ELECTRICAL ENGINEERING (4400)

4400:541. Digital Communication. (3 Credits)

4400:545. Wireless Communications. (3 Credits)
Prerequisite: 4400:541. Theory and analysis of wireless communication systems, wireless propagation, multiple access, modulation, demodulation, multipath channel characterization, diversity, cellular, and PCS services and standards.

4400:548. Optical Communication Networks. (3 Credits)
Optical waveguides and optical integrated components, optical transmitters and receivers, optical communication network design.

4400:553. Antenna Theory. (3 Credits)

4400:555. Microwaves. (4 Credits)
Dynamic fields, Maxwell's equation and wave equations. Field analysis of wave guides, microwave components, techniques and systems.

4400:561. Optical Electronics and Photonic Devices. (3 Credits)
Lightwave engineering, photonic principles and optical electronic device technology.

4400:572. Control Systems II. (4 Credits)
State variable analysis, design of control systems. Discrete systems, analysis, digital computer control. Experiments include hybrid, AC control system, digital computer control.

4400:583. Power Electronics I. (3 Credits)
Elements of power electronics circuits. Rectifiers, converters, inverters analysis and design.

4400:584. Power Electronics Laboratory & Design Project. (2 Credits)
Prerequisite: 4400:583 or equivalent. Experiments on different types of power electronic converters: AC/DC, DC/DC, DC/AD, and AC/AC. Design project to include design, simulation, building, and testing of a power electronic circuit.

4400:585. Electric Motor Drives. (3 Credits)
Application of electric machines, choice of motor for particular drive. Application of power semiconductor circuits in electric machinery.

4400:589. Design of Electric and Hybrid Vehicles. (3 Credits)
Prerequisite: Permission by Instructor. Principles of electric and hybrid vehicles. Characteristics of electric machines, engines, transmissions, batteries, fuel cells, ultracapacitors. Vehicle control strategies, communication networks, and overall system integration.

4400:598. Special Topics: Electrical Engineering. (1-3 Credits)
(May be taken more than once.) Prerequisite: permission of department chair. Special topics in electrical engineering.

4400:641. Random Signal Analysis. (3 Credits)
Analysis, interpretation and smoothing of engineering data through application of statistical and probability methods.

4400:642. Imaging System Engineering. (3 Credits)
Prerequisite: 4400:561. Engineering principles of imaging systems, analysis, design, and evaluation of imaging systems, processing techniques, and applications.

4400:643. Information Theory. (3 Credits)
Source and channel models, entropy, relative entropy, mutual information, data compression, random coding bound and channel coding theorem, channel capacity for Gaussian channels, practical coding schemes, network information theory.

4400:645. Advanced Wireless Communications. (3 Credits)
Advanced topics in wireless communications including MIMO, multiuser and cooperative communications.

4400:646. Digital Signal Processing. (3 Credits)
Relations between continuous and discrete-time Fourier expansions. Sampling, aliasing, sampling rate conversion. Operator concepts in signal processing, all-pass systems, FFT, digital filter design.

4400:647. Digital Spectral Analysis & Signal Modeling. (3 Credits)
Prerequisites: 4400:646 or permission of instructor. Methods and theory of spectral analysis and signal modeling are investigated in detail. Applications of theory include speech processing, optimal filtering, biomedical systems, digital communications.

4400:648. Optical Network Architecture. (3 Credits)
Prerequisite: 4400:548. Principles of optical network architecture, analysis, design, control, and fault management.

4400:649. Error Control Coding. (3 Credits)
Error control coding techniques for communications including block codes, cyclic codes, convolutional codes, turbo codes, LDPC codes, coded modulation and iterative decoding.

4400:650. Electromagnetic Theory I. (3 Credits)

4400:651. Electromagnetic Theory II. (3 Credits)
Prerequisite: 4400:650 or permission of the course instructor. Scattering: TEM waves; guided wave theory; transmission lines, closed-boundary guides and cavities, modal orthogonality and completeness, Green's function, excitation and coupling, open-boundary waveguides.

4400:652. Computer Electromagnetics. (3 Credits)
Prerequisite: 4400:650 or permission of the course instructor. Analytic and numerical techniques for electromagnetic fields, conformal mapping, finite difference method, finite element method, and the method of moments.

4400:655. Advanced Antenna Theory & Design. (3 Credits)
Prerequisite: 4400:553 or equivalent. Basic properties and recent advances of microstrip antennas. Analysis and design of reflector antennas. Analysis and synthesis of linear and planar antenna arrays.

