ELECT. ENGINEERING - ECE GRAD (ECE-GY)

ECE-GY 997X MS THESIS IN ELECTRICAL & COMPUTER ENGINEERING DEPARTMENT (3-9 Credits)
Typically offered occasionally
The student is required to conduct a theoretical and/or experimental project in a research area in electrical engineering, computer engineering, electrophysics, system engineering, or telecommunication networks. The project is chosen based on the student's specialized interest and preparation and is guided by a faculty member who is expert in the chosen subject. Oral-thesis defense and formal, bounded thesis are required. Registration of at least 6 credits over continuous semesters is required. A student must secure a thesis adviser before registration. | Prerequisite: Degree status.
Grading: Satisfactory/Unsatisfactory
Repeatable for additional credit: Yes

ECE-GY 999X PHD DISSERTATION IN ELECTRICAL ENGINEERING DEPT (3-9 Credits)
Typically offered occasionally
The dissertation is an original investigation of an electrical-engineering problem. The work must demonstrate creativity and include features of originality and utility worthy of publication in a recognized journal. Candidates must successfully defend their dissertations orally and submit a bounded thesis. Registration of at least 21 credits over continuous semesters is required. | Prerequisite: Passing PhD qualifying examination.
Grading: Satisfactory/Unsatisfactory
Repeatable for additional credit: Yes

ECE-GY 5023 WIRELESS INFORMATION SYSTEMS LABORATORY I (3 Credits)
This course includes hands-on experience with a combination of laboratory experiments, lectures and projects relating to spread spectrum code division multiple access (CDMA) wireless communication systems. Specific topics include pseudo-noise code generation, transmitters and receivers for direct sequence and frequency hopping systems, acquisition and tracking, CDMA wireless computer communications, UHF channel propagation characteristics including multipath time delay profiles and attenuation measurements, bit error rate measurements, phase locked loops and spectrum sharing with existing narrowband users. Prerequisite: Graduate status or EE-UY 3404.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5033 WIRELESS INFORMATION SYSTEMS LABORATORY II (3 Credits)
This course includes hands-on experience with a combination of laboratory experiments, lectures and projects relating to basic and advanced topics in wireless communications. Specific topics include mixers, IQ modulation, phase locked loops, receiver design, PN code acquisition, smart antennas and RFID. | Prerequisite: EL-GY 5023.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5143 Multimedia Laboratory (3 Credits)
This course provides hands-on experience in processing and communication of speech, audio, image and video signals. Topics include sampling and quantization, sampling rate conversion, lossless and lossy compression, basic techniques in speech, audio, image and video coding, multimedia conferencing, video on-demand, video multicasting, multimedia document creation. Students are exposed to popular software and hardware for multimedia signal processing and document creation. Each week includes a lecture and a lab. | Prerequisites: graduate status or EE-UY 3054 or equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5213 Introduction to Systems Engineering (3 Credits)
Typically offered occasionally
This course introduces fundamentals of systems engineering process. Topics: Multi-disciplinary systems methodology, design and analysis of complex systems. Brief history of systems engineering. Mathematical models. Objective functions and constraints. Optimization tools. Topics to be covered include identification, problem definition, synthesis, analysis and evaluation activities during conceptual and preliminary system design phases. Decision analysis and utility theory. Information flow analysis in organizations. Elements of systems management, including decision styles, human information processing, organizational decision processes and information system design for planning and decision support. Basic economic modeling and analysis. Requirements development, life-cycle costing, scheduling and risk analysis. Application of computer-aided systems engineering (CASE) tools. | Prerequisite: Graduate status.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5223 Sensor Based Robotics (3 Credits)
Typically offered occasionally
Topics in this course include robot mechanisms, robot arm kinematics (direct and inverse kinematics), robot arm dynamics (Euler Lagrange, Newton-Euler and Hamiltonian Formulations), six degree-of-freedom rigid body kinematics and dynamics, quaternion, nonholonomic systems, trajectory planning, various sensors and actuators for robotic applications, end-effector mechanisms, force and moment analysis and introduction to control of robotic manipulators. Co-listed as ME-GY 5223 | Prerequisite: Graduate standing or advisor approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5253 APPLIED MATRIX THEORY (3 Credits)
Typically offered occasionally
The course focuses on in-depth introduction to theory and application of linear operators and matrices in finite-dimensional vector space. Topics: determinants, eigenvalues and eigenvectors. Theory of linear equations. Canonical forms and Jordan canonical form. Matrix analysis of differential and difference equations. Singular value decomposition. Variational principles and perturbation theory. Numerical methods. | Prerequisites: Graduate status
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5463 Introduction to RF/Microwave Integrated Circuits (3 Credits)
Typically offered occasionally
The course topics include: review of transmission lines and smith chart. Introduction of signal graphs technique. Noise in microwave circuits. Introduction to active devices for RF and microwave circuits. S-parameter modeling. Design of amplifiers, stability analysis and examples. Oscillators and mixers. Transistor and dielectric resonator oscillators. Design considerations and examples. Introduction to microwave systems. | Prerequisite: EE-UY 3604. *Online version available.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5473 Introduction to VLSI System Design (3 Credits)
This course covers CMOS processing technology, MOS transistor theory, static/dynamic circuit and logic design techniques, circuit performance estimation, standard cells and gate arrays, clocking strategies, input/output structures, datapath, memory and control logic design. Advanced VLSI CAD tools are used for schematic capture, layout, timing analysis and simulations for functionality and performance. | Prerequisite: Senior or Graduate status, CS-UY 2204 & EE-UY 3114 or equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5483 Real Time Embedded Systems (3 Credits)
This course provides an overview of the unique concepts and techniques needed to design and implement computer systems having real-time response requirements in an embedded environment. It contrasts the concepts and techniques of real time and embedded systems with those of more traditional computer systems. Topics include: Basic concepts of real time and embedded systems, hardware features, programming languages, real time operating systems, synchronization techniques, performance optimization and current trends in real time and embedded systems such as incorporating internet connectivity. | Prerequisite: Knowledge of C, Pascal or other programming language and a basic understanding of computer architecture.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5493 ADVANCED HARDWARE DESIGN (3 Credits)
This course shows how a hardware-description language (for example, VHDL) can be used for computer hardware modeling, logic synthesis, register-level synthesis and simulation. The resulting design with hundreds or thousands of gates is then ready to be downloaded to form FPGA chips or silicon cells. Programs used: QuickVHDL, modeling and simulation tools from Mentor Graphics or similar large-scale programs. A design project is required and students make a written and oral presentation. | Prerequisite: Graduate status.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5513 Electro-Optics I (3 Credits)
This course describes the phenomena of and introduces the analyzing techniques for wave propagation in optical systems. Topics include: Review of Maxwell equations; propagation of plane waves: polarization, reflection, refraction, interfaces and multilayers; Fourier optics and diffraction; Ray and Gaussian beams; Optical cavities; Guided optical beams, optical fibers and guiding layers; Dispersion and mode distortion in fibers. | Prerequisites: Graduate status, EE-UY 3604 or equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5523 Electro-Optics II (3 Credits)
This course focuses on active optical systems. Topics include: resonant optical cavities; laser oscillation and amplification; general characteristics of lasers, laser excitation; semiconductor lasers; detection of optical radiation. | Prerequisite: EL-GY 5513.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5533 Physics of Nanoelectronics (3 Credits)
Typically offered occasionally
The course covers limits to the ongoing miniaturization (Moore's Law) of the successful silicon device technology imposed by physical limitations of energy dissipation, quantum tunneling and discrete quantum electron states. Topics: quantum physical concepts and elementary Schrodinger theory. Conductance quantum and magnetic flux quantum. Alternative physical concepts for devices of size scales of 1 to 10 nanometers, emphasizing role of power dissipation. Tunnel diode, resonant tunnel diode, electron wave transistor; spin valve, tunnel valve, magnetic disk and random access memory; single electron transistor, molecular crossbar latch, quantum cellular automata including molecular and magnetic realizations. Josephson junction and rapid single flux quantum' computation. Photo- and x-ray lithographic patterning, electron beam patterning, scanning probe microscopes for observation and for fabrication; cantilever array as dense memory, use of carbon nanotubes and of DNA and related biological elements as building blocks and in self-assembly strategies. Co-listed as PH-GY 5493. | Prerequisites: PH-UY 2033 or instructor's permission.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5553 Physics of Quantum Computing (3 Credits)
