ELECTR. AND COMPUTER ENGIN. (ECE)

ECE 7010 High Voltage Techniques and Insulation Design Criteria 3 cr
Laboratory generation and measurement techniques related to ac and dc high voltages, conventional and steep front high voltage pulses, composite voltages and pulsed currents. Charge measurements. Test techniques for assessing insulation quality and life.

ECE 7020 Power Transmission Lines: Phenomenon and Insulation Design 3 cr
High voltage dc, ac and hybrid transmission line corona modes, electrostatic and ionized field calculations, field effects of overhead transmission lines. Surge propagation including corona effect. Transmission line insulation design to withstand normal/abnormal voltages and conditions. Modern and conventional arrestors. Principles and practice of insulation coordination.

ECE 7030 Advanced Electrical Machines 3 cr
Magnetically-coupled circuits, energy conversion principles, field generation in ac machines, windings and inductances, reference frame theory, dc machine and dc drives, scalar control of induction machines, vector control of induction machines, drives for special machines.

ECE 7040 Signal and Data Compression 3 cr
The course presents the theory of signal and data compression with their applications in engineering, including lossless compression (Shannon-Fano, Huffman, arithmetic and dictionary) and lossy compression, including scalar and vector quantization. References to sub-band and transform coding (wavelets and fractal) and analysis-synthesis coding will be made.

ECE 7050 Switching and Automata Theory 3 cr
The course presents basic material in discrete mathematics and the theory of switching circuits. It provides electrical and computer engineering students with a firm basis in the modern theory of logic design, and illustrates some applications through formal characterization of combinational functions and sequential machines, using contemporary techniques for the automatic synthesis and diagnosis of digital systems.

ECE 7060 Power system Protection 3 cr
Philosophy of power system protection; Typical protection schemes; Instrument transformers; Protection hardware and application; Protection relay testing techniques; Software models of relays and their use in simulation studies.

ECE 7070 Power System Analysis 3 cr
Power system operation; load flow analysis; transient stability modeling and simulation using the classical model; detailed machine models for transient stability analysis, modeling of exciters, governors, and FACTS devices for transient stability analysis; methods of transient stability analysis; voltage stability concepts and assessment.

ECE 7072 Advanced Power Electronics 30 cr
AC/DC and DC/DC converters, switching functions, voltage source converters, advanced PWM techniques, analytical modeling and simulation, control system design, applications of power electronics in motor drives and power systems, additional topics of current interest.

ECE 7076 Advanced Electric Machines and Drives 3 cr
Magnetically-coupled circuits, energy conversion principles, field generation in ac machines, windings and inductances, reference frame theory, dc machine and dc drives, scalar control of induction machines, vector control of induction machines, drives for special machines.

ECE 7170 Queueing Systems for Telecommunications 3 cr
Applied stochastic models for queuing systems; analysis of queueing models using matrix-analytic methods and also traditional transform based approaches. Course will focus on applications; how to develop models that represent real communication network problems and how to analyze them.

ECE 7180 Embedded Systems Engineering 3 cr
A Structured approach to the design of modern digital systems is presented with specific emphasis on embedding computer applications. Topics will include the formal methodology of digital design together with selected topics from the current research literature

ECE 7190 Micromachining and MEMS Technology 3 cr
The course focuses on micromachining and micro-electro-mechanical systems (MEMS). Topics include microfabrication technologies, microactuators, and microsensors. Applications to optical, electrical, mechanical, chemical, and biological systems are discussed.

ECE 7200 Advanced Wireless Communication 3 cr
The course covers several advanced issues in wireless communication networks. Topics of study will include trends and future of mobile computing, advanced wireless technologies, multimedia wireless LANs, wireless ad hoc networks, energy mgmt, channel coding, privacy issues in wireless networking.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: Either ECE 4250 or ECE 4700.

ECE 7202 Cognitive Wireless Networks 3 cr
The course will address both the theoretical concepts and system-level implementation issues for cognitive wireless networks. The topics covered will include information-theoretic analysis of cognitive radio systems, challenges and issues in designing cognitive radio systems, architectures and protocols for cognitive wireless networks, distributed adaptation and optimization methods, channel allocation cognitive machine learning techniques, interoperability issues, cross-layer optimization of cognitive radio systems, and applications of cognitive radio networks.