4400:666. Simulation of Nanoscale and Molecular-Scale Systems. (3 Credits)
The course describes modern simulation techniques for the analysis of nano-scale phenomena: molecular dynamics, fast algorithms for multiatomic and multiparticle systems, and initial methods in electronic structure calculation.
4400:677. Optimal Control I. (3 Credits)
Prerequisite: 4400:674. Formulation of optimization problem; application of variational calculus, maximum principle and optimality principle to control problems. Computational techniques in optimization.

4400:680. Dynamics & Control of Power Electronic Circuits. (3 Credits)
Prerequisites: 4400:583 or equivalent. Averaged and sampled-data models for rectifiers and DC/DC converters. Small and large-signal models about the cyclic steady-state. Feedback controls using classical and modern approaches.

4400:686. Dynamics of Electric Machines. (3 Credits)
Prerequisites: graduate status in Electrical Engineering. Voltage and mechanical differential equations of electric machines, analytical and numerical methods for solution of a system of machine differential equations.

4400:687. Power Electronics II. (3 Credits)
Prerequisite: 4400:583 or equivalent. Effects of the nonidealities of the power circuit components, magnetics, base and gate drives, thyristor commutation circuits, heat transfer and thermal issues. Analysis and design of advanced power circuits.

4400:688. Control of Electric Machines. (3 Credits)
Prerequisites: graduate student in Electrical Engineering. Elements of control circuits for electric drives, techniques for torque/speed control of electric machines.

4400:689. Power Semiconductor Devices. (3 Credits)
Prerequisite: graduate status in Electrical Engineering. Structure and physics of power semiconductor devices: diodes, Bipolar junction transistors, MOSFETS, Thyristors, Power MOS-Bipolar devices (IGTMCT). Emphasis on the issues that characterize these devices from the lower power semiconductor devices.

4400:693. Special Problems: Electrical Engineering. (1-3 Credits)
(May be taken more than once) Prerequisite: permission of department chair. For a qualified graduate student. Supervised research or investigation in major field of training or experience. Credits dependent upon nature and extent of project.

4400:698. Master’s Research: Electrical Engineering. (1-6 Credits)
Prerequisite: Permission of advisor. (May be repeated.) Research on a suitable topic in electrical engineering culminating in a master’s thesis.

4400:699. Master’s Thesis. (1-6 Credits)
Prerequisite: permission of department chair. Research and thesis on some suitable topic in electrical engineering.

4400:753. Topics in Electromagnetics. (3 Credits)
Prerequisite: 4400:651. Introduction to advanced techniques in fields. Topics include application of Green’s function techniques and related boundary value problems.

4400:772. Model Reduction Techniques for Control Systems. (3 Credits)
Prerequisite: 4400:674 or permission of the instructor. Classical, modern, and optimal techniques for computing reduced order models of linear, nonlinear, and infinite dimensional systems. Minimal realizations of multi-variable systems are also considered.

4400:774. Advanced Linear Control Systems. (3 Credits)
Prerequisite: 4400:674 and a course in Real Analysis or equivalent. Covers topics related to the design of robust control systems. The synthesis of controllers which yield stable closed-loop systems will be considered. The H8-optimality criterion for controller design is included. Special emphasis will be given to the robust stabilization problem and the disturbance attenuation problem.

4400:775. Robust Control. (3 Credits)
Prerequisite: 4400:674. Input-output and state-space characterizations of robust control systems, and design techniques based on the algebraic Riccati equation. Decentralized and reliable control design methodologies.

4400:777. Optimal Control II. (3 Credits)
Prerequisite: 4400:677. Advanced state-feedback optimal control. Output feedback issues, including loop transfer recovery, optimal observer design, reduced-order controllers, frequency weighting, and decentralized control.

4400:778. Adaptive Control. (3 Credits)
Prerequisite: 4400:671 or permission of instructor. This course will provide the advanced graduate student with the techniques required for the control of time-varying nonlinear and stochastic systems. Topics include minimum prediction error control, least squares estimation, certainty equivalence adaptive control. Kalman filtering, minimum variance control, LQG control and stochastic adaptive control.

4400:779. Advanced Topics in Control. (3 Credits)
Prerequisite: 4400:776. Discussions of recent advances in control systems.

4400:794. Advanced Seminar: Electrical Engineering. (1-3 Credits)
(May be taken more than once) Prerequisite: permission of department chair. Advanced level coverage of specialized topics. For student seeking Ph.D. in engineering.

4400:898. Preliminary Research. (1-15 Credits)
(May be repeated.) Prerequisite: approval of dissertation director. Preliminary investigations prior to submission of a dissertation proposal to the Interdisciplinary Doctoral Committee.

4400:899. Doctoral Dissertation. (1-15 Credits)
(May be repeated.) Prerequisite: acceptance of research proposal by the Interdisciplinary Doctoral Committee and approval of the dissertation director. Original research by the doctoral student.