Typically offered occasionally
The course focuses on limits to the performance of binary computers, traveling salesman and factorization problems, security of encryption. Topics: the concept of the quantum computer based on linear superposition of basis states. The information content of the qubit. Algorithmic improvements enabled in the hypothetical quantum computer. Isolated two-level quantum systems, the principle of linear superposition as well established. Coherence as a limit on quantum computer realization. Introduction of concepts underlying present approaches to realizing qubits (singly and in interaction) based on physical systems. The systems under consideration are based on light photons in fiber optic systems; electron charges in double well potentials, analogous to the hydrogen molecular ion; nuclear spins manipulated via the electron nuclear spin interaction and systems of ions such as Be and Cd which are trapped in linear arrays using methods of ultra-high vacuum, radiofrequency trapping and laser-based cooling and manipulation of atomic states. Included: summary and comparison of the several approaches. Co-listed as PH-GY 5553. | Prerequisites: PH-GY 2004 Introductory Physics II.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5613 Introduction to Electric Power Systems (3 Credits)
Typically offered occasionally
The course focuses on basic concepts in electric power systems. Topics include: three-phase circuits; component modeling (generators, transmission lines, transformers, etc.); per-unit system; symmetrical components; power flow; short circuit; transient stability; introduction to advanced topics: contingency analysis, optimum power flow, electromagnetic transients, geomagnetically induced currents, and harmonics. The course is complemented by laboratory experiments on synchronous and induction (wind) generators. | Prerequisite: Advisor consent (knowledge of electric circuits and electromagnetic energy conversion)
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5623 FINITE ELEMENTS FOR ELECTRICAL ENGINEERING (3 Credits)
Typically offered occasionally
This course introduces the finite elements method for solving electrical engineering problems. Topics: a refresher of basic concepts of electromagnetism. Introduction to the solution methods of partial differential equations. Comparative summary of the solution methods for Maxwell equations. Finite elements, Garlekin and least squares approaches. Description of some commercial software packages. In this hands-on course, students do assignments and final projects using the finite elements software COMSOL Multiphysics. | Pre-Requisite: Graduate Status or EE-UY 3604 and EE-UY 3824.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5663 Physics of Alternative Energy (3 Credits)
Typically offered occasionally
This course concentrates on non-petroleum sources of energy include photovoltaic cells, photocatalytic generators of hydrogen from water and nuclear fusion reactors. Topics: advanced physics of these emerging technical areas are introduced in this course. Semiconductor junctions, optical absorption in semiconductors, photovoltaic effect. Energy conversion efficiency of the silicon solar cell. Single crystal, polycrystal and thin film types of solar cells. Excitons in bulk and in confined geometries. Excitons in energy transport within an absorbing structure. Methods of making photocatalytic surfaces and structures for water splitting. Conditions for nuclear fusion. Plasmas and plasma compression. The toroidal chamber with magnetic coils as it appears in recent designs. Nuclear fusion by laser compression (inertial fusion). Small-scale exploratory approaches to fusion based on liquid compression and electric field ionization of deuterium gas. Co-listed as PH-GY 5663. | Prerequisites: PH-UY 2033 or instructor's permission
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5683 Electric Drives Characteristics and Controls (3 Credits)
The course centers on conversion of load (resistive) torque, inertia, mass and force to a rotating shaft; acceleration and deceleration times; motor power-rating selection; thermal consideration at different duty cycles; load diagram construction; four-quadrant speed control operation for DC and AC motors; Worked examples. | Prerequisite: EE-UY 3824 or equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5713 MICROWAVE ENGINEERING LABORATORY/PROJECT (3 Credits)
The course covers design, fabrication, testing of passive circuits (couplers and filters), active circuits (amplifier and oscillator) and antennas using printed circuits. Topics: design and stimulation using microwave CAD tools (ADS, HFSS, PCAAMT), HP-8510 automated network analyzer measurement, frequency and time domain measurement, printed circuit layout and photo etching. | Prerequisite: EE-UY 3604 Co-requisite: EL-GY 5733 or EL-GY 6713.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5733 RF and Microwave Systems Engineering (3 Credits)
Typically offered occasionally
The course covers following topics: Review of electromagnetic theory and transmission lines. Printed transmission lines. S, Z, Y, ABCD parameters, network theory, signal flow graphs, CAD methods. Excitation of waveguides. Single and multisection impedance transformer, power divider, directional coupler, hybrid circuits. Microwave resonator: series, parallel resonators, stubs and cavities. Filter theory and designs, coupled-line filters, Kuroda identities, Chebychev and maximally flat filters. | Prerequisite: Graduate status or EE-UY 3604.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5753 Introduction to Plasma Engineering (3 Credits)
The course focuses on basic plasma concepts and applications; parameters describing the plasma; motion of charged particles in electromagnetic fields; effect of particle collisions on plasma transport: diffusion and mobilities. Plasmas as dielectric media; plasma dielectric response functions for collective plasma oscillations and for electromagnetic wave propagation in plasma. Plasmas for practical applications. | Prerequisite: Graduate status or EE-UY 3604.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 5813 BIOMEDICAL INSTRUMENTATION (3 Credits)
This course gives an overview on the theory, design and application of biomedical instrumentation used for dagnosis, monitoring, treatment and scientific study of physiological systems. The objective of this course is to enable students to design, build and test useful circuits, and to interface them with a computer using a data acquisition system for further signal analysis and processing. Cross-listed with EL-GY 5813. | Prerequisite: EE-UY 2024 or equivalent course in circuits, programming experience.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6010 GUIDED STUDIES IN ELEC ENGR (1 Credit)
Typically offered occasionally
Guided studies on various topics in Electrical Engineering.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6013 Digital Communications (3 Credits)
Typically offered occasionally
The course covers the following topics: Principles of M-ary communication: signal space methods, optimum detection. Fundamental parameters of digital communication systems, various modulation techniques and their performance in terms of bandwidth efficiency and error probability. Efficient signaling with coded waveforms. Block coding and convolutional coding. Joint modulation and coding. Equalization for communication over bandlimited channels. Brief overview of digital communications over fading multipath channels. | Prerequisites: EE-UY 3404, EL-GY 6303. *Online version available.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6015 GUIDED STD IN ELEC ENGR (1.5 Credits)
Typically offered occasionally
Guided studies on various topics in Electrical Engineering.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6020 GUIDED STD IN ELEC ENGR (2 Credits)
Typically offered occasionally
Guided studies on various topics in Electrical Engineering.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6023 Wireless Communications (3 Credits)
Typically offered occasionally
This course covers the fundamentals of wireless communications including statistical descriptions of the wireless channel (path loss models, large-scale and small-scale fading), digital communication over fading channels (channel estimation, receiver design and performance, Shannon theory of time-varying channels, channel coding, diversity and related MAC-layer concepts), introduction to cellular systems and multiple access (frequency reuse, OFDM, CDMA, capacity analysis and basics of multiuser information theory) and MIMO communication. Examples will be provided from state-of-the-art cellular and wireless LAN standards. | Prerequisites: EL-GY 6013.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6025 GUIDED STD IN ELEC ENGR (2.5 Credits)
Typically offered occasionally
Guided studies on various topics in Electrical Engineering.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6063 Information Theory (3 Credits)
Typically offered occasionally
Mathematical information measures: entropy, relative entropy and mutual information. Asymptotic equipartition property, entropy rates of stochastic processes. Lossless source encoding theorems and source coding techniques. Channel capacity, differential entropy and the Gaussian channel. Lossy source coding rate distortion theory. Brief overview of network information theory. | Prerequisite: ECE-GY 6303 and Graduate status.
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: ECE-GY 6303 and Graduate status.

