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.
Requisites: Sophomore standing or member of Engineering Guest Students
Course Designation: Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2023

E C E 203 – SIGNALS, INFORMATION, AND COMPUTATION
3 credits.

Introduction to the signals, information, and computational techniques in electrical engineering.
Requisites: (MATH 211, 217, 221, or 275) or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Summer 2023

E C E 204 – DATA SCIENCE & ENGINEERING
3 credits.

A hands-on introduction to Data Science using the Python programming language. Data-centric and computational thinking. Describe, analyze, and make predictions using data from real-world phenomena. Programming in Python. Importing, manipulating, summarizing, and visualizing data of various types. Notions of bias, fairness, and ethics in data science.
Requisites: MATH 112, 114, 171, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 219 – ANALYTICAL METHODS FOR ELECTROMAGNETICS ENGINEERING
2 credits.

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. Applies analysis tools from vector calculus to the calculation and prediction of electrical system properties. Examples include calculating electric and magnetic fields, electric potentials, total electric charge, and electric flux from change or current sources.
Requisites: MATH 234 or 376, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: (PHYSICS 202, 208, or 248) and E C E 219, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Summer 2023

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.
Requisites: (MATH 222 or 276) and (PHYSICS 202, 208, or 248), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Summer 2023

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. Prior experience with MATLAB [such as E C E 203] is strongly encouraged but not required.
Requisites: (MATH 222 or 276) and (PHYSICS 202, 208, or 248), or member of Engineering Guest Students
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/COMP SCI 252 – INTRODUCTION TO COMPUTER ENGINEERING
3 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.
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: Summer 2023

E C E 270 – CIRCUITS LABORATORY I
1 credit.

Experiments cover Kirchhoff's laws, inductors, basic operational amplifier circuits, and frequency response.
Requisites: E C E 210 and (E C E 230 or concurrent enrollment), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Summer 2023

E C E 271 – CIRCUITS LABORATORY II
1 credit.

Experiments cover electronic device characteristics, limitations and applications of operational amplifiers, and feedback circuits.
Requisites: E C E 270 and (E C E 340 or concurrent enrollment), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Summer 2023

E C E 303 – INTRODUCTION TO REAL-TIME DIGITAL SIGNAL PROCESSING
2 credits.

Emphasizes the implementation of DSP algorithms on a digital signal processor in "real-time." Many of the signal processing algorithms that were used in E C E 203 will be reviewed in MATLAB and then will be implemented on a floating point signal processor in "real-time" using the C programming language. Explore many basic digital signal processing processes in real-time. Gain the ability to create and develop your own Digital Signal Processing projects for a modern digital signal precessor using an Integrated Development Environment. Lab hardware will be provided.
Requisites: E C E 203 or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: (E C E 355, 356, or concurrent enrollment) or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: E C E 271 and (E C E 335 or concurrent enrollment), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2020

E C E 306 – LINEAR ACTIVE CIRCUITS LABORATORY
1 credit.

Direct coupled and operational amplifier characteristics; applications of feedback; practical aspects.
Requisites: E C E 271 and 340, or member of Engineering Guest Students
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.
Requisites: E C E 271 and 340, or member of Engineering Guest Students
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.
Requisites: E C E 271 and 340, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: E C E 353 or concurrent enrollment, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: E C E 271 and (E C E 340 or concurrent enrollment), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: E C E 220 or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 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.
Requisites: E C E 203 or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Summer 2023

E C E 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.
Requisites: (E C E 203 or 330) or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 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.
Requisites: E C E 330 or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Summer 2020

E C E 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.
Requisites: E C E 330, MATH 319, 320, 376, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 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.
Requisites: (E C E 220, 230, and PHYSICS/E C E 235), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 340 – ELECTRONIC CIRCUITS I
3 credits.

A first course in modeling, characterization, and application of semiconductor devices and integrated circuits. Development of appropriate models for circuit-level behavior of diodes, bi-polar and field effect transistors, and non-ideal op-amps. Application in analysis and design of linear amplifiers. Frequency domain characterization of transistor circuits.
Requisites: (E C E 203 and 230) or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Summer 2023

E C E 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.
Requisites: E C E 340 or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/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.
Requisites: Satisfied Quantitative Reasoning (QR) A requirement and E C E/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 2023

E C E 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.
Requisites: COMP SCI/E C E 252 and (COMP SCI 300 or 302 prior to Fall 2018), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

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.
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: Summer 2023

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.
Requisites: E C E 230, or graduate/professional standing, or member of Engineering Guest Students, or declared in Capstone Certificate in Power Conversion and Control
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: (E C E 230 or 376) or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2021

E C E 370 – ADVANCED LABORATORY
2 credits.