ECE 7204 Queueing Systems for Telecommunications 3 cr
Applied stochastic models for queueing systems; analysis of queueing models using matrix-analytic methods and also traditional transform-based approaches. Course will focus on applications; how to develop models that represent real communication network problems and how to analyze them.

ECE 7210 Fractal and Chaos Engineering 3 cr
This course presents the general theory of fractals and their applications in engineering, including fractal modelling of complex phenomena, such as dielectric discharges, and fractal image compression. It also relates fractals to chaos and dynamics.

ECE 7220 Topics in VLSI Test and Fault Tolerance 3 cr
Faults and fault models for VLSI. Test generation algorithms. Design for testability: scan design for sequential circuits; built-in test; testable PLA design. Totally self-checking logic. Fault tolerance in VLSI: yield and performance enhancement through redundancy. System level diagnosis: applications to VLSI processor arrays.

ECE 7230 Artificial Neural Circuits and Networks 3 cr
Examination of electronic neural networks and related computational systems, both from a circuit theory and from a system-theory perspective. Digital and analog VLSI implementations of neural systems are presented and compared. Connections with other systems from physics, biology and computer science are made.

ECE 7240 Signal Theory 3 cr
Representation and analysis of deterministic signals: Continuous and Discrete; Random processes and spectral analysis; Bandlimited signals and systems.

ECE 7250 Information Theory and Applications 3 cr
Development of information theory and the engineering implications for the design of communication systems and other information handling systems.

ECE 7260 Broadband Communication Networks 3 cr
This course provides fundamentals for designing and analyzing broadband communication networks. The major content includes: structure and organization of broadband communication networks, typical protocols and technologies applied in broadband communication networks mathematical network modeling, and performance analysis. **PR/CR: A minimum grade of C is required unless otherwise indicated.** Prerequisite: Undergraduate level Probability Theory & Random Processes.

ECE 7270 Scattering and Diffraction of Electromagnetic Waves 6 cr
Formulation and analysis of scattering problems by classical methods. Radar cross section of smooth bodies by geometrical and physical optics. Diffraction by edges. Impedance and Leontovitch boundary conditions.

ECE 7280 Static Compensation in Power Systems 3 cr
Requirements for Static Compensation in Power Systems. The thyristor controlled reactor (TCR) and thyristor switched capacitor (TSC). Advanced GTO thyristor compensators. Operation and control of compensators. Load Compensation, filter design and specifications.

ECE 7310 Power System Transient Simulation 3 cr
Methods of Network Equation Formulation; Modeling of network nonlinearities and transmission lines; Modeling of electrical machines and controls.

ECE 7320 Sampled-Data Control Systems 3 cr
Analysis and design of discrete-time systems, compensation to improve stability and performance, introduction to digital logic control.

ECE 7330 Experimental Methods for Electronic Materials 3 cr
Methods for growing and analyzing electronic materials. Growth will include chemical vapour deposition, diffusion, and plasma processing. Analysis will include capacitance, voltage and current voltage techniques.

ECE 7370 Memory Devices and Systems 3 cr
Review of computing system architectures. Memory structures and implementations: static, dynamic, synchronous, asynchronous, single and multiport. Testability of memories. Smart memories. Memories for VLSI: configurable and reconfigurable. Case study of a CMOS self-synchronizing RAM.

ECE 7400 Neural Nets and Neurocomputing 3 cr
Foundations of neural networks. Basic architecture and different structures. Associative networks. Mapping networks. Spatio-temporal networks. Learning and adaptability. Supervised and unsupervised learning. Stability. Adaptive resonance networks. Self-organization. Examples of existing systems. Applications.

ECE 7410 Phased Array Antennas 3 cr
Linear and Planar Arrays Theory; Pattern Synthesis Techniques, Analysis and Design of Radiating elements, Phase Shifters and Beam-Forming Network; Scanning Techniques; Effect of phase, amplitude and mechanical errors on Array Performance.

ECE 7430 Experimental Methods of Microwave Engineering 3 cr
Methods for determining: scattering parameters; insertion, mismatch and return loss; cavity parameters. Detector and mixer performance characteristics. Power measurement. System noise determination. Antenna radiation pattern and gain measurements.

ECE 7440 Current Research Issues in Electrical Engineering 3 cr
Presentation of important research developments in the area of Electrical Engineering, selected to complement other established graduate courses. Approval of the head of the department is required to register for this course.