ECE-GY 6073 Error Control Coding (3 Credits)
The course covers the following topics: The general theory of linear codes. Galois fields. Coding and error correction methods. Linear block codes. Convolutional codes. Parallel and serial concatenated codes. Iterative decoding algorithms. Low density parity check codes. | Prerequisites: EL-GY 6303.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6113 Digital Signal Processing I (3 Credits)
Typically offered occasionally
Discrete and continuous-time linear systems. Z-transform. Fourier transforms. Sampling. Discrete Fourier transform (DFT). Fast Fourier transform (FFT). Digital filtering. Design of FIR and IIR filters. Windowing. Least squares in signal processing. Minimum-phase and all-pass systems. Digital filter realizations. Matlab programming exercises. Co-listed as BE-GY 6403 | Prerequisites: Graduate status. *Online version available.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6123 Image and Video Processing (3 Credits)
Typically offered occasionally
This course introduces fundamentals of image and video processing, including color image capture and representation; color coordinate conversion; contrast enhancement; spatial domain filtering (linear convolution, median and morphological filtering); two-dimensional (2D) Fourier transform and frequency domain interpretation of linear convolution; 2D Discrete Fourier Transform (DFT) and DFT domain filtering; image sampling and resizing; geometric transformation and image registration; video motion characterization and estimation; video stabilization and panoramic view generation; basic compression techniques (entropy coding, vector quantization, predictive coding, transform coding); JPEG image compression standard; wavelet transform and JPEG2000 standard; video compression using adaptive spatial and temporal prediction; video coding standards (MPEGx/H26x); Stereo and multi-view image and video processing (depth from disparity, disparity estimation, video synthesis, compression). Students will learn to implement selected algorithms in MATLAB or C-language. | Prerequisites: Graduate Standing or Undergraduate Standing having completed EE-UY 3054 and EE-UY 2233. Suggested Corequisites: EL-GY 6113 and EL-GY 6303 (not required)
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6143 MACHINE LEARNING (3 Credits)
Typically offered Fall and Spring
This course is an introduction to the field of machine learning, covering fundamental techniques for classification, regression, dimensionality reduction, clustering, and model selection. A broad range of algorithms will be covered, such as linear and logistic regression, neural networks, deep learning, support vector machines, tree-based methods, expectation maximization, and principal components analysis. The course will include hands-on exercises with real data from different application areas (e.g. text, audio, images). Students will learn to train and validate machine learning models and analyze their performance. May not take if student has already completed ECE-UY 4563. | Prerequisite: Graduate status with undergraduate level probability theory
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: Graduate status.

ECE-GY 6183 Digital Signal Processing Laboratory (3 Credits)
Typically offered occasionally
Real-time implementation of algorithms for digital signal processing (DSP) with an emphasis on audio processing. Audio input-output and buffering. Filtering (recursive and non-recursive filters, structures). Fast Fourier transform and windowed spectral analysis. Digital audio effects (delay line, amplitude modulation, reverberation, distortion, phase vocoder). Time-varying and adaptive filters. Students with learn to implement these algorithms for real-time audio processing in software (e.g., Matlab and Python). | Prerequisites: EE-UY 3054 or equivalent (for undergraduate students) or Graduate Standing.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6213 SYSTEM MODELING,ANALYSIS & DESIGN (3 Credits)
Introduction of basic system concepts such as system state, inputs, outputs and disturbances. Modeling methods and Computer Aided Systems Engineering (CASE) formal structures. CASE tools for solving practical systems related problems. Quantitative techniques including linear programming, network flow analysis, integer and nonlinear programming, Petri nets, basic probabilistic and stochastic tools, Markov processes, queueing theory and Monte Carlo techniques for simulation. Fundamentals of decision and risk analysis. | Prerequisite(s): EL-GY 5213. Corequisite(s): EL-GY 6303 recommended.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6223 Nonlinear and Sampled-Data Control Systems (3 Credits)
Introduction of nonlinear systems. Phase plane analysis, nonlinearities, linearization, limit cycles and averaging. Stability techniques: describing function, Lyapunov functions, Popov locus ad circle criterion. Analysis and design of sampled-data systems by Z-transforms and state variable methods. Semiglobal and global stabilization of nonlinear sampled-data systems. PrerequisItes: Graduate status and EL-GY 6253.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6233 System Optimization Method (3 Credits)
Typically offered occasionally
Formulations of system optimization problems. Elements of functional analysis applied to system optimization. Local and global system optimization with and without constraints. Variational methods, calculus of variations, and linear, nonlinear and dynamic programming iterative methods. Examples and applications. Newton and Lagrange multiplier algorithms, convergence analysis. | Prerequisites: Graduate status and EL-GY 5253 or EL-GY 6253 or equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6243 System Theory and Feedback Control (3 Credits)
Design of single-input-output and mul-tivariable systems in frequency domain. Stability of interconnected systems from component transfer functions. Parameterization of stabilizing controllers. Introduction to optimization (Wiener-Hopf design). | Prerequisites: Graduate status and EE-UY 3064.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6253 Linear Systems (3 Credits)
Typically offered occasionally
Basic system concepts. Equations describing continuous and discrete-time linear systems. Time domain analysis, state variables, transition matrix and impulsive response. Transform methods. Time-variable systems. Controllability, observability and stability. SISO pole placement, observer design. Sampled data systems. | Prerequisites: Graduate status and EE-UY 3054 or EL-GY 5253.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6263 Game Theory (3 Credits)
Typically offered Fall
The goal of this class is to provide a broad and rigorous introduction to game-theoretic methods and algorithms for complex systems. The material spans disciplines as diverse as engineering (including control theory and signal processing), computer science (including artificial intelligence, algorithms and distributed systems), micro-economic theory, operations research, public policies, psychology and belief systems. A primary focus of the course is on the application of cooperative and non-cooperative game theory for both static and dynamic models, with deterministic as well as stochastic descriptions. The coverage will encompass both theoretical and algorithmic developments, with multi-disciplinary applications. | Prerequisites: Graduate Standing
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6303 Probability and Stochastic Processes (3 Credits)
Typically offered occasionally
Continuous and discrete random variables and their joint probability distribution and density functions; Functions of one random variable and their distributions; Independent random variables and conditional distributions; One function of one and two random variables; Two functions of two random variables and their joint density functions; Jointly distributed discrete random variables and their functions; Characteristic functions and higher order moments; Covariance, correlation, orthogonality; Jointly Gaussian random variables; Linear functions of Gaussian random variables and their joint density functions. Stochastic processes and the concept of Stationarity; Strict sense stationary (SSS) and wide sense stationary (WSS) processes; Auto correlation function and its properties; Poisson processes and Wiener processes; Stochastic inputs to linear time-invariant (LTI) systems and their input-output autocorrelations; Input-output power spectrum for linear systems with stochastic inputs; Minimum mean square error estimation (MMSE) and orthogonality principle; Auto regressive moving average (ARMA) processes and their power spectra. Co-listed as BE-GY 6453. | Prerequisite: Graduate status. *Online version available.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6333 Detection and Estimation Theory (3 Credits)
Typically offered occasionally
Binary hypothesis testing and Bayes' criteria; Receiver operating characteristics; Composite hypothesis testing. Parameter estimation theory - Random parameter estimation; Minimum mean square error (MMSE) estimation; Maximum a-posteriori (MAP) estimation; Nonrandom parameter estimation; Minimum variance unbiased estimators; Cramer-Rao bound and Rao-Blackwell theorem; Multiple parameter estimation and Fisher information matrix. Series representation of stochastic processes; Karhunen Loeve (K-L) expansion of a stochastic process over a finite time. Stationary stochastic processes; Autocorrelation function and power spectrum; Spectrum extension problem from finite autocorrelations; Maximum entropy solution and auto regressive processes. Direction of arrival (DoA) estimation using multiple sensors; Detection of distinct signals in white noise and colored noise. | Prerequisites: EL-GY 6303.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6353 INTERNET ARCHITECTURE & PROTOCOLS (3 Credits)
Typically offered occasionally
This course introduces basic local area networking technologies and protocols in a set of lectures and laboratory experiments. Topics: link level protocols. Local area networks: CSMA/CD, Token Ring, IEEE standards and protocols. The Internet protocol suite: IP, ARP, RARP, ICMP, UDP and TCP. LAN Interconnection: bridges, routers and gateways. Application protocols: SNMP, FTP, SMTP and NFS. | Prerequisite: ECE-UY 3613
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6363 Data Center and Cloud Computing (3 Credits)
Typically offered Fall
Data center and cloud computing are key technologies in building large-scale Internet services. Many service providers rely on data center and cloud computing platforms to provide applications, storage, computation, etc. This course covers the fundamental knowledge of data center and cloud computing and offers hands-on experience. Topics to be discussed include data center and cloud platform architecture, data center network designs, software-defined networks, data center security, traffic engineering, resource management, green data centers, and multi-access edge computing. The course provides a series of labs for students to learn various tools used in data centers and cloud computing. | Prerequisites: ECE-GY 6353 or equivalent course.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6373 Local and Metropolitan Area Networks (3 Credits)
