Courses numbered 500 to 799 = undergraduate/graduate. (Individual courses may be limited to undergraduate students only.) Courses numbered 800 to 999 = graduate.

**EE 577. Special Topics in Electrical and Computer Engineering** (1-4).
New or special courses presented on sufficient demand. Repeatable for credit. Prerequisite: departmental consent.

**EE 577L. Renewable Energy Engineering** (3).
Analysis and design of renewable energy systems, including solar, wind, hydroelectric, geothermal, and biomass systems. Analysis and design of energy storage systems that integrate with renewable energy systems. Integration of renewable energy systems with the electric power supply system. Prerequisites: Physics 314 and EE 282.

**EE 577M. Real-Time Signal Processing Applications** (3).
In most digital signal processing operations, it is assumed that we have sampled signals which are considered as digital signals. Often in classroom educations, these signals are usually stored for subsequent retrieval or synthesized when needed, for convenience for demonstrations or computer-based assignments. However, this does not allow for real-time processing of the signals. "Real-time" processing means guaranteed delivery of data by a certain time. This undergraduate elective course is hardware based with hands-on simulations to introduce students the analysis, design, and implementation of real-time digital signal processing (DSP) applications. The course first briefly introduces basic DSP theory, then focuses on practical, step-by-step framework that provides hands-on experience in real-time DSP to reinforce the basic DSP theory. Students are expected to learn how to use/apply the DSP theory in real-time applications. Prerequisites: EE 383 or equivalent, CS 211.

**EE 585. Senior Design Project I** (2).
3 Lab hours. A design project under faculty supervision chosen according to the student's interest. Does not count toward a graduate degree in electrical engineering, computer engineering or computer science. For undergraduate students only. This class should be taken in the semester prior to the one in which the student is going to graduate. Prerequisites: senior standing, CS 480 or EE 492. Corequisite: PHIL 354 or 385.

**EE 586. Introduction to Communication Systems** (4).
3 Classroom hours; 2 Lab hours. Fundamentals of communication systems; models and analysis of source, modulation, channel and demodulation in both analog and digital form. Reviews Fourier series, Fourier transform, DFT, probability and random variables. Studies in sampling, multiplexing, AM and FM analog systems, and additive white Gaussian noise channel. Additional topics such as PSK and FSK digital communication systems covered as time permits. Prerequisites: EE 383, IME 254.

**EE 588. Advanced Electric Motors** (3).
Advanced electric motor applications and theory. Includes single-phase motors, adjustable speed AC drive applications and stepper motors. Prerequisite: EE 488.

**EE 595. Senior Design Project II** (2).
3 Lab hours. A continuation of EE 585. For undergraduate students only. Will not count toward a graduate degree in electrical engineering, computer engineering or computer science. Prerequisite: EE 585.

**EE 598. Electric Power Systems Analysis** (3).
Analysis of electric utility power systems. Topics include analysis and modeling of power transmission lines and transformers, power flow analysis and software, and an introduction to symmetrical components. Prerequisite: EE 488.

**EE 610. Introduction to Quantum Computing** (3).
Introduction to the theory and practice of quantum computing. Topics covered include the basics of quantum mechanics, Dirac notation, quantum gates and circuits, entanglement, measurement, teleportation and algorithms. Prerequisite: MATH 511.

**EE 684. Introductory Control System Concepts** (3).
Cross-listed as ME 659. An introduction to system modeling and simulation, dynamic response, feedback theory, stability criteria, and compensation design. Prerequisites: (1) EE 282 and MATH 555, or (2) EE 383.

**EE 688. Power Electronics** (4).
3 Classroom hours; 2 Lab hours. Deals with the applications of solid-state electronics for the control and conversion of electric power. Gives an overview of the role of the thyristor in power electronics application and establishes the theory, characteristics and protection of the thyristor. Presents controlled rectification, static frequency conversion by means of the DC link-converter and the cyclo converter, emphasizing frequency, and voltage control and harmonic reduction techniques. Also presents requirements of forced commutation methods as applied to AC-DC control and firing circuit requirement and methods. Introduces applications of power electronics to control AC and DC motors using new methods such as microprocessor. Prerequisites: EE 383, 488, 492.

**EE 691. Integrated Electronics** (3).
A study of BJT and MOS analog and digital integrated circuits. Includes BJT; BiMOS and MOS fabrication; application specific semi-custom VLSI arrays, device performance and characteristics; and integrated circuit design and applications. Prerequisites: CS 194, EE 493.

**EE 697. Electric Power Systems Analysis II** (3).
Analysis, design, modeling and simulation of high-voltage electric power transmission systems and rotating generators. Simulations include short circuit studies, economic dispatch and transient stability. Prerequisite: EE 598.

