; Comp Sci 367; or consent of instructor
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

E C E/M E 577 — AUTOMATIC CONTROLS LABORATORY
4 credits.
Control theory is reduced to engineering practice through the analysis and design of actual systems in the laboratory. Experiments are conducted with modern servo systems using both analog and digital control. Systems identification and modern controls design are applied to motion and torque control. Enroll Info: ME 446 447 or ECE 332 416 or cons inst
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2018

E C E 600 — SEMINAR IN ELECTRICAL AND COMPUTER ENGINEERING
0 credits.
Weekly or bi-weekly seminars on topics in electrical and computer engineering including automatic control, biomedical engineering, communications and signal processing, computer engineering, electromagnetic fields, energy and power systems, photonics, plasma, and solid state. Seminar on a particular topic may include lectures given by faculty, invited speakers, as well as group discussion. Enroll Info: None
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2016

E C E 601 — SPECIAL TOPICS IN ELECTRICAL AND COMPUTER ENGINEERING
1-4 credits.
Advanced topics of special interest to students in various areas of Electrical and Computer Engineering. Enroll Info: Jr st cons inst
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2017

E C E 610 — SEMINAR IN ELECTRICAL AND COMPUTER ENGINEERING
1 credit.
Survey of topics within the department of electrical and computer engineering that introduce students to the materials/techniques to assist them in being successful graduate students. Faculty seminars spanning energy and power systems, applied physics, electromagnetic fields, plasmas, communications and signal processing, controls, photonics, solid state, and computers will be given. Additionally, students will participate in weekly group exercises to enhance their skills in engineering/technical communications, writing, ethics, and project management. Graded homework and a final project are assigned. Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

E C E 611 — INTRODUCTION TO DOCTORAL RESEARCH IN ELECTRICAL & COMPUTER ENGINEERING
2 credits.
A focus on topics within the department of electrical and computer engineering that introduce students to the materials/techniques that will assist them in being successful graduate students. Faculty seminars spanning energy and power systems, applied physics, electromagnetic fields, plasmas, communications and signal processing, controls, photonics, solid state, and computers will be given. Additionally, students will participate in weekly group exercises to enhance their skills in engineering/technical communications, writing, ethics, and project management. Graded homework and a final project are assigned. Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019
E C E 630 — ALL OF SIGNAL PROCESSING
3 credits.
A broad range of basic and advanced signal processing concepts presented in a MATLAB intensive, application driven environment designed to acquaint students with the fundamental ideas and language of signal processing. Enroll Info: Grad st; MATH 222; and STAT 311, 324 or 371; or cons inst
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2014

E C E/MATH 641 — INTRODUCTION TO ERROR-CORRECTING CODES
3 credits.
Coding theory. Codes (linear, Hamming, Golay, dual); decoding-encoding; Shannon’s theorem; sphere-packing; singleton and Gilbert-Varshamov bounds; weight enumerators; MacWilliams identities; finite fields; other codes (Reed-Muller, cyclic, BCH, Reed-Solomon) and error-correction algorithms. Enroll Info: None
Requisites: MATH 541 or graduate/professional standing or member of the Pre-Masters Mathematics (Visiting International) Program
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

E C E 697 — CAPSTONE PROJECT IN SIGNAL PROCESSING AND MACHINE LEARNING
5 credits.
Individual or team project to gain hands-on-experience applying signal processing and machine learning concepts. Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2019

E C E 699 — ADVANCED INDEPENDENT STUDY
1-6 credits.
Enroll Info: None
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2019

E C E 702 — GRADUATE COOPERATIVE EDUCATION PROGRAM
1-2 credits.
Work experience that combines classroom theory with practical knowledge of operations to provide students with a background on which to develop and enhance a professional career. The work experience is tailored for MS students from within the U.S. as well as eligible international students. Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2019

E C E/COMP SCI 707 — MOBILE AND WIRELESS NETWORKING
3 credits.
Design and implementation of protocols, systems, and applications for mobile and wireless networking, particularly at the media access control, network, transport, and application layers. Focus is on the unique problems and challenges presented by the properties of wireless transmission, various device constraints such as limited battery power, and node mobility. Knower of computer networking is strongly encouraged, such as from COMP SCI 640 or E C E 537. Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