This course introduces students to fundamental design issues in wireless and wired local and metropolitan area networks, explains the state-of-the-art solutions proposed and deployed in the field by using latest standards and protocols as examples, and discusses trends in the wireless/wired LAN/MANs. Example wireless technologies covered include the IEEE 802 family of protocols, e.g., WiFi, WiMax and Bluetooth. Example wireline technologies include those associated with Ethernet and MAN technologies such as Resilient Packet Ring. | Prerequisites: EL-GY 5363 or EE-UY 136 or instructor's permission. *Online version available.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6383 High-Speed Networks (3 Credits)
Typically offered occasionally
This course covers the basics, architectures, protocols and technologies for high-speed networks. Topics: synchronous optical network (SONET), asynchronous transfer mode (ATM), ATM adaptation layer (AAL), 10/100/1000/10G Ethernet, Ethernet over SONET (EOS), quality of service control, packet scheduling, network processor, buffer management, flow and congestion control, TCP, high-speed TCP and XCP, Routing and IP fast rerouting, WDM networks, MPLS and GMPLS. Each student is required to complete a project that can be reading, software design or hardware design. | Prerequisites: EE-UY 136 or EL-GY 5373 or equivalent
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6393 NETWORK SECURITY SYSTEMS DESIGN (3 Credits)
While the recent proliferation of broadband wireline and wireless networking technologies have substantially increased the available network capacity and enabled a wide-range of feature-rich high-speed communication services, security remains a major concern. Network attacks have become common recurring events that increasingly threaten the proper functioning and continual success of the communication infrastructure and services. One way to mitigate such threats is to develop new security/defense architectures, systems, methodologies and algorithms that can scale together with the communications infrastructure in terms of operating speed, operational simplicity and manageability. This course aims to understand the theoretical, architectural, system and implementation issues related to all aspects of security in high-speed networks and study various proposed solutions. Students are required to read research papers and complete a term project with either simulation programs to evaluate the proposed schemes, or architecture/VHDL designs for the schemes. | Prerequisites: CS-GY 6823 or advisor approval. *Online version available.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6403 Fundamentals of Analog Integrated Circuit Design (3 Credits)
Typically offered occasionally
The course will begin by providing a device-oriented overview of integrated circuits and silicon fabrication processes and their ramifications on the transistor models. Subsequently, we will discuss various amplifier topologies in ICs using these devices, and also examine in detail topics such as frequency response, linearity, biasing, feedback, operational amplifiers, compensation, and noise. The blocks and circuit architectures discussed in this course are the core components of most integrated systems and essential in applications such as communications, multimedia, imaging, sensors, and biomedical. | Prerequisites: Graduate Standing or EE-UY 3124 and cumulative GPA of 3.0 or higher (Undergraduate students)
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6423 RF Electronics for Wireless Applications (3 Credits)
Tuned circuits and impedance transformers, narrowband nonlinear amplifiers. Tuned circuit sine wave oscillators, mixers, AM modulators and demodulators, FM modulators and demodulators and the phase-locked loop. | Prerequisites: EL-GY 6413.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6443 VLSI System and Architecture Design (3 Credits)
This course continues from EL-GY 6473 and covers top-down VLSI design using VHDL including structural design, modeling, algorithmic and register level design, synthesis, prototyping and implementation using FPGAs and methods to design for test (DFT). This course provides a solid background and hands-on experiences with the CMOS VLSI design process in which custom design techniques (covered in EL-GY 6473) are married with HDL synthesis to produce complex systems. Students complete a project covering design partitioning, placement and routing, automated synthesis and standard cell design and use. The course explores how these techniques are used in designing ASICs, System-on-Chips (SoC) and advanced microprocessors. | Prerequisite: EL-GY 6473.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6453 ADVANCES IN RECONFIGURABLE SYSTEMS (3 Credits)
Typically offered occasionally
Reconfigurable hardware platforms are in widespread use for telecommunications, video processing, cryptography, control and biomedical applications. The course will provide a detailed understanding of the real world reconfigurable hardware design methodologies using Field Programmable Gate Arrays (FPGA). A complete system will be implemented from specification to physical implementation on a FPGA. In the process, the course will discuss (1) designing a complex digital system using a hardware description language; (2) implementing, testing and validating the design on a reconfigurable hardware platform; and (3) providing all relevant design information to be able to integrate the reconfigurable hardware platform in any higher level system. | Prerequisite(s): EL-GY 6463 Advanced Hardware Design
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6463 ADVANCED HARDWARE DESIGN (3 Credits)
Typically offered occasionally
This course shows how a hardware-description language (for example, VHDL) can be used for computer hardware modeling, logic synthesis, register-level synthesis and simulation. The resulting design with hundreds or thousands of gates is then ready to be downloaded to form FPGA chips or silicon cells. Programs used: QuickVHDL, modeling and simulation tools from Mentor Graphics or similar large-scale programs. A design project is required and students make a written and oral presentation. | Prerequisite: Graduate status.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6473 Introduction to VLSI System Design (3 Credits)
Typically offered occasionally
This course covers CMOS processing technology, MOS transistor theory, static/dynamic circuit and logic design techniques, circuit performance estimation, standard cells and gate arrays, clocking strategies, input/output structures, datapath, memory and control logic design. Advanced VLSI CAD tools are used for schematic capture, layout, timing analysis and simulations for functionality and performance. | Prerequisite: Senior or Graduate status, CS-UY 2204 & EE-UY 3114 or equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6483 Real Time Embedded Systems (3 Credits)
Typically offered occasionally
This course provides an overview of the unique concepts and techniques needed to design and implement computer systems having real-time response requirements in an embedded environment. It contrasts the concepts and techniques of real time and embedded systems with those of more traditional computer systems. Topics include: Basic concepts of real time and embedded systems, hardware features, programming languages, real time operating systems, synchronization techniques, performance optimization and current trends in real time and embedded systems such as incorporating internet connectivity. | Prerequisite: Knowledge of C, Pascal or other programming language and a basic understanding of computer architecture.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6493 DIGITAL VLSI SYSTEM TESTING (3 Credits)
Manufacturing test fundamentals; Logic simulation; Fault modeling and simulation; Automatic test pattern generation algorithms (combinational and sequential test generation); Enhancing testability of digital systems; Design for testability; Scan-based testing: Partial scan vs full scan; Transition and path-delay faults and their testing; Advanced testing techniques: Test data compaction and compression techniques; Integrated circuits vs System-on-A-Chip (SOC) design styles and their manufacturing test implications. | Prerequisite: CS-UY 2204 or equivalent
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6513 Fundamentals of Solid-State Electronic Devices (3 Credits)
Typically offered occasionally
Introduction to semiconductor materials, energy band structures, and carrier transport; p-n junctions and Schottky barriers; heterostructures; bipolar and field-effect transistors; and introduction/survey of some electronic/optoelectronic devices that utilizes above device concepts. | Prerequisites: Graduate Standing or Undergraduate Standing with 3.0 GPA or higher and completion of MA-UY 2034 and PH-UY 2023.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6523 Nanoelectronic Devices (3 Credits)
Typically offered occasionally
Introduction to quantum mechanics (Schroedinger's equation); energy-band diagrams in semiconductors, quantum effects in MOS transistors; analytical description of ultra-thin body (UTB) MOSFETs, FinFETs and tunnel FETs; introduction to mesoscopic transport; MIT virtual source model; novel channel materials for transistors (InGaAs, graphene, carbon nanotubes), alternate state variable devices (design in sub-nanometer nodes, spintronics). | Prerequisites: Graduate Standing or undergraduate students must have 3.0 cumulative GPA or higher.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6553 QUANTUM MECHANICS I (3 Credits)
Quantum mechanics with applications to atomic systems. The use of Schrodinger's equations. Angular momentum and spin. Semi-classical theory of field-matter interaction. | Prerequisites: MA-UY 2122, PH-UY 3234 equivalents.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6583 Fiber Optic Communications (3 Credits)
Typically offered occasionally
This course deals with the operating principles of optical communications systems and fiber-optic communication technology. The main elements of systems are presented in block diagrams and discussed individually. The advantages and disadvantages and the applications of Fiber Optic Communications Systems are discussed. Topics include: overview of optical communication systems, review of optics, review of analog and digital communications, the characteristics of optical fibers, optical waveguides, optical sources and transmitters, optical detectors and receivers, optical amplifiers, noise and detection, impairment in optical communication systems and optical network design issues. Upon completion of this course, students are familiar with the principles and technology of optical communication systems, and are able to design a simple point-to-point optical communications link, including bandwidth, loss, signal to noise ratio (S/N) and bit error rate considerations. | Prerequisite: Graduate status or ECE-UY 3604.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6603 Power Electronics (3 Credits)
The course centers on principles of thyristor devices, GTOs, MOSFETs, IGBTs; dynamic characteristics of DC/DC converters; forced commutation circuits; switched-mode power supplies; full- wave and half-wave rectifiers; phase controlled converters; effect of the load characteristics; pulse-width modulated inverters. | Prerequisites: Graduate status and EE-UY 3824 or equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6613 ELECTRICAL TRANSMISSION & DISTRIBUTION SYSTEMS (3 Credits)
