ELECTRICAL AND COMPUTER ENGINEERING (E&C-ENGR)

Courses

E&C-ENGR 5316 Deep Learning Credits: 3
An exploration of neural networks and deep learning, a branch of machine learning concerned with the development and application of modern neural networks. Students will delve into computational practice and tools needed for classification, function approximation, supervised and unsupervised learning and time series analysis. A strong background in calculus, probability, and linear algebra is encouraged and basic competency in Python and MATLAB is required.
Prerequisites: E&C-ENGR 5586 or COMP-SCI 5565.

E&C-ENGR 5501AP Special Topics In Electrical Engineering Credits: 1-4
Special Topics In Electrical Engineering.

E&C-ENGR 5512 Microwave Remote Sensing Credits: 3
Basic principles of remote sensing including scattering, absorption, transmission, and reflection of microwave energy. Basic radiative transfer theory. Microwave remote sensing systems including altimeters, scatterometers, radiometers, synthetic-aperture systems. Principle applications of remote sensing systems including imaging, atmospheric sounding, oceanographic monitoring, ice-sheet dynamics, etc.
Prerequisites: E&C-ENGR 414.

E&C-ENGR 5513 Principles of Antenna Engineering Credits: 3
Review of Maxwell's equations; Poynting vector; boundary conditions; duality principle; image theory; radiation from current sources; vector potentials; TE-TM decomposition of fields; free-space Green's functions; radiation patterns, gain, directivity and impedance concepts; equivalence principle; polarization concepts – Ludwig's 3rd definitions; cavity model theory of microstrip patch and slot antennas; dipole radiation; homogeneous and inhomogeneous plane wave propagation; surface and Zenneck waves at interfaces; fundamental limits on antenna size, gain and bandwidth (D/Q) ratio; array synthesis – Dolph-Chebyshev and Taylor synthesis; mutual coupling analysis; use of RF CAD software – FEKO and CST for a capstone project
Prerequisites: E&C-ENGR 302, E&C-ENGR 380, E&C-ENGR 381, knowledge in Engineering Computation, Technical Writing Skills.

E&C-ENGR 5517 Advanced Microwave Engineering Credits: 3
This course provides an introduction to microwave engineering and design. Topics covered will include rectangular waveguides, microstrip lines, microwave network analysis, the design, and fabrication of microwave devices like power dividers, directional couplers, and resonators. Evaluate the effect of fabrication tolerances on the performance of microwave devices and how to quantify uncertainties.
Prerequisites: E&C-ENGR 302

E&C-ENGR 5518 Advanced Radar Systems & Techniques Credits: 3
Radar equation; MTI, Pulsed Doppler and Tracking Radars; Detection of and information from Radar Signals; Radar Antennas, Transmitters and Receivers; Radar Propagation and clutter.
Prerequisites: E&C-ENGR 302, E&C-ENGR 380.

E&C-ENGR 5519 Applied Numerical Analysis Credits: 3
Numerical algorithms and analytics as they apply to accuracy, efficiency, scalability, and stability within the fields of computing and engineering. Current numerical computation trends, their limitations, advantages, and disadvantages will be discussed and modeled via problem-solving techniques. MATLAB proficiency, strongly recommended, but any computational platform can be utilized. E&C-ENGR 341R or Math 407 also recommended.
Prerequisites: E&C-ENGR 241 or MATH 300.

E&C-ENGR 5528 Advanced Embedded Systems Credits: 3
This course examines the hardware/software aspects associated with developing microcontroller-based computer systems. The students learn about the architecture and assembly language for popular microcontrollers and how to take advantage of a variety of input/output options that include binary ports, A/D and D/A converters, communication ports, and interfacing techniques for various applications. Graduate students are required to do Embedded Systems lab experiments.
Prerequisites: E&C-ENGR 426, E&C-ENGR 427.

E&C-ENGR 5530 Digital Electronics Credits: 3
Electronic hardware aspects of digital systems. Includes state-of-the-art information on integrated-circuit logic devices and their applications.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5532 Biomedical Instrumentation Credits: 3
Biomedical objectives, physical and engineering principles; optimal equipment design and actual performance of biomedical instrumentation; considers practical instrumentation problem solutions and unsolved problems.
Prerequisites: E&C-ENGR 330.