E C E 711 — DYNAMICS AND CONTROL OF AC DRIVES
3 credits.
Principles of power converters, two axis models of AC machines and AC drives, simulation of drive systems, analytical modeling of drives, dynamic behavior of induction and synchronous motors and drive systems. Offered every third semester. Enroll Info: ECE 332 411 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 712 — SOLID STATE POWER CONVERSION
3 credits.
Advanced course in power electronics which provides an understanding of switching power converters. Included are DC-to-DC, AC-to-DC, DC-to-AC, and AC-to-AC converters, commutation techniques, converter control, interfacing converters with real sources and loads. Offered every third semester. Enroll Info: ECE 412 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018
**ECE 713 — ELECTROMAGNETIC DESIGN OF AC MACHINES**
3 credits.

Electromagnetic design concepts and application to AC machines, magnetic circuit concepts, calculation of equivalent circuit parameters of induction, synchronous and permanent magnet machines from geometric data, copper and iron loss calculations, theory and application of finite elements to electromagnetic devices. Offered every third semester. Enroll Info: ECE 411 or 511 or equiv

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2019

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**ECE 714 — UTILITY APPLICATION OF POWER ELECTRONICS**
3 credits.

Power electronic application to utility systems is a rapidly growing field with major impact on the industry. This course will cover material on HVDC transmission, energy storage systems, renewable sources, static compensators, and flexible ac transmission systems. Enroll Info: ECE 412, ECE 427, cons inst

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Summer 2019

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**ECE 717 — LINEAR SYSTEMS**
3 credits.

Equilibrium points and linearization; natural and forced response of state equations; system equivalence and Jordan form; Lyapunov, asymptotic, and BIBO stability; controllability and duality; control-theoretic concepts such as pole-placement, stabilization, observers, dynamic compensation, and the separation principle. Enroll Info: MATH 340 or cons inst

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2018

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**ECE 719 — OPTIMAL SYSTEMS**
3 credits.

Optimality considerations in the study of dynamical systems; applications to electrical systems gain selection, tuning, conditions for optimality, feedback and instability, iterative methods, filtering, prediction, smoothing, dynamic programming controller synthesis, stability and robustness criteria. Enroll Info: ECE 334 or cons inst

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2018

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**ECE 723 — ON-LINE CONTROL OF POWER SYSTEMS**
3 credits.


**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2018

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**ECE/N/E/PHYSICS 724 — WAVES AND INSTABILITIES IN PLASMAS**
3 credits.

Waves in a cold plasma, wave-plasma interactions, waves in a hot plasma, Landau damping, cyclotron damping, magneto-hydrodynamic equilibria and instabilities, microinstabilities, introduction to nonlinear processes, and experimental applications. Enroll Info: PHYSICS/E C E/N E 525 PHYSICS 721 or ECE 740 or cons inst

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2019

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**ECE/N/E/PHYSICS 725 — PLASMA KINETIC THEORY AND RADIATION PROCESSES**
3 credits.

Coulomb Collisions, Boltzmann equation, Fokker-Planck methods, dynamical friction, neoclassical diffusion, collision operators radiation processes and experimental applications. Enroll Info: Physics, ECE, NEEP 525 PHYSICS 721 or ECE 740 or cons inst

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2018

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**ECE/N/E/PHYSICS 726 — PLASMA MAGNETOHYDRODYNAMICS**
3 credits.