Typically offered occasionally
Introduction to T&D systems. Choice of voltage and frequency. Radial and meshed networks. Aerial lines: construction, parameters and thermal rating. Cables: installations, impedance and thermal ring. Transformers and reactors: types, connections and parallel operation. Capacitors: construction and application to transmission, distribution and industrial systems. Grounding systems. Characteristics of loads: customer classes, voltage sensitivity, duty cycle, and load growth. Loss minimization by system reconfiguration and capacitor switching. Modern grids: nano-, micro-, mini-, smart-, and super-grid. | Prerequisite: Knowledge of Electric Power System"
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6623 Smart Grids: Control, Economics, Planning and Regulation (3 Credits)
Typically offered occasionally
This course teaches multi-disciplinary fundamentals of power engineering, economics, optimization, and policy analysis that constitute modern power system economics and planning. These fundamentals make it possible to understand and study the concept of smart grids as a particular case of large-scale, network-constrained infrastructure that can be simulated by using various optimization techniques. The course also provides knowledge to pursue advanced work on transmission- and distribution-level smart grid technologies, e.g. renewable generation, demand response, energy storage. | Prerequisites: Graduate status and EL-GY 5613 or equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6633 ELECTROMAGNETIC TRANSIENTS IN POWER SYSTEMS (3 Credits)
Analysis of lumped-circuit, normal and abnormal transients in power equipment and systems. Short-circuit fault analysis and transient recovery of three-phase circuits. Analysis of traveling-wave surges on transmission lines, windings and integrated systems. | Prerequisites: Graduate status and EL-GY 5613 or equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6643 Relay Fault Protection (3 Credits)
Protective relay functions and classification. Electromechanical relay types, operating principles and basic characteristics. Communication channels for relaying. Current and voltage transformers, transducers. Protection of busses, transformers, generators, motors and other station equipment by the zone protection method. Distribution and transmission line relaying systems. Relay setting calculations. Primary and backup protection, application and philosophy with applied relay engineering examples. | Prerequisites: Graduate status and EL-GY 5613 or equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6653 POWER SYSTEM OPERATION AND CONTROL (3 Credits)
Typically offered occasionally
This course focuses on optimal control problem for deterministic and stochastic systems with various constraints. Topics: solution for both continuous and discrete-time systems using the maximum principle and dynamic programming. Fuel and time optimal control problems. Optimal filtering and estimation. Stochastic and hybrid optimal control problems. Computational methods. Multidisciplinary applications of optimal control. | Prerequisites: Graduate status, ECE-GY 6623 or permission of the instructor.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6663 Distributed Generation Systems (3 Credits)
Typically offered occasionally
Benefits and limitations and classification of small generating systems; principles of operation and electrical equivalent circuits of fuel cells, solar cells, micro-turbines, reciprocating engines, wind turbines and gas turbines; fault conditions; reactive power support; power quality issues. | Prerequisites: EE-UY 3824 and EL-GY 5613 or equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6673 RESONANT POWER CONVERTERS (3 Credits)
Typically offered occasionally
Class D and E rectifiers. Class D inverters. Class E inverters. Phase-controlled resonant inverters. Class DE inverters. Resonant dc-dc converters. Soft switching. Quasiresonant and multiresonant converters. Control and modeling of resonant converters. | Prerequisite(s): EE-UY 3824 or an approved equivalent
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6683 Electric Drives (3 Credits)
Typically offered occasionally
Reduction of load performance characteristics to the motor shaft. Electromechanical energy conversion. Acceleration and deceleration time. Construction of load diagram. Choice of motor type and size for different duty cycles. Four quadrant operation. Basics of Direct-Current and Induction motor drives. Permanent magnet and synchronous drives. Electrical braking. Conventional and modern speed control of DC and AC drives. Also included are many worked examples taken from practical electric drive systems. | Prerequisites: Graduate status and EE-UY 3824 or an approved equivalent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6693 Electronic Power Supplies (3 Credits)
Typically offered occasionally
This course covers following topics: Review of power relationships. Power semiconductor switching devices. Rectifiers. Basic PWM dc-dc switching cells. Non-isolated and isolated PWM dc-dc converters. Control of PWM converters. Resonant and softswitching converters. Low drop-out (LDO) voltage regulators. Switched capacitor charge pumps. PWM inverters. Applications to computer equipment, portable units, distributed power systems, uninterruptible power supplies and electric drives. Power quality and EMI issues. American and International power-supply standards. | Prerequisite: EE-UY 3824 or equivalent. *Online version available.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6713 Electromagnetic Theory and Applications (3 Credits)
Typically offered occasionally
This course introduces Maxwell's equations, wave equation, vector potentials, boundary conditions and Poynting vector. Time-harmonic fields and phasor approach are introduced. The properties of freely propagating plane waves in uniform and layered media are derived, as well as waves guided by structures, including various transmission lines, hollow waveguides and dielectric waveguides. A unified treatment of wave propagation is given with general theorems and examples drawn from microwaves, integrated circuits and optics. | Prerequisites: Graduate status and EE-UY 3604.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6723 ELECTROMAGNETIC RADIATION AND ANTENNAS (3 Credits)
Typically offered occasionally
The electromagnetic fields radiated by current elements are derived from Maxwell's equations. From these results, the fields radiated by many types of antennas are derived, including various types of dipoles, arrays, aperture, and frequency independent and traveling wave antennas. Concepts introduced include radiation resistance and pattern, directivity, gain, effective area, reciprocity, bandwidth, noise temperature, mutual coupling and array scanning impedance. | Prerequisites: Graduate status and EL-GY 6713, or EL-GY 3604 with grade B or better.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6753 UHF Propagation for Wireless Systems (3 Credits)
The course examines UHF radio applications for cellular mobile radio telephones, wireless local area networks and personal communications networks, propagation and reflection of plane waves and spherical waves; antennas for transmitting and receiving; path loss and link budgets; Huygens' principle; Fresnel zone and diffraction of plane and spherical waves; mathematical models of UHF propagation over a flat earth, around buildings in cities and within buildings; influence of propagation on capacity of cellular systems. | Prerequisites: Graduate status and undergraduate electromagnetics course. *Online version available.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6813 Medical Imaging I (3 Credits)
Typically offered occasionally
This course introduces the physics, instrumentation and signal processing methods used in X-ray imaging (projection radiography), X-ray computed tomography, nuclear medicine (SPECT/PET), ultrasound imaging, magnetic resonance imaging and optical imaging. Co-listed with BE-GY 6203 Prerequisites: Undergraduate level courses in multivariable calculus (MA-UY 2112 & MA-UY 2122 or MA-UY 2114), physics (PH-UY 2033), probability (MA-UY 3012), signals and systems (EE-UY 3054). Students who do not have prior courses in signals ans systems must take EL-GY 6113 / BE-GY 6403 - Digital Signal Processing I as a prerequisite or must obtain instructor's approval; EL-GY 6123 - Image and Video Processing is also recommended but not required.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6823 MEDICAL IMAGING II (3 Credits)
This course introduces mechanisms and concepts related to image acquisition, subsequent image processing and image formation in various biomedical imaging modalities. Building on material covered in EL-GY 5823/BE6203-Medical Imaging I, this course focuses on advanced topics such as functional magnetic resonance imaging (MRI), ultrasound imaging, biomagnetic imaging and optical tomographic imaging. | Prerequisites: EL-GY 5823/BE-GY 6203. Co-listed as BE-GY 6213.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 6913 Computing Systems Architecture (3 Credits)
Typically offered Fall
This course provides students with an understanding of computer systems architectures and fundamental computer- performance and capacity-improvement techniques. An assembly language and an instruction set are presented and a uniprocessor computer is built to implement the instruction set. Processor implementation with a data path and hardwired and microprogrammed control is introduced, and pipelining is described as a strategy to improve throughput. Memory-hierarchy alternatives are introduced to improve the capacity of the computing system. The concept of virtual memory and its hardware implementation is introduced. Out-of-order processors, and associated instruction scheduling algorithms and techniques are described and evaluated. Branch prediction is introduced. The main memory system is described and pre-fetching is discussed as a technique to improve main memory access latency. The course concludes with an introduction to single chip multi-core computing technology. Hands-on programming exercises to illustrate the concepts are inter-woven throughout the course. | Prerequisites: Undergraduate degree in EE/CE/CS
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 7023 Space-Time Wireless Communications (3 Credits)
The course provides an introduction to Multiple-Input Multiple-Output (MIMO) wireless communication systems. MIMO system capacity, MIMO system design criteria. Space-time block and trellis codes. Spatial multiplexing and receiver design. Applications to MIMO OFDM systems. | Prerequisites: EL-GY 6303. Co-requisites: EL-GY 6013 or EL-GY 6023.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 7123 DEEP LEARNING (3 Credits)
Typically offered Fall
This course provides an overview of deep neural network learning (covering mathematical foundations as well as example applications in NLP, computer vision, and reinforcement learning). Upon successful completion, students will be able to grasp the mathematical basics of deep learning, solve practical machine learning problems in applications, and implement software prototypes of deep learning solutions to these problems. | Prerequisites: ECE-GY 6143 or CS-GY 6923 or equivalent graduate course