**EE 726. Digital Communication Systems I** (3).
Presents the theoretical and practical aspects of digital and data communication systems. Includes the modeling and analysis of information sources as discrete processes; basic source and channel coding, multiplexing and framing, spectral and time domain considerations related to ASK, PSK, DPSK, QPSK, FSK, MSK, and other techniques appropriate for communicating digital information in both base-band and band-pass systems; intersymbol interference, effects of noise on system performance, optimum systems and general M-ary digital systems in signal-space. Prerequisites: EE 586 and 754.

Covers the fundamental concepts of modeling and analysis of discrete event systems, with an emphasis on understanding computer and communication networks. Course begins with an in-depth introduction to discrete event systems (state space, transitions, and system classification). Subsequent topics include languages and automata (untimed, timed and stochastic timed automata). A unified modeling framework centered on automata is followed towards achieving a better understanding of complex systems. Prerequisites: IME 254, MATH 511.

A course in random processes designed to prepare the student for work in communications controls, computer systems information theory and signal processing. Covers basic concepts and useful analytical tools for...
EE 726. Digital Communication Systems II (3).
Studies modern digital communication systems. Discusses topics such
as carrier and symbol synchronization techniques, fading multipath
channels, frequency-hopped spread spectrum systems, smart antenna
array systems, space time codes (STC), space-time block codes
(STBC), multi-input multi-output (MIMO), orthogonal frequency
division multiplexing (OFDM) systems, and multi carrier code division
multiple access (MC-CDMA) communication. Prerequisite: EE 726.

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EE 777C. Network Programming (1-4).
Introduces techniques for developing TCP and UDP network clients,
servers, and applications. Topics covered include sockets, client/server
design alternatives, concurrent processes and threads, web applications,
and security. Programming-intensive course that assumes some
experience with programming in a high-level language. Prerequisite:
CS 300 (or an equivalent course).

EE 782. Digital Signal Processing (3).
Presents the fundamental concepts and techniques of digital signal
processing. Time domain operations and techniques include difference
equations and convolution summation. Covers Z-transform methods,
frequency-domain analysis of discrete-time signals and systems,
discrete Fourier transform, and fast Fourier transform. Emphasizes the
frequency response of discrete-time systems and the relationship to
analog systems. Prerequisite: EE 383.

EE 784. Digital Control Systems (3).
Studies the effects of sampling and quantization, discrete systems
analysis, sampled-data systems and Z-domain and state space design.
Prerequisite: EE 684 or ME 659.

EE 790. Independent Study in Electrical Engineering (1-3).
Arranged individual, independent study in specialized content areas
in electrical engineering under the supervision of a faculty member.
Repeatable for credit. Prerequisite: departmental consent.

EE 792. Linear Systems (3).
Review of mathematics relevant to state-space concepts. Formulation
of state-variable models for continuous-time and discrete-time linear
systems. Concepts of controllability, observability, stabilizability and
detectability. Pole placement and observer design. State transformation
techniques and their use in analysis and design of linear control
systems. Prerequisite: EE 684 or ME 659.

EE 796. Electric Power Distribution (3).
Analysis, design, modeling and simulation of radial medium-voltage
electric power distribution systems. Simulations include power flow
and short circuit. Prerequisite: EE 598.

Studies cooperative communication systems in which the users
collaborate in their data transmissions. Cooperative transmission is
regarded as an efficient, low cost technique to obtain the advantages
of multiple antennas. Introduces fundamental cooperative protocols
as well as recent advanced topics in relay communication systems.
Prerequisites: EE 726, 754 or equivalent.
and lattice codes. Course requires a knowledge of probability, random variables, random processes, and fundamental modulation and demodulation schemes for digital communication systems, basic channel models, e.g., additive white Gaussian noise (AWGN), multipath fading, and interference. Prerequisites: ECE 726, ECE754.

EE 877S. Detection and Estimation (3).
Deals with extracting information from observed signals. Observations are typically distorted or corrupted due to various reasons. Therefore, detection and estimation problems are formulated in a probabilistic framework, where unknown behavior is assumed to be random. The objective is to extract information about some phenomenon related to a given random observation. Detection problems aim at deciding among a finite number of possibilities. Estimation problems aim at finding estimated values of certain quantities that are not observed directly. Detection and estimation theory has a wide range of applications, including networking and communication systems, power systems and control systems. Prerequisite: EE 754 or departmental consent.

EE 877X. EECS Graduate Seminar (1).
Provides an opportunity to learn about contemporary research and technologies in electrical engineering, computer engineering and computer science. Students are expected to strengthen their topics of current interest and explore beyond their own research area thorough oral and written presentations.