E&C-ENGR 5533 Advanced Analog Integrated Circuit Design Credits: 3
This course will cover the analysis and design of analog and mixed signal integrated circuits, with an emphasis on design principles for realizing state-of-the-art analog circuits. The course will provide the critical concepts by giving physical and intuitive explanations in addition to the quantitative analysis of important analog building block circuits. First-order hand calculations and extensive computer simulations are utilized for performance evaluation and circuit design. Students will be required to complete a final project which will involve the design at the layout level of an analog circuit. Successful designs will be fabricated through the MOSIS Educational Service.
Prerequisites: E&C-ENGR 276, E&C-ENGR 330.

E&C-ENGR 5534 Computer Arithmetic Credits: 3
Computer arithmetic is a sub field of digital computer organization. It deals with the hardware realization of arithmetic functions to support various computer architectures as well as with arithmetic algorithms for firmware/software implementation. A major thrust of digital computer arithmetic is the design of hardware algorithms and circuits to enhance the speed of various numeric operations. Verilog HDL is used as tool to simulate the algorithms and circuits.
Prerequisites: E&C-ENGR 226, E&C-ENGR 5535.

E&C-ENGR 5535 Hdl-Based Digital Systems Design Credits: 3
This course covers hardware design techniques using a Hardware Description Language (HDL). It also discusses several digital system design methodologies, including structural specifications of hardware, HDL-based simulations and testbenches. Courses focus on the synthesis methodologies for use-defined primitives (UPD), data types, operators, Verilog constructs multiplexed datapaths, buses, bus drivers, FSMs, assignments, case, functions, tasks, named events and rapid prototyping techniques with Verlog HDL, ASICs and FPGAs.
Prerequisites: E&C-ENGR 226.

E&C-ENGR 5536 Power Electronics II Credits: 3
Circuit concepts and analysis techniques for transistor switching regulators, thyristor choppers, transistor inverters, self-commutated thyristor investers and cycloconverters.
Prerequisites: E&C-ENGR 436.

E&C-ENGR 5537 Mixed-Signal Integrated Circuit Design Credits: 3
Modern integrated circuit design often requires the integration of analog and digital circuits on the same chip. This integration provides numerous advantages over purely analog or digital approaches. This course will cover the analysis and design of mixed-signal integrated circuits and will address the challenges of having both analog and digital circuits on the same substrate. Important mixed-signal circuits such as data converters and filters will be studied in detail.
Prerequisites: E&C-ENGR 5533.

E&C-ENGR 5539 Advanced Nanoscale Devices & Circuits Credits: 3
This course will cover advances in nanoscale device design and circuit integration. Students will be introduced to fundamentals of device physics such as material structure, band diagram, transport, and electrostatics as they apply to nanodevices. A range of merging nanodevices will be studied including emerging nanowire transistors, carbon nanotube transistors, magnetic tunneling junctions, memristors and phase-change ram as well as their integration in both conventional and unconventional computing techniques. A research-orientated course, students will use research methods, concepts, articles, methodologies, and proposals.
Prerequisites: E&C-ENGR 5542.

E&C-ENGR 5540 Advanced Nanomanufacturing Credits: 3
Students will evaluate semiconductor processing theory and applications as well as limitations of existing process techniques. Advances in both physical implementation and circuit/integration techniques will be introduced along with an overview of topics such as optical lithography, EUV lithography, nanoimprint, implantation and manufacturing aware circuit design. Students will also participate in modeling and simulation laboratory work with state-of-the-art semiconductor processing and device simulation tools such as SRIM, Sentaurus TCAB Process and Sentaurus TCAD Device. Basic knowledge of research processes and methodology is encouraged for this research-intensive course.
Prerequisites: E&C-ENGR 5542.