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 7133 Digital Signal Processing II (3 Credits)
Typically offered occasionally
Filter design via optimization. Spectral factorization. Minimum-phase FIR filter design. Multirate systems. Interpolation. Short-time Fourier transform (STFT). Filter banks. Wavelet transforms (in one and two dimensions). Lattice filters for filter banks. Sparse signal processing (optimization algorithms and applications). Signal/image models (mixture models, non-Gaussian, etc.). Inverse problems (de-blurring, missing data estimation). Matlab programming exercises. | Prerequisites: EL-GY 6113 or Equivalent. *Online version available.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 7143 Advanced Machine Learning (3 Credits)
Typically offered Spring
This course presents the main concepts, techniques, algorithms, and state-of-the-art approaches in modern machine learning from both theoretical and practical perspective. Students will be exposed to new mathematical proof techniques and up-to-date machine learning coding environments and benchmark datasets. The program of the course includes empirical risk minimization, support vector machines, kernels, optimization techniques for machine learning, clustering, principal component analysis, Expectation-Maximization, online learning algorithms, boosting, decision trees, graphical models, and deep learning. The course contains tutorials on selected most popular machine learning software environments. The course finally emphasizes interesting and important open problems in the field. Mathematical maturity (https://en.wikipedia.org/wiki/Mathematical_maturity) is required from students registering for the course. | Prerequisites: A grade of A- or better in (ECE-GY 6143 or CS-GY 6923) and a grade of B+ or better in ECE-GY 6303.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 7153 ARRAY SIGNAL PROCESSING (3 Credits)
General sonar and radar array processing concepts. Array performance considerations. Narrowband and broadband signal processors. Classical and high resolution techniques for source direction finding. Eigenstructurebased techniques and spatial smoothing techniques. Performance analysis of eigenstructure-based techniques. Asymptotic distribution of eigenparameters associated with smoothed sample covariance matrices in uncorrelated and coherent scenes. Wiener solution and adaptive algorithms. Least Mean Square (LMS), accelerated gradient search and gradient algorithms with constraints. Direct implementation by inversion of the sample covariance matrix and transient response considerations. Smart antenna design concepts for Rayleigh fading cellular communication channels. Space Time Adaptive Processing (STAP) for ground and air moving target detection. | Prerequisites: Graduate status, EL-GY 6113 and EL-GY 6313.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 7213 ROBOT LOCALIZATION AND NAVIGATION (3 Credits)
Typically offered Spring
This course presents the concepts, techniques, algorithms, and state-of-the-art approaches for robot perception, localization, and mapping. The course will show the theoretical foundations and will also have a substantial experimental component based on Matlab/ROS. The course will start from basic concepts in probability and then introduce probabilistic approaches for data fusion such as Bayes Filters, Kalman Filter, Extended Kalman Filter, Unscented Kalman Filter, and Particle Filter. Then, the course will introduce the SLAM problem showing how this has recently been solved using batch optimization and graph methods. Finally, mapping algorithms will also be briefly discussed. | Prerequisites: ECE-GY 6253 or instructor's approval
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: ECE-GY 6253.

ECE-GY 7233 OPTIMAL AND STOCHASTIC CONTROL AND APPLICATIONS (3 Credits)
Typically offered Spring
This course focuses on optimal control problem for deterministic and stochastic systems with various constraints. Topics: solution for both continuous and discrete-time systems using the maximum principle and dynamic programming. Fuel and time optimal control problems. Optimal filtering and estimation. Stochastic and hybrid optimal control problems. Computational methods. Multidisciplinary applications of optimal control. | Prerequisites: Graduate status, ECE-GY 6233 and ECE-GY 6253 or permission of the instructor
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 7253 State Space Design for Linear Control Systems (3 Credits)
Typically offered occasionally
Topics covered in this course include canonical forms; control system design objectives; feedback system design by MIMO pole placement; MIMO linear observers; the separation principle; linear quadratic optimum control; random processes; Kalman filters as optimum observers; the separation theorem; LQG; Sampled-data systems; microprocessor-based digital control; robust control and the servocompensator problem. | Prerequisites: Graduate status and EL-GY 6253.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 7353 Network Modeling and Analysis (3 Credits)
Typically offered occasionally
The course introduces the analytical techniques used in the design and performance analysis of networks. Building on their knowledge of networking technology and applied mathematics, especially probability, students learn basic queuing theory, to be applied to performance analysis of multiplexers, switches and multiple access networks. Newer techniques such as the network calculus, the study of non-Poissonian long range dependent traffic sources and applications to TCP, admission control, advanced packet switches and IEEE 802.11 networks are introduced. | Prerequisites: EE-UY 136 or EL-GY 5373 or equivalent and EL-GY 6303 (acceptable as co-requisite)
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 7363 Network Design and Algorithms (3 Credits)
Typically offered occasionally
The course covers network design, which consists of topology design and traffic routing taking into account dynamics in network states, such as link/node failures and traffic demand variations. Efficient design models and optimization methods are crucial to simultaneously achieve good network user performance and high savings in network deployment and maintenance. This course introduces mathematical models, design problems and optimization algorithms that can be used to guide network design practice. Subjects include: Network Design Problem Modeling, Optimization Methods, Multi-Commodity Flow Routing, Location and Topological Design, Fair Networks, Resilient Network Design, Robust Network Design, Multi-Layer Networks. | Prerequisite: EE-UY 136 or EL-GY 5373 or equivalent
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 7373 High Performance Switches and Routers (3 Credits)
Typically offered occasionally
This course addresses the basics, the theory, architectures and technologies to implement high-performance high-speed large-scale routers and switches. The fundamental concepts and technologies of packet forwarding, classification and switching learned in the class are useful and practical when designing IP routers, Ethernet switches and optical switches. Topics: IP Route Lookup, Packet Classification, Packet Scheduling, Buffer Management, Basics of Packet Switching, Output-buffered Switches, Shared-memory Switches, Crosspoint-buffered Switches, Input-buffered Switches, Clos-network Switches, Multi-Stage Buffered Switches, Two-Stage Load-Balanced Switches, Optical Packet Switches and ASIC for IP Routers. | Prerequisites: EE-UY 136 or EL-GY 5373 or equivalent
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 8223 APPLIED NONLINEAR CONTROL (3 Credits)
Stability and stabilization for nonlinear systems; Lyapunov stability and functions, input-output stability and control Lyapunov functions. Differential geometric approaches for analysis and control of nonlinear systems: controllability, observability, feedback linearization, normal form, inverse dynamics, stabilization, tracking and disturbance attenuation. Analytical approaches: recursive back stepping, input-to-state stability, nonlinear small-gain methods and passivity. Output feedback designs. Various application examples for nonlinear systems including robotic and communication systems. | Prerequisites: Graduate status and EL-GY 6253 or EL-GY 7253.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 8233 OPTIMAL AND STOCHASTIC CONTROL AND APPLICATIONS (3 Credits)
This course focuses on optimal control problem for deterministic and stochastic systems with various constraints. Topics: solution for both continuous and discrete-time systems using the maximum principle and dynamic programming. Fuel and time optimal control problems. Optimal filtering and estimation. Stochastic and hybrid optimal control problems. Computational methods. Multidisciplinary applications of optimal control. | Prerequisites: Graduate status, ECE-GY 6233 and ECE-GY 6253 or permission of the instructor
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 8253 LARGE SCALE SYSTEMS AND DECENTRALIZED CONTOL (3 Credits)
Typically offered occasionally
This course introduces analysis and synthesis of large-scale systems. Topics: systemorder reduction algorithms, interconnected system stability, series expansion and singular perturbation. Lyapunov designs. Applications to traffic networks, power systems and transportation networks. Decentralized control: decentralized fixed-mode, LQR, frequency- shaped cost functionals and overlapping decompositions. Stability of interconnected systems and Vector Lyapunov analysis. | Prerequisites: Graduate status and EL-GY 7253 or instructor's permission.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 9013 SELECTED TPCS IN WIRELESS COMM (3 Credits)
This course covers selected topics of current interest in wireless communications. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9023 SELECTED TPCS IN WIRELESS COMM (3 Credits)
This course covers selected topics of current interest in wireless communications. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9033 SELECTED TPCS IN WIRELESS COMM (3 Credits)
This course covers selected topics of current interest in wireless communications. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9043 SELECTED TPCS IN WIRELESS COMM (3 Credits)
Typically offered occasionally
This course covers selected topics of current interest in wireless communications. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9053 SELECTED TPCS IN WIRELESS COMM (3 Credits)
Typically offered occasionally
This course covers selected topics of current interest in wireless communications. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9093 SELECT TOPICS IN WIRELESS COMMUNICATION (3 Credits)
This course covers selected topics of current interest in wireless communications. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9113 SEL TOP IN SIGNAL PROCESSING (3 Credits)
The course centers on selected topics of current interest in signals and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9123 SELECTED TOPICS IN SIGNAL PROCESSING (3 Credits)
The course centers on selected topics of current interest in signals and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes
Prerequisites: ECE-GY 6143.