Experiments related to the required core material.
Requisites: E C E 271 and (E C E 340 or concurrent enrollment), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: (MATH 222 or 276) and (PHYSICS 202, 208, or 248), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 377 – FUNDAMENTALS OF ELECTRICAL AND ELECTRO-MECHANICAL 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.
Requisites: (MATH 234 or 376), (PHYSICS 202, 208, or 248), and E C E 376, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: Sophomore standing or member of Engineering Guest Students
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2022

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

Directed study projects as arranged with instructor.
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 2023

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.
Requisites: E C E 203, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 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 modeling of ac machines.
Requisites: (E C E 355, 356, or 377), graduate/professional standing, or member of Engineering Guest Students, or declared in Power Conversion and Control Capstone Certificate
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 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.
Requisites: E C E 342, graduate/professional standing, member of Engineering Guest Students, or declared in Capstone Certificate in Power Conversion and Control
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 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.
Requisites: E C E 320, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 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.
Requisites: E C E 330, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 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.
Requisites: E C E 330, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 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.
Requisites: E C E 330 and COMP SCI 300, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 434 – PHOTONICS
3 credits.

Introduction to ray optics, physical optics and interference, applications of Fourier optics, absorption, dispersion, and polarization of light. Light sources, including lasers (gas, solid state, and semiconductor), modulation and detection of light.
Requisites: PHYSICS/E C E 235 and (E C E 320, PHYSICS 322, or concurrent enrollment in either one), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/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.
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 2023

E C E 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.
Requisites: (E C E 203 or 330), graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 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.
Requisites: (E C E 203 or 330), graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/M E 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.
Requisites: Senior standing or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 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.
Requisites: E C E 335, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

E C E 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.
Requisites: E C E 340 and 420, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2021

E C E 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.
Requisites: E C E 315 and COMP SCI 300 (or COMP SCI 302 or 367 prior to Fall 2018), or graduate/professional standing, not open to special students. Students with credit for E C E 454 or 554 may not enroll.
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 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.
Requisites: COMP SCI 400 (or COMP SCI 367 prior to Fall 2018), or graduate/professional standing, not open to special students. Students with credit for E C E 453 or 554 may not enroll.
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/B M E 462 – MEDICAL INSTRUMENTATION
3 credits.

Design and application of electrodes, biopotential amplifiers, biosensors, therapeutic devices. Medical imaging. Electrical safety. Measurement of ventilation, blood pressure and flow.
Requisites: E C E 340, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E/B M E 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. Knowledge of computer programming language like C, C++ or Java, strongly encouraged.
Requisites: E C E 330 and (COMP SCI 200, 220, 300, 301, or placement into COMP SCI 300), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 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.
Requisites: (E C E 305 or 335), graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2021

E C E 489 – HONORS IN RESEARCH
1-3 credits.

Undergraduate honors research projects supervised by faculty members.
Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2023

E C E 491 – SENIOR DESIGN PROJECT
3 credits.

Engineering design projects supervised by faculty members.
Requisites: Consent of instructor
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: E C E 711 or concurrent enrollment
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2023

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.
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 2023

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.
Requisites: E C E 411 and 427, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2023

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.
Requisites: E C E 412, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

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.
Requisites: (COMP SCI 200, 220, 300, 301, 302, 310, or placement into COMP SCI 300) 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 2023

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.
Requisites: (E C E 320 or PHYSICS 322), graduate/professional standing, or member of Engineering Guest Students
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 2023

E C E/N E/PHYSICS 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.
Requisites: E C E/N E/PHYSICS 525, graduate/professional standing, or member of Engineering Guest Students
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 2023

E C E/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.
Requisites: PHYSICS 322 or E C E 320, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2021

E C E/COMP SCI/M E 532 – MATRIX METHODS IN MACHINE LEARNING
3 credits.

Linear algebraic foundations of machine learning featuring real-world applications of matrix methods from classification and clustering to denoising and data analysis. Mathematical topics 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. Previous exposure to numerical computing (e.g. Matlab, Python, Julia, R) required.
Requisites: (MATH 234, 320, 340, 341, or 375) and (E C E 203, COMP SCI 200, 220, 300, 301, 302, 310, 320, or placement into COMP SCI 300), graduate/professional standing, or declared in Capstone Certificate in Computer Sciences for Professionals
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 2023

E C E/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.
Requisites: E C E 330 and (MATH 320 or 340), graduate/professional standing, or member of Engineering Guest Students
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 2022

E C E 536 – INTEGRATED OPTICS AND OPTOELECTRONICS
3 credits.