E&C-ENGR 5542 Introduction to VLSI Design Credits: 3
With a focus on CMOS Digital technology this course covers the basic concepts of integrated circuits, various methods of designing VLSI circuits, and techniques to analyze performance metrics (speed, area, power and noise). Clocking, interconnect and scaling issues of integrated circuit will also be discussed. It will cover device, interconnect and circuit level implementation issues of both logic and memory circuits. To familiarize students with the realities of design complexities and layout environment they will get exposure to VLSI CAD tools in the following levels - schematic, layout, extraction and circuit simulation through the labs and projects.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5545 Advanced Flexible Electronics Credits: 3
The course covers the design and mechanics of flexible electronics, materials, substrates, processing, device, and applications. Students will learn how science and technology are applied to the emerging flexible electronics area. A semester project will design a flexible electronic circuit based on a research paper.
Prerequisites: PHYSICS 250, CHEM 211, and E&C-ENGR 330

E&C-ENGR 5547 Advanced Application-Specific Integrated Circuit Physical Design and Testing Credits: 3
This course focuses on physical implementation of Application Specific Integrated Circuits. This is a hands-on and lab-driven course where students go through lab experiments in order to go from RTL to GDSII. Students learn to implement their own design from scratch to be implemented in a chip. The main topics to be covered in this course are environmental setup, RTL Design, and Netlist to GDSII, including Floor planning, Placement, power planning, scan chain reordering, global routing, clock tree synthesis, power analysis and ECO. Students then design, optimize, and test power consumption and post-layout assumptions.
Prerequisites: E&C-ENGR 330

E&C-ENGR 5553 Wind Energy System Engineering Credits: 3
This course explores the power conversion and control of wind energy conversion systems (WECS) from the electrical engineering perspective. It provides a comprehensive and in-depth analysis of wind as a source of energy, aerodynamic of wind turbine, wind generators, system configurations, power converters, control schemes, and system design of various practical wind energy systems.

E&C-ENGR 5556 Advanced Instrumentation and Control Credits: 3
The instrumentation and control of industrial processes and systems. Introduction to Programmable Logic Controllers. Simulation modeling of various systems.
Co-requisites: E&C-ENGR 358 (or MEC-ENGR 415).

E&C-ENGR 5557 Fundamentals of Solar Photovoltaic Cells Credits: 3
The science and engineering of solar cell/solar photovoltaic (PV) spans several disciplines namely physics, chemistry, electronic and electrical engineering. Even though solar cell related researches are carried out in those traditional disciplines but it is not widely taught as a comprehensive course. This course highlights the fundamental science and engineering of solar PV devices, solar energy conversion as well as solar cell manufacturing issues. It covers from basic to modern solar PV devices, including typical solar cell materials, basic device physics, ideal and non-ideal models, device parameters and design, and device fabrication.

E&C-ENGR 5558 Automatic Control System Design Credits: 3
Techniques for feedback system design and analysis; computational aids, compensator design and examples, state variable methods, non-linear systems, ad sampled-data control systems.
Prerequisites: E&C-ENGR 226, E&C-ENGR 358.

E&C-ENGR 5559 Introduction to Photovoltaic Systems Credits: 3
The course presents an updated background of world energy production and consumption, a summary of the solar spectrum, how to locate the sun and how to optimize the capture of its energy, as well as the various components that are used in PV systems. Some section of the course has also been added to explain why certain photovoltaic (PV) designs are done in certain ways, as well as how the design process is implemented. Economic and environmental issues as PV design criteria are discussed along with the most recently available technology and design and installation practice.

E&C-ENGR 5560 Electric Power Distribution Systems Credits: 3
Operation and design of utility and industrial distribution systems including distribution system planning; load characteristics; application of distribution transformers; design of subtransmission lines, distribution substations, primary systems, secondary systems, Smart Grid; application of capacitors; voltage regulation and reliability.
Prerequisites: E&C-ENGR 466.

E&C-ENGR 5561 Advanced Power System Protection Credits: 3
Fault analysis, instrument transformers, protective relays, substation protection and control schematics, numerical relaying, distribution system protection, transmission line protection, transformer protection, bus protection, protection of rotating machines, and microgrid protection.
Prerequisites: EC ENGR 466.

E&C-ENGR 5563 Sustainable Energy System Engineering Credits: 3
This course focuses on understanding the theory and application of emerging energy technologies, including solar, wind, biomass, oceanic, geothermal, hydropower, fuel cell (hydrogen), nuclear, and other more exotic energy sources. A premise of the course is that a sustainable energy technology must both be technically feasible and economically viable. We consequently investigate the above energy technologies and the technological promise, progress, and application of each energy source, as well as its economic opportunities and challenges. Renewable energy sources will be highlighted with a focus on projections for a sustainable energy future.