ECE-GY 9133 SEL TOPCS IN SIGNAL PROCESSING (3 Credits)
The course centers on selected topics of current interest in signals and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9143 SELECTED TOPICS IN SIGNAL PROC (3 Credits)
Typically offered occasionally
The course centers on selected topics of current interest in signals and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes
Prerequisites: ECE-GY 6143 and ECE-GY 6913.

ECE-GY 9153 SEL TOPCS IN SIGNAL PROCESSING (3 Credits)
The course centers on selected topics of current interest in signals and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9163 SEL TOPCS IN SIGNAL PROCESSING (3 Credits)
The course centers on selected topics of current interest in signals and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes
Prerequisites: ECE-GY 6143.

ECE-GY 9173 SEL TOPCS IN SIGNAL PROCESSING (3 Credits)
Typically offered occasionally
The course centers on selected topics of current interest in signals and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9183 SEL TOPCS IN SIGNAL PROCESSING (3 Credits)
Typically offered occasionally
The course centers on selected topics of current interest in signals and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9193 SEL TOPCS IN SIGNAL PROCESSING (3 Credits)
The course centers on selected topics of current interest in signals and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9213 SEL TOPCS CONTROL ENGINEERING (3 Credits)
Typically offered occasionally
The course discusses topics of current interest to feedback and control-system engineers. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9223 SEL TOP. CTRL ENGRNG (3 Credits)
Typically offered occasionally
The course discusses topics of current interest to feedback and control-system engineers. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9233 SEL TOP. CTRL ENGRNG (3 Credits)
The course discusses topics of current interest to feedback and control-system engineers. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9243 SEL TOP. CTRL ENGRNG (3 Credits)
The course discusses topics of current interest to feedback and control-system engineers. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9253 SEL TOP. CTRL ENGRNG (3 Credits)
The course discusses topics of current interest to feedback and control-system engineers. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9263 SELECTED TOPICS IN CONTROL SYSTEMS (3 Credits)
The course discusses topics of current interest to feedback and control-system engineers. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9273 SEL TOP. CTRL ENGRNG (3 Credits)
The course discusses topics of current interest to feedback and control-system engineers. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9283 SEL TOP: CTRL ENGRNG (3 Credits)
The course discusses topics of current interest to feedback and control-system engineers. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9293 SEL TOP: CTRL ENGRNG (3 Credits)
The course discusses topics of current interest to feedback and control-system engineers. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9313 SEL TOP: TELECOM NETWORK (3 Credits)
The course covers selected topics of current interest in telecommunications and networking. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9323 SEL TOP: TELECOM NETWORK (3 Credits)
The course covers selected topics of current interest in telecommunications and networking. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9333 SEL TPCS IN TELECOMM & NTWK FROM INFO SYS (3 Credits)
Typically offered occasionally
The course covers selected topics of current interest in telecommunications and networking. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9343 SEL TOP: TELECOM NETWORK (3 Credits)
The course covers selected topics of current interest in telecommunications and networking. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9353 SEL TOP: TELECOM NETWORK (3 Credits)
Typically offered occasionally
The course covers selected topics of current interest in telecommunications and networking. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9363 SEL TOP: TELECOM NETWORK (3 Credits)
The course covers selected topics of current interest in telecommunications and networking. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9373 SEL TOP: TELECOM NETWORK (3 Credits)
The course covers selected topics of current interest in telecommunications and networking. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9383 SEL TOP: TELECOM NETWORK (3 Credits)
The course covers selected topics of current interest in telecommunications and networking. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9393 SEL TOP: TELECOM NETWORK (3 Credits)
The course covers selected topics of current interest in telecommunications and networking. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9413 ST: COMP ELEC DEVICES & SYSTEM (3 Credits)
This course examines special topics of current interest in the field of electronic devices, circuits and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9423 ST: COMP ELEC DEVICES & SYSTEM (3 Credits)
Typically offered occasionally
This course examines special topics of current interest in the field of electronic devices, circuits and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9433 ST: COMP ELEC DEVICES & SYSTEM (3 Credits)
This course examines special topics of current interest in the field of electronic devices, circuits and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9443 ST: COMP ELEC DEVICES & SYSTEM (3 Credits)
This course examines special topics of current interest in the field of electronic devices, circuits and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9453 ST: COMP ELEC DEVICES & SYSTEM (3 Credits)
This course examines special topics of current interest in the field of electronic devices, circuits and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9463 SELECTED TOPICS IN COMPUTER DEVICES & SYSTEMS (3 Credits)
This course examines special topics of current interest in the field of electronic devices, circuits and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9473 SEL TPCS IN COMPUTER ELECTRONIC DEVICES & SYSTEMS (3 Credits)
Special topics of current interest to staff in the field of electronic devices, circuits and systems. (See departmental mailing for detailed description of each particular offering.) Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9483 SEL TPCS IN COMPUTER ELECTRONIC DEVICES & SYSTEMS (3 Credits)
Special topics of current interest to staff in the field of electronic devices, circuits and systems. (See departmental mailing for detailed description of each particular offering.) Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9493 ST: COMP ELEC DEVICES & SYSTEM (3 Credits)
This course examines special topics of current interest in the field of electronic devices, circuits and systems. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9513 SELECTED TOPICS IN QUANTUM ELECTRONICS & MATERIAL SCIENCE (3 Credits)
The course covers topics of current interest dealing with the interaction of matter with electromagnetic fields. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9523 SEL TOP/QUANTUM ELEC & MAT SCI (3 Credits)
The course covers topics of current interest dealing with the interaction of matter with electromagnetic fields. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9533 SEL TOP/QUANTUM ELEC & MAT SCI (3 Credits)
The course covers topics of current interest dealing with the interaction of matter with electromagnetic fields. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9543 SEL TOP/QUANTUM ELEC & MAT SCI (3 Credits)
The course covers topics of current interest dealing with the interaction of matter with electromagnetic fields. (See department mailing for detailed description of each particular offering.) Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9553 SEL TPC ELECTRO-OPT, QUANT ELEC, & MAT SCI (3 Credits)
The course covers topics of current interest dealing with the interaction of matter with electromagnetic fields. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9563 SEL TPC QUANTUM ELEC & MAT SCI (3 Credits)
The course covers topics of current interest dealing with the interaction of matter with electromagnetic fields. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9573 SEL TPC QUANTUM ELEC & MAT SCI (3 Credits)
The course covers topics of current interest dealing with the interaction of matter with electromagnetic fields. (See department mailing for detailed description of each particular offering.) Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9583 SEL TPC QUANTUM ELEC & MAT SCI (3 Credits)
The course covers topics of current interest dealing with the interaction of matter with electromagnetic fields. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9593 SEL TPC QUANTUM ELEC & MAT SCI (3 Credits)
The course covers topics of current interest dealing with the interaction of matter with electromagnetic fields. (See department mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9613 SELECTED TOPICS IN POWER ENGINEERING (3 Credits)
The course looks at topics of current interest in electric power engineering. (See departmental mailing for detailed description of each particular offering. | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9623 SELECTED TOPCS IN POWER ENGR (3 Credits)
Typically offered occasionally
The course looks at topics of current interest in electric power engineering. (See departmental mailing for detailed description of each particular offering. | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9633 SELECTED TOPCS IN POWER ENGR (3 Credits)