Characteristics of semiconductors; study of physical mechanisms and modeling of solid state electronic and photonic devices; principles of optoelectronic processing and examples of integrated optoelectronics.
Requisites: E C E 335 and (E C E 420 or 434), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 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.
Requisites: E C E 203 and (COMP SCI 400 or 367 prior to Fall 2018), graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2022

E C E/COMP SCI/M E 539 – INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS
3 credits.

Theory and applications of artificial neural networks: multi-layer perceptron, self-organization mapdeep neural network convolutional neural network, recurrent network, support vector machines genetic algorithm, and evolution computing. Applications to control, pattern recognition, prediction, and object detection and tracking.
Requisites: COMP SCI 200, 220, 300, 301, 302, 310, placement into COMP SCI 300, 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: Summer 2023

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.
Requisites: E C E 340, graduate/professional standing, or member of Engineering Guest Students
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.
Requisites: (E C E 335 or 340), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2020

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.
Requisites: (E C E 440 or 447), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2021

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.
Requisites: (PHYSICS 322 or E C E 420) and (PHYSICS 449, 531, or 545), graduate/professional standing, or member of Engineering Guest Students
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.
Requisites: (E C E 420 or 447), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

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.
Requisites: E C E 335, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2022

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.
Requisites: (E C E 335 or 548), graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 551 – DIGITAL SYSTEM DESIGN AND SYNTHESIS
3 credits.

Introduction to the use of hardware description languages and automated synthesis in design. Advanced design principles. Verilog and VHDL description languages. Synthesis from hardware description languages. Timing-oriented synthesis. Relation of integrated circuit layout to timing-oriented design. Design for reuse.
Requisites: E C E/COMP SCI 352, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

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.
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 2023

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.
Requisites: E C E/COMP SCI 352, E C E 353, and (COMP SCI 400 or 367 prior to Fall 2018), graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 554 – DIGITAL ENGINEERING LABORATORY
4 credits.

Practical aspects of computer system design. Design, construction, and testing of significant digital subsystems. Design, construction, and programming of pipelined digital computers.
Requisites: E C E 551 and E C E/COMP SCI 552, not open to special students. Students with credit for E C E 453 or 454 may not enroll.
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: (E C E/COMP SCI 352 and E C E 340), graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 556 – DESIGN AUTOMATION OF DIGITAL SYSTEMS
3 credits.

Use of digital computers to simulate, partition, place and interconnect digital electronic systems.
Requisites: E C E/COMP SCI 352 and (COMP SCI 300 or 367 prior to Fall 2018), graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/COMP SCI 561 – PROBABILITY AND INFORMATION THEORY IN MACHINE LEARNING
3 credits.

Probabilistic tools for machine learning and analysis of real-world datasets. Introductory topics include classification, regression, probability theory, decision theory and quantifying information with entropy, relative entropy and mutual information. Additional topics include naive Bayes, probabilistic graphical models, discriminant analysis, logistic regression, expectation maximization, source coding and variational inference.
Requisites: (MATH 320, 340, 341, 375, or M E/COMP SCI/E C E 532 or concurrent enrollment) and (E C E 331, STAT/MATH 309, 431, STAT 311, 324, M E/STAT 424 or MATH 531) or grad/profsnl standing or declared in Capstone Certificate in Computer Sciences for Professionals
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: No
Last Taught: Fall 2022

E C E/I SY E 570 – ETHICS OF DATA FOR ENGINEERS
3 credits.

Introduction to ethical issues in data engineering and principled solutions. Algorithmic fairness (individual fairness, group fairness, counterfactual fairness), differential privacy and its applications, and robustness. Builds on prior experience with machine learning/data science programming.
Requisites: Consent of instructor
Repeatable for Credit: No

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.
Requisites: M E 346 or E C E 332, or graduate/professional standing or member of Engineering Guest Students
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.
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.
Requisites: Junior standing or member of Engineering Guest Students
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2023

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.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

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.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

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.
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 MACHINE LEARNING AND SIGNAL PROCESSING
5 credits.

Individual or team project to gain hands-on-experience applying machine learning and signal processing concepts.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2023

E C E 699 – ADVANCED INDEPENDENT STUDY
1-6 credits.