MHD equations and validity in hot plasmas; magnetic structure and magnetic flux coordinates; equilibrium in various configurations; stability formulation, energy principle, classification of instabilities; ideal and resistive instability in various configurations, evolution of nonlinear tearing modes; force-free equilibria, helicity, MHD dynamo; experimental applications. Enroll Info: PHYSICS/E C E/N E 525 PHYSICS 721 or ECE 740 or cons inst

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2018
E C E 729 — THEORY OF INFORMATION PROCESSING AND TRANSMISSION
3 credits.
Definition of measures of information and their properties, capacity of discrete and continuous channels with noise, source and channel coding theorems, fundamentals of channel coding, noiseless source coding, and source coding with a fidelity criterion. Enroll Info: ECE 331 or MATH/STAT 431 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

E C E 730 — MODERN PROBABILITY THEORY AND STOCHASTIC PROCESSES
3 credits.
Stochastic processes in linear and nonlinear systems; stationarity, continuity, ergodicity; power spectrum and systems; estimation theory, filtering and prediction; harmonic analysis; nonstationary normal processes. Enroll Info: ECE 331 or equiv
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

E C E 731 — ADVANCED POWER SYSTEM ANALYSIS
3 credits.
Electrical transients due to faults and switching. Effect on power system design and operation. Traveling waves and surge protection. Computerized analysis of power transients. Enroll Info: Con reg ECE 511 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 734 — VLSI ARRAY STRUCTURES FOR DIGITAL SIGNAL PROCESSING
3 credits.
An overview of the architectures and design methodologies of VLSI array processors for digital signal processing. Emphasis is placed on the techniques of mapping algorithms onto array structures for real time signal processing. Enroll Info: ECE 431, 552, or equiv, or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

E C E 735 — SIGNAL SYNTHESIS AND RECOVERY TECHNIQUES
3 credits.
Signals and their representation. Signal synthesis subject to constraints on peak voltage, energy, duration-bandwidth product. The theory of alternating projections onto convex sets and applications to inverse problems in signal processing: signal recovery using incomplete data, image recovery in tomography using limited views, phase retrieval in optical astronomy. Enroll Info: ECE 431 or 533 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

E C E 736 — WIRELESS COMMUNICATIONS
3 credits.
Theory design and analysis of mobile wireless communication systems from a signal processing perspective. Emphasis on code-division multiple-access (CDMA) systems employing direct-sequence spread-spectrum (DS-SS) signaling. Topics include characterization of mobile wireless channels, demodulation of DS-SS signals, diversity techniques, interference suppression methods, and low-complexity adaptive receivers. Enroll Info: ECE 437 or equiv ECE 730, or cons inst. ECE 732 recommended
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2016

E C E 738 — ADVANCED DIGITAL IMAGE PROCESSING
3 credits.
Deterministic and stochastic spatio-temporal image models, transform domain processing. Markov random fields and anisotropic diffusion; MAP parameter estimation, ill-posed inverse problems, robust statistics and non-linear digital filtering in image processing. Applications to image restoration, motion estimation, (video) image compression (MPEG, JPEG) and tomography. Enroll Info: ECE 533 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

E C E/M E 739 — ADVANCED ROBOTICS
3 credits.
In-depth study of advanced robotics modeling and control. Topics include kinematics, motion planning, dynamics and control of serial chain robotic manipulators. Concepts are explored through a combination of theoretical and numerical modeling techniques. Enroll Info: ME 446 or ECE 332 or equiv; MATH 320 or 340; Familiarity with high level computational programming language such as Matlab, or consent of instructor
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019
E C E 740 — ELECTROMAGNETIC THEORY
3 credits.
Time harmonic fields and waves in linear media with applications to radiation, guiding and scattering; wave and surface impedance and admittance concepts; duality, uniqueness, image theory, equivalence principle, induction and compensation theorems, reciprocity, Green's functions, wave functions, potential and transform theory. Enroll Info: ECE 420 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