EE 877Y. Nonlinear Systems (3).
Focus is more on methods to analyze nonlinear systems, as opposed to control of nonlinear systems. Topics include: (1) introduction to nonlinear systems, (2) one-dimensional nonlinear system: bifurcations (saddle-node, transcritical, and pitchfork bifurcations), (3) two-dimensional nonlinear systems: phase portraits, limit cycles, bifurcations (saddle-node, transcritical, pitchfork, and Hopf bifurcations), (4) weakly nonlinear oscillators (Van der Pol equation, and Duffing equation), method of averaging, (5) Lyapunov analysis, and (6) describing function methods. Prerequisite: EE 792.

EE 877Z. Nano Communications (3).
Nano communication is the exchange of information at the nanoscale and it is at the basis of any wired/wireless interconnection of nano machines, enabling a plethora of applications in the biomedical, environmental, industrial and military fields. Presents different approaches to realize this type of communication through electromagnetic, ultrasonic and magnetic-induction communications. Each of these alternatives is described by following a bottom-up approach, i.e., first, an overview of its specific enabling device technology is presented and, second, the state of the art in terms of communication channel modeling, physical layer techniques (e.g., modulation, coding, transmission) and link layer solutions (e.g., medium access control, error control) is described. In addition to the theoretical knowledge that is assessed in exams, students are assigned independent group projects focused in the different core areas of the field. Through the projects, students have the chance to learn and practice COMSOL Multi-physics, MATLAB, and LabVIEW. At end of the semester, students write a technical report and orally present their work in class. Course provides students with the necessary knowledge to work in a cutting-edge research field, at the intersection of nanotechnologies and information and communication technologies.

EE 878. Master’s Directed Project (1-4).
A project conducted under the supervision of an academic advisor for the directed project option. Requires a written report and an oral presentation on the project. Graded S/U. Prerequisite: consent of academic advisor.

EE 885. Robust Control Systems (3).
When applying control theory to real systems, engineers are faced with uncertainties in plant models, plant disturbances, and sensor noise. Robust control theory is an optimal approach for applying feedback control theory to systems with these uncertainties. Students completing this course should be capable of analyzing a linear control system in terms of performance and robustness, designing controllers and estimators using H-infinity optimization, and reducing plant model and/or controller implementation orders. Prerequisites: EE 792, EE 684 or ME 659.

EE 886. Error Control Coding (3).
Introduces error control codes, including Galois fields, linear block codes, cyclic codes, Hadamard codes, Golay codes, BCH codes, Reed-Solomon codes, convolutional codes, Viterbi decoding algorithm, Turbo codes, and ARQ protocols. Applies to digital 3G and 4G cellular and satellite communication systems. Prerequisite: EE 726.

EE 893. Optimal Control (3).
Reviews mathematics relevant to optimization, including calculus of variations, dynamic programming, and other norm-based techniques. Formulates various performance measures to define optimality and robustness of control systems. Studies design methods for various classes of systems, including continuous-time, discrete-time, linear, non-linear, deterministic and stochastic systems. Prerequisite: EE 792.

EE 897. Operation and Control of Power Systems (3).
Acquaints electric power engineering students with power generation systems, their operation in economic mode, and their control. Introduces mathematical optimization methods and applies them to practical operating problems. Introduces methods used in modern control systems for power generation systems. Prerequisite: EE 598.

EE 898. Electric Power Quality (3).
Measurement, analysis, modeling, simulation and mitigation of electric power quality on medium- and low-voltage distribution systems. Prerequisite: EE 697.

EE 976. PhD Dissertation (1-16).
Repeatable for credit. Graded S/U. Prerequisite: admission to doctoral aspirant status.

EE 981. Cooperative Education (1).
A work-related placement with a supervised professional experience to complement and enhance the academic program. Intended for master’s-level or doctoral students in electrical engineering. Repeatable for up to 8 hours. May not be used to satisfy degree requirements. Graded S/U. Prerequisites: departmental consent and a graduate GPA of at least 3.000.

EE 986. Wireless Spread-Spectrum Communication (3).
Explains what spread-spectrum communication is and why direct-sequence code-division multiple access (DS-CDMA) spread-spectrum is used for wireless communication. Studies the block diagrams of the IS-95 forward and reverse wireless communication links under multi-path mobile fading environment using analysis techniques and simulation. Analyzes pseudo-noise (PN) signal generation, the band-limited waveform shaping filter, convolutional coding, interleaver, Walsh code orthogonal modulation, Rake finger receivers, no coherent Walsh orthogonal sub-optimal demodulation, other simultaneously supportable subscribers, and third generation CDMA. Prerequisite: EE 726.

EE 990. Advanced Independent Study (1-3).
Arranged individual, independent study in specialized content areas in engineering under the supervision of a faculty adviser. Repeatable toward the PhD degree. Prerequisites: advanced standing and departmental consent.