The course looks at topics of current interest in electric power engineering. (See departmental mailing for detailed description of each particular offering. | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9643 SELECTED TOPICS IN POWER ENGINEERING (3 Credits)
Typically offered occasionally
The course looks at topics of current interest in electric power engineering. (See departmental mailing for detailed description of each particular offering. | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9653 SPECIAL TPCS IN POWER ENGINEERING (3 Credits)
The course looks at topics of current interest in electric power engineering. (See departmental mailing for detailed description of each particular offering. | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9663 SELECTED TOPICS IN POWER ENGINEERING (3 Credits)
The course looks at topics of current interest in electric power engineering. (See departmental mailing for detailed description of each particular offering. | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9683 SELECTED TOPICS IN POWER ENGINEERING (3 Credits)
The course looks at topics of current interest in electric power engineering. (See departmental mailing for detailed description of each particular offering. | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9693 SELECTED TOPICS IN POWER ENGINEERING (3 Credits)
The course looks at topics of current interest in electric power engineering. (See departmental mailing for detailed description of each particular offering. | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9713 SEL TOP ELECTRDYMC/WAVE/ PLASM (3 Credits)
The course discusses topics of current interests in plasmas, electromagnetic and acoustic wave propagation, diffraction and radiation, including wave interactions with plasmas, materials and special mathematical and numerical techniques. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9723 SEL TOP ELECTRDYMC/WAVE/ PLASM (3 Credits)
The course discusses topics of current interests in plasmas, electromagnetic and acoustic wave propagation, diffraction and radiation, including wave interactions with plasmas, materials and special mathematical and numerical techniques. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9733 SEL TOP ELECTRDYMC/WAVE/ PLASM (3 Credits)
The course discusses topics of current interests in plasmas, electromagnetic and acoustic wave propagation, diffraction and radiation, including wave interactions with plasmas, materials and special mathematical and numerical techniques. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9743 SEL TOP ELECTRDYMC/WAVE/ PLASM (3 Credits)
The course discusses topics of current interests in plasmas, electromagnetic and acoustic wave propagation, diffraction and radiation, including wave interactions with plasmas, materials and special mathematical and numerical techniques. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9753 SEL TOP ELECTRDYMC/WAVE/ PLASM (3 Credits)
The course discusses topics of current interests in plasmas, electromagnetic and acoustic wave propagation, diffraction and radiation, including wave interactions with plasmas, materials and special mathematical and numerical techniques. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9763 SEL TOP ELECTRDYMC/WAVE/ PLASM (3 Credits)
The course discusses topics of current interests in plasmas, electromagnetic and acoustic wave propagation, diffraction and radiation, including wave interactions with plasmas, materials and special mathematical and numerical techniques. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9773 SEL TOP ELECTRDYMC/WAVE/ PLASM (3 Credits)
The course discusses topics of current interests in plasmas, electromagnetic and acoustic wave propagation, diffraction and radiation, including wave interactions with plasmas, materials and special mathematical and numerical techniques. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9783 SEL TOP ELECTRDYMC/WAVE/ PLASM (3 Credits)
The course discusses topics of current interests in plasmas, electromagnetic and acoustic wave propagation, diffraction and radiation, including wave interactions with plasmas, materials and special mathematical and numerical techniques. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9793 SEL TOP ELECTRDYMC/WAVE/ PLASM (3 Credits)
The course discusses topics of current interests in plasmas, electromagnetic and acoustic wave propagation, diffraction and radiation, including wave interactions with plasmas, materials and special mathematical and numerical techniques. (See departmental mailing for detailed description of each particular offering.) | Prerequisite: Specified when offered.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9900 Seminar in Electrical and Computer Engineering (0 Credits)
Typically offered occasionally
This course consists of seminar presentations on recent developments in electrical and computer engineering by speakers from industry, research and education institutions. To receive a satisfactory grade, a student must attend at least two thirds of the seminars during the semester registered. A PhD student must register and obtain satisfactory grade for at least four semesters. | Prerequisite: none.
Grading: Grad Poly Pass/Fail
Repeatable for additional credit: Yes

ECE-GY 9920 Summer Graduate Internship (0 Credits)
This course provides graduate students majoring in electrical engineering, computer engineering, electrophysics, systems engineering, telecommunication networks or wireless innovation the opportunity to gain practical training off campus. Such training will enhance and strengthen the students overall educational experience by obtaining practical experience in currently active areas in industry. | Adviser approval is required.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9933 Readings in Electrical and Computer Engineering I (3-6 Credits)
Typically offered occasionally
This course requires a student to read advanced literature in a research field relevant to electrical and computer engineering, under guidance of a faculty member who is expert in the field. Oral presentation and a written report is required. Not more than 3 credits may be taken toward the master's degree. A student must secure a project adviser before registration. | Prerequisite: Degree status.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9941 Advanced Projects III (1.5 Credits)
Typically offered occasionally
Theoretical and/or experimental projects in various research areas in electrical and computer engineering. Projects assigned on basis of specialized interest and preparation of the student and conducted under guidance of a faculty member who is expert in the chosen subject. Oral presentation and/or a written report is required at the discretion of the adviser. | Prerequisite: Graduate Standing and at least one semester of coursework
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 9943 Readings in Electrical and Computer Engineering II (3 Credits)
This course requires a student to read advanced literature in a research field relevant to electrical and computer engineering, under guidance of a faculty member who is expert in the field. Oral presentation and a written report are required. No more than 3 credits may be taken toward the master`s degree. A student must secure a project adviser before registration. | Prerequisite: Degree status.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ECE-GY 9953 ADVANCED PROJECT I (3 Credits)
Typically offered occasionally
This course requires a student to conduct a theoretical and/or experimental project in a research area in electrical and computer engineering. The project is chosen based on the student's specialized interest and preparation and is guided by a faculty member who is expert in the chosen subject. Oral presentation or a written report is required at the adviser's discretion. A student must secure a project adviser before registration. | Prerequisite: Degree status.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 9963 ADVANCED PROJECT II (3 Credits)
Typically offered occasionally
This course requires a student to conduct a theoretical and/or experimental project in a research area in electrical and computer engineering. The project is chosen based on the student's specialized interest and preparation and is guided by a faculty member who is expert in the chosen subject. Oral presentation or a written report is required at the adviser's discretion. A student must secure a project adviser before registration. | Prerequisite: Degree status.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ECE-GY 9980 Electrical Engineering Area Exam (0 Credits)
Typically offered occasionally
In the area exam, the student reviews the prior research in the student's chosen dissertation topic and presents preliminary research results and additional research plan. The area exam is conducted by the Guidance Committee, but may be open to other interested faculty and students. The Guidance Committee attends and evaluates the student's performance and determines whether the student demonstrates the depth of knowledge and understanding necessary to carry out research in the chosen area. Results of the exam will be recorded in the student's transcript as ECE-GY 9980. The student must submit a written report that summarizes prior research and the future plan at least one week before the scheduled exam time. The report should follow the Ph.D. dissertation template and be at least 25 pages long. The student must take and pass the area exam within 2 years after passing the Ph.D. qualifying exam. Students who fail to pass the exam by the deadline might be disqualified from the program.
Grading: Grad Poly Pass/Fail
Repeatable for additional credit: Yes