Directed study projects as arranged with instructor.
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 2023

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.
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 2023

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.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

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.
Requisites: E C E 411 and graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

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.
Requisites: E C E 412 and graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 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.
Requisites: (E C E 411 or 511) and graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 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. Covers material on HVDC transmission, energy storage systems, renewable sources, static compensators, and flexible ac transmission systems.
Requisites: E C E 412, 427, and graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

E C E 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. Knowledge of linear algebra [such as MATH 340] required.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 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. Knowledge of State Space System Analysis [such as E C E 334] strongly encouraged.
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 723 – ON-LINE CONTROL OF POWER SYSTEMS
3 credits.

State estimation based on line-flow measurements. Detection and correction of incorrect on-line measurements. Reduction techniques. Network security evaluation. On-line contingency studies and contingency remedial action. Calculation of penalty factors and optimal power dispatch strategies. On-line stability determination. Parallel processors for on-line studies. Knowledge of basic probability analysis [such as E C E 331, STAT/MATH 431, or STAT 311] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

E C E/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. Basic knowledge of plasmas [such as PHYSICS/E C E/N E 525] and advanced electromagnetics [such as PHYSICS 721 or E C E 740] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

E C E/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. Basic knowledge of plasmas [such as PHYSICS/E C E/N E 525] and advanced electromagnetics [such as PHYSICS 721 or E C E 740] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E/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. Basic knowledge of plasmas [such as PHYSICS/E C E/N E 525] and advanced electromagnetics [such as PHYSICS 721 or E C E 740] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 729 – INFORMATION THEORY
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. Knowledge of basic probability analysis [such as E C E 331, STAT/MATH 431, or STAT 311] required.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

E C E 730 – PROBABILITY AND RANDOM PROCESSES
3 credits.

Review of basic probability. Advanced probability concepts. Random vectors; linear filtering of random processes; stationarity; power spectral densities; estimation; convergence; Markov chains; Poisson process; Wiener process. Knowledge of basic probability analysis [such as E C E 331, STAT/MATH 431, or STAT 311] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

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.
Requisites: E C E 427 and graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2021

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. Knowledge of digital signal processing [such as E C E 431] and computer architecture [such as E C E/COMP SCI 552] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

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.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2020

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. Knowledge of probability [such as E C E 730] and digital communication [such as E C E 437] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

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. Knowledge of image processing [such as E C E/COMP SCI 533] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/M E 739 – KINEMATICS, DYNAMICS, AND CONTROL OF ROBOTIC MANIPULATORS
3 credits.

Robotics analysis and design, focusing on the analytical fundamentals specific to robotic manipulators. Serial chain robotic manipulator forward and inverse kinematics, differential kinematics, dynamics, motion planning, and controls. Knowledge of linear algebra [such as MATH 320], high-level computational programming language such as MATLAB, and system dynamics [such as M E 340] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

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. Knowledge of electromagnetics [such as E C E 420] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 741 – SEMICONDUCTOR DIODE LASERS AND OTHER OPTOELECTRONIC DEVICES
3 credits.

An overview of modern photonic technology and an introduction to key parameters and concepts; the basic mechanisms determining the relationship between optical gain and current density, and quantum-well laser structures; physics of high-power phase-locked laser arrays or other optoelectronics devices. Knowledge of electromagnetics [such as E C E 320] and solid-state electronics [such as E C E 335] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2021

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. Knowledge of high-level programming language like MATLAB strongly encouraged. Knowledge of electromagnetics [such as E C E 320] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

E C E 743 – HIGH-POWER DIODE LASERS AND AMPLIFIERS
3 credits.

Single-mode diode lasers and amplifiers and their applications; an 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. Knowledge of electromagnetics [such as E C E 320] and solid-state electronics [such as E C E 335] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2020

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. Knowledge of advanced engineering electromagnetics [such as E C E 740] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

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.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

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. Knowledge of lasers [such as PHYSICS/E C E 546] and graduate-level electromagnetics [such as E C E 740 or PHYSICS 721] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

E C E 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. 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 E C E 320 or E C E 434], is strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E/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. Knowledge of electromagnetics [such as E C E 320 or PHYSICS 321], mechanics [such as M E 340], or vibrations [such as M E 440] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E/N 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, wiggler/wave-particle dynamics, Cerenkov masers, gyrotrons, coherent gain and efficiency, spontaneous emission, beam sources and quality, related accelerator concepts experimental results and applications.
Requisites: E C E 740
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2019

E C E/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., E C E/COMP SCI 552) and operating system functions (e.g., COMP SCI 537)
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2021

E C E 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. Knowledge of computer architecture [such as E C E 552] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E/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., E C E/COMP SCI 552).
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 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. Knowledge of probability [such as E C E 431] and computer architecture [such as E C E/COMP SCI 552] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/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. E C E 555 or equivalent experience is strongly recommended.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/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 encourage to have programming skills and to have taken a course in Digital System Fundamentals such as E C E/COMP SCI 352.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2021

E C E/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, multis, dataflow machines, special purpose processors. Students are strongly encouraged to have knowledge of computer architecture (e.g., E C E/COMP SCI 552).
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E/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 encourage to have completed COMP SCI 367 or COMP SCI 400 or to have equivalent experience.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E/COMP SCI 760 – MACHINE LEARNING
3 credits.