E&C-ENGR 5564 Advanced Smart Grid and SCADA Systems Credits: 3
Distributed generation, microgrids, power system automation using SCADA, communication protocols for SCADA communication, cybersecurity issues in smart grid, phasor measurement units, smart meters, demand response, application of machine learning and data analytics in smart grid.

E&C-ENGR 5565 Auxiliary Electric System Design Credits: 3
This course provides design, operation, contingency analysis and black start requirements of an Auxiliary Electric System (AES) for a coal fired power plant using industry standards (IEEE-666, NEMA MG-1, ANSI C57 and C37 as well as relevant IEC).
Prerequisites: E&C-ENGR 466 or Department Approval.

E&C-ENGR 5567 Power Systems II Credits: 3
This course covers power system matrices, power flow analysis, Gauss-Seidel and Newton-Raphson techniques, fast-decoupled load flow, economic dispatch, transient stability and operation, and power system control.
Prerequisites: E&C-ENGR 358, E&C-ENGR 466.

E&C-ENGR 5568 Economics of Power Systems Credits: 3
Transmission loss formula coefficients, incremental costs and losses, economic scheduling of generation, and applications.
Prerequisites: E&C-ENGR 466, E&C-ENGR 467.

E&C-ENGR 5569 Reliability of Electric Power Systems Credits: 3
Development and use of mathematical models for the calculation and estimation of various measures of reliability in electric power systems, Reliability restoration times and cost assessment of generation, transmission, distribution and composite systems are analyzed.
Prerequisites: COMP-SCI 394R.

E&C-ENGR 5570 Principles of Digital Communication Systems Credits: 3
Principles of random processes, information sources and source coding, modulation and demodulation, block and convolutional error control coding, and equalization.
Prerequisites: COMP-SCI 394R, E&C-ENGR 380.

E&C-ENGR 5572 Antennas & Propagation For Wireless Systems Credits: 3
This course introduces the mathematical aspects of the basic antenna parameters such as vector potential, gain, directivity, impedance, radiation patterns, and develops a comprehensive theory of antenna arrays including the effects of mutual coupling. In-depth modeling studies for wire, aperture and microstrip antennas, is presented; diffraction of plane electromagnetic (TE and TM) waves by perfectly conducting half-planes and wedges-applications to site-specific propagation path modeling in wireless systems.
Prerequisites: E&C-ENGR 341R, E&C-ENGR 412.

E&C-ENGR 5573 Advanced Electric Power Lab Credits: 3
Advanced applications of concepts experienced in Generating Plants, Substations and Power Plants of fundamentals and concepts of power systems to practical power plan and industrial applications. Operational limitations of all components of power system equipment. Single and Three Phase Circuits, Generators/Alternators, Transformers, Motors, and specialty items (Coronal mass Ejection, Ferroresonance, System Protection).
Prerequisites:E&C-ENGR 466 and Consent of the Department.

E&C-ENGR 5577 Wireless Communications Credits: 3
Principles of the design and analysis of wireless communications, Study of propagation mechanisms, statistical characterization of wireless channels, diversity and MIMO, spread spectrum and CDMA, Orthogonal Frequency Division Multiplexing (OFDM).
Prerequisites: COMP-SCI 394R.

E&C-ENGR 5578 Multimedia Communication Credits: 3
Visual communication is dominating the Internet and mobile networks. This class covers topics on video signal processing, modeling, compression, and communication. Includes information theory foundations on source coding, lossless coding schemes, video coding framework, as well as the current status of video coding standards and multimedia communication systems.

E&C-ENGR 5580 Digital Signal Processing Credits: 3
Analysis and representation of discrete-time signals and systems including a discussion of discrete-time convolution, difference equations, the z-transform and the discrete Fourier transform. Similarities with and distinctions between discrete-time and continuous-time signals and systems. Digital network structures for implementation of both recursive (infinite impulse response) and nonrecursive) finite impulse response) digital filters. FFT (Fast Fourier Transform) algorithm for computation of the discrete Fourier transform. Graduate students will be expected to successfully complete a number of additional projects as compared with E&C-ENGR 480.
Prerequisites: E&C-ENGR 380.