E C E 741 — SEMICONDUCTOR DIODE LASERS AND OTHER OPTOELECTRONIC DEVICES
3 credits.
In the first part of the course this modern photonic technology will be overviewed, and key parameters and concepts will be introduced. In the second part, the basic mechanisms determining the relationship between optical gain and current density, as well as quantum-well laser structures will be treated. The third part will cover the physics of high-power phase-locked laser arrays or other optoelectronics devices. Enroll Info: ECE 320, ECE 335 or equiv; Physics 244 or 241, some basic electromagnetics and optics
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 742 — COMPUTATIONAL METHODS IN ELECTROMAGNETICS
3 credits.
Computational techniques for solving differential and integral equations that govern static, frequency-domain, and time-domain electromagnetic field phenomena. Applications of the finite-difference time-domain method, finite-element method, and method of moments to practical electromagnetics engineering problems. Enroll Info: ECE 420 or equiv fluency in a high-level programming lang; COMP SCI 412 or equiv recommended
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 743 — HIGH-POWER DIODE LASERS AND AMPLIFIERS
3 credits.
In the first part, the basics of single-mode diode lasers and amplifiers as well as their applications will be treated. The second part will include in-depth treatment of the four basic types of high-power coherent diodes: phase-locked arrays, master-oscillator power amplifiers, unstable resonators, and external-cavity-controlled resonators. Enroll Info: ECE 320, ECE 335 or equiv; Physics 244 or 241, some basic electromagnetics and optics
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2018

E C E 744 — THEORY OF MICROWAVE CIRCUITS AND DEVICES
3 credits.
Scattering matrices; symmetrical junctions; impedance and ABCD matrices; equivalent circuits. Wave propagation in periodic structures and anisotropic media; Floquet's theorem; Brillouin diagrams; Hartree harmonics; tensor permeability, conductivity, and permittivity; coupled wave equations; normal modes; applications in ferrite devices. Enroll Info: ECE 444 or ECE 740 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 745 — SOLID STATE ELECTRONICS
3 credits.
Physical principles underlying the action of semiconductor devices, chemical bonding and energy band structure, Boltzmann transport theory, optical and high frequency effects, diffusion and drift, interfaces, properties of elemental and compound semiconductors. Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

E C E/PHYSICS 746 — QUANTUM ELECTRONICS
3 credits.
Elementary aspects of Lagrange theory of fields and field quantization; Bose, Fermi and Pauli operators; interaction of fields; quantum theory of damping and fluctuations; applications to lasers, nonlinear optics, and quantum optics. Enroll Info: ECE-PHYSICS/E C E 546; PHYSICS 721 or ECE 740
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2011
Electrical and Computer Engineering (ECE)

ECE 747 — NANOPHOTONICS
3 credits.

Optics/photonics at nanometer and micrometer length scales, including EM waves in dielectrics and metals, computational electromagnetics, waveguides and waveguide coupling, optical resonators, basic nanofabrication techniques, thin-film interference, surface-plasmon polaritons, localized surface-plasmon resonances, applications of plasmonics, super-resolution imaging, photonic crystals, composite materials and metamaterials, metasurfaces. Enroll Info: Knowledge of Maxwell's equation and basic ray/wave optics, as would typically be obtained from junior-level or higher electromagnetics or optics courses [such as ECE 320 or ECE 434], is strongly encouraged.

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

ECE/PHYSICS 748 — LINEAR WAVES
3 credits.

General considerations of linear wave phenomena; one dimensional waves; two and three dimensional waves; wave equations with constant coefficients; inhomogenous media; random media. Lagrangian and Hamiltonian formulations; asymptotic methods. Enroll Info: ECE 440 or PHYSICS 322 or cons inst

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

ECE/E/PHYSICS 749 — COHERENT GENERATION AND PARTICLE BEAMS
3 credits.

Fundamental theory and recent advances in coherent radiation charged particle beam sources (microwave to X-ray wavelengths) including free electron lasers, wigglers/beam-particle dynamics, Cerenkov masers, gyrotrons, coherent gain and efficiency, spontaneous emission, beam sources and quality, related accelerator concepts experimental results and applications. Enroll Info: ECE 740 or PHYSICS 721, or equiv, or cons inst

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2014

ECE/COMP SCI 750 — REAL-TIME COMPUTING SYSTEMS
3 credits.

Introduction to the unique issues in the design and analysis of computer systems for real-time applications. Hardware and software support for guaranteeing timeliness with and without failures. Resource management, time-constrained communication, scheduling and imprecise computations, real-time kernels and case studies. Students are strongly encouraged to have knowledge of computer architecture (e.g., ECE/COMP SCI 552) and operating system functions (e.g., COMP SCI 537). Enroll Info: None

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016

ECE 751 — EMBEDDED COMPUTING SYSTEMS
3 credits.