Computational approaches to learning: including inductive inference, explanation-based learning, analogical learning, connectionism, and formal models. What it means to learn. Algorithms for learning. Comparison and evaluation of learning algorithms. Cognitive modeling and relevant psychological results.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/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).
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/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.
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

E C E/B M E/MED PHYS 778 – MACHINE LEARNING IN ULTRASOUND IMAGING
3 credits.

Concepts and machine learning techniques for ultrasound beamforming for image formation and reconstruction to image analysis and interpretation will be presented. Key machine learning and deep learning concepts applied to beamforming, compressed sampling, speckle reduction, segmentation, photoacoustics, and elasticity imaging will be evaluated utilizing current peer-reviewed publications.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E/COMP SCI 782 – ADVANCED COMPUTER SECURITY AND PRIVACY
3 credits.

Security and privacy issues in software, networks, and hardware systems. Security vulnerabilities, privacy threats, threats modeling, and mitigation strategies. Privacy issues related to user interaction with devices, online systems, and networks. In addition, a selection of more advanced topics will be covered. Possible examples include applied cryptography in the context of systems, security and privacy policies, user authentication, and cyber-physical systems. Builds on prior experiences with one or more of the following: networking, security, modern machine learning, embedded systems, and mobile computing.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 790 – MASTER'S RESEARCH
1-9 credits.

Independent work on master's research overseen by a qualified instructor.
Requisites: Declared in Electrical Engineering: Research, M.S. or Electrical Engineering: Power Engineering, M.S.
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2023

E C E 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. Knowledge of linear systems [such as E C E 717] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E 821 – OPTIMAL CONTROL AND VARIATIONAL METHODS
3 credits.

Variational principles in optimization and optimal control, constrained control and reachability analysis, stability of optimal control, data-driven methods for optimal control. Knowledge of linear systems [such as E C E 717] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E 826 – THEORETICAL FOUNDATIONS OF LARGE-SCALE MACHINE LEARNING
3 credits.

Mathematical foundations of large-scale machine learning and optimization. Focus on recent texts in machine learning, optimization, and randomized algorithms, focused on tradeoffs that are driving algorithmic design in this new discipline. These trade-offs revolve around speed of convergence, statistical accuracy, robustness, scalability, algorithmic complexity, and implementation.
Requisites: COMP SCI/E C E 761
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

E C E 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.
Requisites: E C E 730
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

E C E 841 – ANTENNAS
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.
Requisites: E C E 740
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

E C E/MATH 842 – TOPICS IN APPLIED ALGEBRA
3 credits.

Applied topics with emhasis 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).
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 2022

E C E 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.
Requisites: E C E 745
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

E C E/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. Knowledge of electromagnetics [such as E C E 320 or PHYSICS 321] or mechanics [such as M E 340] encouraged.
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/COMP SCI/STAT 861 – THEORETICAL FOUNDATIONS OF MACHINE LEARNING
3 credits.

Advanced mathematical theory and methods of machine learning. Statistical learning theory, Vapnik-Chevronenkis Theory, model selection, high-dimensional models, nonparametric methods, probabilistic analysis, optimization, learning paradigms.
Requisites: E C E/COMP SCI 761 or E C E 830
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

E C E/MATH/STAT 888 – TOPICS IN MATHEMATICAL DATA SCIENCE
1-3 credits.

Advanced topics in the mathematical foundations of data science
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: Spring 2023

E C E 890 – PRE-DISSERTATOR'S RESEARCH
1-9 credits.

Independent work on doctoral research overseen by a qualified instructor.
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 2023

E C 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.
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 2023

E C E/N E/PHYSICS 922 – SEMINAR IN PLASMA PHYSICS
0-1 credits.

Current topics in plasma physics.
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 2023

E C E 990 – DISSERTATOR'S RESEARCH
1-12 credits.

Independent work on dissertation overseen by a qualified instructor.
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 2023

E C E 999 – ADVANCED INDEPENDENT STUDY
1-3 credits.

Directed study projects as arranged with instructor.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2023