ELECTRICAL ENGINEERING (4400)

4400:541 Digital Communication (3 Credits)

4400:545 Wireless Communications (3 Credits)
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 initio methods in electronic structure calculation.
4400:573 Nonlinear Control (3 Credits)
Corequisite: 4400:674 or instructor permission. Designed to provide students with qualitative insights into nonlinear systems as well as techniques for controlling such systems. Topics include describing functions, Popov and circle criteria, jump resonances, subharmonics, phase plane, conservative systems, Lyapunov theory, bifurcation of attractors, and routes to chaos.

4400:674 Control System Theory (3 Credits)
Prerequisite: instructor permission. Advance modern control theory for linear systems. Controllability, observability, minimal realizations of multivariate systems, stability, state variable feedback, estimation, and an introduction to optimal control.

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 (IGBT, MCT). 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 multivariable 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: 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: 4400:677. 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.