Embedded applications, embedded processors and multiprocessors, embedded system design and simulation, configurable/reconfigurable embedded systems, embedded compilers and tool chains, run-time systems, application design and customization, hardware and software co-design, low-power design. Enroll Info: ECE 552

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

ECE/COMP SCI 752 — ADVANCED COMPUTER ARCHITECTURE I
3 credits.

Processor design, computer arithmetic, pipelining, multi-operation processors, vector processors, control units, precise interrupts, main memory, cache memories, instruction set design, stack machines, busses and I/O, protection and security. Students are strongly encouraged to have knowledge of computer architecture (e.g., ECE/COMP SCI 552). Enroll Info: None

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

ECE 753 — FAULT-TOLERANT COMPUTING
3 credits.

Fault modeling, redundancy techniques and reliability evaluation, error detecting and correcting codes, self-checking circuits, fault diagnosis, software fault tolerance, and case studies. Enroll Info: COMP SCI/ ECE 552, STAT/MATH 431 or equiv, or cons inst

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2014
Electrical and Computer Engineering (ECE)

ECE/COMP SCI 755 — VLSI SYSTEMS DESIGN
3 credits.

Overview of MOS devices and circuits; introduction to integrated circuit fabrication; topological design of data flow and control; interactive graphics layout; circuit simulation; system timing; organizational and architectural considerations; alternative implementation approaches; design project. ECE 555 or equivalent experience is strongly recommended. Enroll Info: None

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2018

ECE/COMP SCI 756 — COMPUTER-AIDED DESIGN FOR VLSI
3 credits.

Broad introduction to computer-aided design tools for VLSI, emphasizing implementation algorithms and data structures. Topics covered: design styles, layout editors, symbolic compaction, module generators, placement and routing, automatic synthesis, design-rule checking, circuit extraction, simulation and verification. Students are strongly encouraged to have programming skills and to have taken a course in Digital System Fundamentals such as ECE/COMP SCI 352. Enroll Info: None

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

ECE/COMP SCI 757 — ADVANCED COMPUTER ARCHITECTURE II
3 credits.

Parallel algorithms, principles of parallelism detection and vectorizing compilers, interconnection networks, MIMD machines, processor synchronization, data coherence, multithreaded dataflow machines, special purpose processors. Students are strongly encouraged to have knowledge of computer architecture (e.g., ECE/COMP SCI 552). Enroll Info: None

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

ECE/COMP SCI/E M A/E P/M E 759 — HIGH PERFORMANCE COMPUTING FOR APPLICATIONS IN ENGINEERING
3 credits.

An overview of hardware and software solutions that enable the use of advanced computing in tackling computationally intensive Engineering problems. Hands-on learning promoted through programming assignments that leverage emerging hardware architectures and use parallel computing programming languages. Students are strongly encouraged to have completed COMP SCI 367 or COMP SCI 400 or to have equivalent experience. Enroll Info: None

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

ECE/COMP SCI 761 — MATHEMATICAL FOUNDATIONS OF MACHINE LEARNING
3 credits.

Mathematical foundations of machine learning theory and algorithms. Probabilistic, algebraic, and geometric models and representations of data, mathematical analysis of state-of-the-art learning algorithms and optimization methods, and applications of machine learning. Students should have taken a course in statistics and a course in linear algebra (e.g., STAT 302 and MATH 341). Enroll Info: None

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

ECE/BME 762 — BIOMEDICAL INSTRUMENTATION
3 credits.

Design and application of specialized biomedical instrumentation. Information retrieval techniques. Lab. Enroll Info: ECE 462 or cons inst

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2011

ECE/CBE/MATH 777 — NONLINEAR DYNAMICS, BIFURCATIONS AND CHAOS
3 credits.

Advanced interdisciplinary introduction to qualitative and geometric methods for dissipative nonlinear dynamical systems. Local bifurcations of ordinary differential equations and maps. Chaotic attractors, horseshoes and detection of chaos. Enroll Info: None

Requisites: Graduate/professional standing or member of the Pre-Masters Mathematics (Visiting International) Program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2016

ECE 790 — MASTER'S RESEARCH OR THESIS
1-9 credits.