E&C-ENGR 5582 Computer Vision Credits: 3
The image is an essential form of information representation and communication in modern society. This course focuses on topics of computer vision, teaching computer how to understand images. Topics include image formation, color and texture features, key points detection, aggregation, subspace methods in image modeling, and deep learning image classification, with many applications in photography, media and entertainment, education, defense and medicine.

E&C-ENGR 5584 Advanced Digital Image Processing Credits: 3
Fundamentals of applied grayscale digital image processing, image sensing and acquisition and quantization, basic set and discrete convolution operations with images, intensity transformations and spatial domain filtering via convolutional masks (smoothing, Laplacian and gradient masks), frequency domain filtering via the two-dimensional discrete transform, two-dimensional sampling and Nyquist theory, frequency domain filtering using lowpass/highpass, rectangular, round, Guassian and Butterworth filters, image restoration using noise filtering via mean order-statistic and adaptive filters, bandpass, band reject and notch filters, Weiner filters, image deblurring filters, computed aided tomography (i.e. CAT scans), morphological image processing and image segmentation.
Prerequisites: E&C-ENGR 380 and prior experience with MATLAB.

E&C-ENGR 5586 Pattern Recognition Credits: 3
Decision functions, distance measures, minimum distance classifiers, hard clustering methods, fuzzy clustering methods, statistical pattern recognition methods, Bayesian classifiers, error probabilities, estimation of density functions, perceptrons, least-mean-square algorithms, feature selection, dimensionality reduction and syntactic pattern recognition.
Prerequisites: COMP-SCI 394R (or STAT 436), a course in high-level programming language.

E&C-ENGR 5590 Special Topics In Electrical And Computer Engineering Credits: 1-4
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5590NA Special Topics In Electrical And Computer Engineering Credits: 1-4
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5590NM Special Topics In Electrical And Computer Engineering Credits: 1-4

E&C-ENGR 5590PQ Special Topics In Electrical And Computer Engineering Credits: 1-4

E&C-ENGR 5597 Directed Readings Credits: 1-3
Readings in an electrical and computer engineering areas selected by the graduate student in consultation with a faculty member. Arrangements must be made prior to registration.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5598 Research Seminar Credits: 1-3
Graduate research and/or readings in an electrical and computer engineering area selected by the graduate student in consultation with a faculty member. Arrangements must be made prior to registration.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5599 Research Credits: 1-6
Independent investigation in field of electrical engineering to be presented in the form of a thesis.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5600 Problems Credits: 2-5
Supervised investigation in electrical engineering to be presented in form of report.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5606 Electromagnetic Scattering and Antenna Theory Credits: 3
Dyadic analysis; integral equations and Green's functions; field theorems-uniqueness, induction equivalence, reciprocity; image and Babinet's Principles; applications to antennas; method of stationary phase and applications to aperture antennas; array antennas and mutual coupling analysis; method of moments; asymptotic techniques and applications to EM scattering from wedges, cylinders, and spheres; RF propagation path loss modeling and conformal antennas.
Prerequisites: E&C-ENGR 412.

E&C-ENGR 5616 Parallel and Distributed Processing Credits: 3
Covers the fundamental issues involved in designing and writing programs for simultaneous execution. Semaphores and monitor constructs are covered to provide a basis for critical section programming. Expansion of these concepts provide a basis for the analysis and design of control systems for multiprocessor devices and computer networks.
Prerequisites: A systems programming course and you must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5617 Neural Network Based Computing System Credits: 3
The course will consider computing systems based on neural networks and learning models, along with implementations and applications of such systems.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5618 Artificial Intelligence Credits: 3
Concepts, theories, and models pertaining to neural nets, pattern recognition, learning systems, and programmed problem solving.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5633 Nanoelectronics II: Nanoscale Integration & Manufacturing Credits: 3
This course is continuation of Nanoscale Devices and circuits course offered in Fall 2016. In this course students will learn theory about semiconductor processing, and their applications. Limitations of existing process techniques will be discussed, and advances in both physical implementation and circuit/integration techniques will be introduced. Some example of topics that will be covered are: optical lithogrpahy, EUV lithography, nanoimprint, implantation, manufacturing aware circuit design, etc. The laboratory work will include modeling and simulation with state-of-the-art semiconductor processing and device simulation tools such as: SRIM, Sentaurus TCAD Process, Sentaurus TCAD Device, etc. Research intensive course.
Co-requisites: E&C-ENGR 5542.