Enroll Info: None

Requisites: Declared in a Electrical Engineering graduate program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2019
ECE 817 — NONLINEAR SYSTEMS
3 credits.

Modelling nonlinear systems, linearization, equilibria, solution concepts, phase plane analysis, stability concepts, Lyapunov methods, oscillations, vector space methods, control system nonlinearities and design. Selected topics from the following: input-output methods, switching and variable structure systems, feedback linearization, and Lyapunov robustness. Enroll Info: ECE 717 or equiv
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016

ECE 821 — OPTIMAL CONTROL AND VARIATIONAL METHODS
3 credits.

Variational methods in optimal control, functional analytic and vector space tools, time-optimal control and reachable sets, the Pontryagin Maximum Principle, linear quadratic regulators, stability of optimized systems, introduction to H-infinity control. Enroll Info: ECE 717 or equiv
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2013

ECE 830 — ESTIMATION AND DECISION THEORY
3 credits.

Estimation and decision theory applied to random processes and signals in noise: Bayesian, maximum likelihood, and least squares estimation; the Kalman filter; maximum likelihood and maximum aposteriori detection; adaptive receivers for channels with unknown parameters or dispersive, fading characteristics; the RAKE receiver; detection systems with learning features. Enroll Info: ECE 730 or equiv
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

ECE 841 — ELECTROMAGNETIC RADIATION AND TRANSMISSION
3 credits.

Applications of Maxwell's field equations to radiation problems; transmission of radio waves; radiation and impedance characteristics of various antennas and arrays. Analysis of complete antenna systems. Enroll Info: ECE 440 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2018

ECE/MATH 842 — TOPICS IN APPLIED ALGEBRA
3 credits.

Applied topics with emphasis on algebraic constructions and structures. Examples include: algebraic coding theory; codes (algebraic-geometric, convolutional, low-density-parity-check, space-time); curve and lattice based cryptography; watermarking; computer vision (face recognition, multiview geometry). Enroll Info: None
Requisites: Graduate/professional standing or member of the Pre-Masters Mathematics (Visiting International) Program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

ECE 845 — TRANSPORT IN SEMICONDUCTOR DEVICES
3 credits.

Transport of carriers in electronic devices, starting from the Boltzmann equation and the quantum mechanical treatment of scattering, and covering applications to devices; transport in 2D structures; modeling of transport; experiments and devices involving hot electrons. Enroll Info: ECE 745
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

ECE/PHYSICS 848 — NONLINEAR WAVES
3 credits.

General considerations of nonlinear wave phenomena; nonlinear hyperbolic waves; nonlinear dispersion; nonlinear geometrical optics; Whitham's variational theory; nonlinear and parametric instabilities; solitary waves; inverse scattering method. Enroll Info: ECE 748 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

ECE/COMP SCI/STAT 861 — THEORETICAL FOUNDATIONS OF MACHINE LEARNING
3 credits.

Requisites: ECE/COMP SCI 761 or ECE 830
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019
EC E 890 — PRE-DISSERTATOR'S RESEARCH
1-9 credits.

Enroll Info: None
Requisites: Declared in a Electrical Engineering graduate program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2019

EC E 901 — SPECIAL TOPICS IN ELECTRICAL AND COMPUTER ENGINEERING
1-3 credits.

Special advanced topics across Electrical and Computer Engineering. The topics covered, instructors, and prerequisites all vary with semester and with section. Particular topics typically reflect state-of-the-art ideas and research. Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2019

EC E/N/E/PHYSICS 922 — SEMINAR IN PLASMA PHYSICS
0-1 credits.

Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2019

EC E 990 — RESEARCH OR THESIS
1-12 credits.

Enroll Info: For students with dissertator status only
Requisites: Declared in Electrical Engineering PhD
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2019

EC E 999 — ADVANCED INDEPENDENT STUDY
1-3 credits.

Enroll Info: None
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2019