E&C-ENGR 5635 Vlsi Systems Design Credits: 3
Course discuss design of the MOSFETs (nFETs and pFETs), and high speed CMOS cascades in VLSI. It also covers the design of various arithmetic circuits, different fast adders, memories, and chip-level physical designs requirements in the VLSI subsystems are also the focus of this course. It uses Verilog HDL/VHDL as a tool to design VLSI systems.
Prerequisites: E&C-ENGR 5535 (or knowledge of VHDL).

E&C-ENGR 5642 Advanced VLSI Design Credits: 3
Course focuses on the issues and challenges of high performance VLSI circuits and systems. The course will be based on papers published in accredited journals and conference proceedings. The goals of this course: (1) Familiarize students with the current and emerging trends, issues and design alternatives of deep submicron and nanoscale IC technologies; (2) Help students acquire the knowledge and skills required for graduate study and research, and professional careers in IC industry; and (3) Teach students how to collect and survey technical materials, develop new research ideas, write research papers, and present technical contents in front of an audience.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5645 Optimal Control Theory Credits: 3
Analysis and design of dynamic systems using optimal control theory parameter optimization, dynamic optimization, computational methods, differential games.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5646 Stochastic Optimal Estimation and Control Credits: 3
Surveys random process theory; stochastic control and optimization; estimation and filtering based on Kalman-Bucy techniques; stochastic stability; adaptive and learning control systems.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5647 Emerging Interdisciplinary Research in Nanotechnology Credits: 3
This cross-disciplinary course will focus on nanoscale materials, devices and circuit technologies, and its applications in the next generation computing, communication, electronics, biomedical, energy and environment sectors. The course will familiarize students with recent technological progresses and potential socio-economic impacts in the broader fields of nanotechnology. This will be a high level graduate course for students from diverse academic backgrounds. Instructor's prior approval is recommended.

E&C-ENGR 5660 Power-Systems Stability Credits: 3
Performance of synchronous machines under transient conditions, power system stability, system fault computations using symmetrical components; computer solutions of power system problems.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5661 Solid State Energy Conversion Credits: 3
Solid state direct energy conversion; and design of thermoelectric generators and heat pumps.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5662 Power Electronic Drives Credits: 3
Advanced study of dc and ac motor drives controlled by power electronic methods, including phase controlled rectifier de chopper, cycloconverter, variable frequency inverters.
Prerequisites: E&C-ENGR 5536.

E&C-ENGR 5664 Lightning and Switching Surges in Power Systems Credits: 3
Overvoltage, switching surge and lightning effects of a power system. Use of grounding and lightning arresters. Effects of surges off and on machines.
Prerequisites: E&C-ENGR 466 (or equivalent), E&C-ENGR 467 (or equivalent).

E&C-ENGR 5668 Advanced Computer Methods in Power System Analysis Credits: 3
Power system matrices. Sparse matrix methods. Advanced load flow analysis techniques and concepts. Contingency analysis. State estimation.
Prerequisites: E&C-ENGR 466, strong background in FORTRAN or C.

E&C-ENGR 5670 Direct Current Power Systems Credits: 3
Characteristic and performance analysis of DC transmission lines and associated conversion systems.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5672 Power Systems Relaying Credits: 3
Theory of relaying systems for power system protection, improvement of power system stability. Relay coordination; performance of relays during transient swings and out-of-step conditions.
Prerequisites: E&C-ENGR 466.

E&C-ENGR 5690 Advanced Topics In Electrical And Computer Engineering Credits: 1-4
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5697 Advanced Directed Readings Credits: 1-5
Advanced readings in an electrical and computer engineering area selected by the graduate student in consultation with a faculty member. Arrangements must be made prior to registration.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5698 Advanced Research Seminar Credits: 1-5
Advanced Graduate research and/or readings in an electrical and computer engineering area selected by the doctoral student in consultation with a faculty member. Arrangements must be made prior to registration.
Prerequisite: You must be in the School of Science and Engineering Graduate program.

E&C-ENGR 5699 Dissertation Research Credits: 1-9
Doctoral Dissertation.
Prerequisite: You must be in the School of Science and Engineering Graduate program.