ECE 7450 High Frequency Integrated Circuit Design and Analysis 3 cr
Monolithic microwave integrated circuit fabrication and circuit design techniques. Analysis and modeling of microwave passive components and GaAs active devices. High frequency circuit simulation techniques. Basic circuit examples.

ECE 7460 Real time Process Engineering 3 cr
Identification, description, and analysis of the behaviour of systems of real-time communicating processes, and the application of real-time process algebras in the design of hardware and software systems. **PR/CR: A minimum grade of C is required unless otherwise indicated.** Prerequisite: COMP 3430.

ECE 7540 Selected Topics of Solid State Electronics 3 cr
Homojunction and heterojunction phenomena; Gunn effect, organic semiconductors, properties of thin films, quantum electronic devices, space charge limited current devices, and newly developed solid state electronic devices.

ECE 7560 Principles of Signal Compression and Coding 3 cr
This course covers the fundamental principles underlying lossy coding of information signals for communication and storage: scalar and vector quantization; introduction to rate-distortion theory and high-rate theory; entropy-coded quantization; principles of predictive coding; transform coding and bit-allocation; trellis coding; channel-optimized quantization; applications.

ECE 7590 Telecommunication Networking 3 cr
This course will cover issues in the design and analysis of telecommunication networks and systems in terms of physical implementation, protocols, routing algorithms, management, software interfaces, and applications. Focus will be on high speed LAN, WAN and Telecommunication networks using a systems engineering perspective. **PR/CR: A minimum grade of C is required unless otherwise indicated.** Prerequisites: although no prerequisites are required, either course ECE 4250 or COMP 4300 would be recommended.

ECE 7650 Current Research in Computer Engineering 3 cr
Presentation of important research developments in the area of Computer Engineering, selected to complement other established graduate courses in this area.

ECE 7660 Logic Problem Solving 3 cr
Introduction to declarative techniques in symbolic problem solving with emphasis on relational representations, query construction, and recursive formulations of knowledge structures in engineering.

ECE 7670 Optimization Methods for Computer-aided Design 3 cr
Constrained optimization of functions of several variables. Optimization methods suitable for the solution of engineering problems by modern digital computers. Both gradient and direct search methods are included.

ECE 7680 Dielectric Properties and Phenomena 3 cr
Elementary structure of matter, polarization, response of dielectrics to static and periodic fields, ionization and decay processes, electrical breakdown of gases, liquids, and solids.

ECE 7700 Nonlinear Systems Analysis 1 3 cr
Introduction to nonlinear phenomena; linearization; state-space methods - quantitative and qualitative; introduction to the principal methods of determining stability.

ECE 7720 Optimal Control 1 3 cr
Introduction to optimal control systems; topics will include statement of the control problem, controllability, calculus of variations, Pontryagin's Maximum Principle, and design of optimal controls.

ECE 7740 Physical Electronics 1 3 cr
Fundamental principles. Wave mechanics, statistical mechanics, structure of matter, free electron theory and electron emission, band theory of solids, electrical conduction, and transport phenomena.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: ECE 3600 or equivalent.

ECE 7750 Physical Electronics 2 3 cr
Properties of materials. Semiconductors, junction phenomena; ferroelectrics, magnetic materials, superconductivity, optical processes, effects of radiation.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: ECE 3600 and ECE 4190 or equivalent.

ECE 7780 Microwave Circuits 3 cr
Circuit properties of microwave transmission systems. Matrix representation and analysis of microwave networks, microwave junctions, resonators, and impedance matching networks.

ECE 7810 Solution of Fields by Numerical Methods 1 3 cr
Numerical integration, differentiation. Finite-difference solutions of the Poisson, Laplace and Helmholtz equations. Initial-value problems. The eigen problem. Examples chosen from electromagnetic, thermal, fluid-flow, stress, and other fields.

ECE 7880 Distributed Energy Generation 3 cr
Rationale for distributed generations (DG); Distributed electricity generation technologies (thermal and renewable); Availability of renewable energy resources; Technical and economic evaluation of DG projects; DG grid integration issues and interconnection standards; Microgrids.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: Energy Systems I or equivalent course.

ECE 7890 Power System Control 3 cr
The application of modern systems engineering methods to power system problems.

ECE 7920 Human Physiology for Engineers 3 cr
The analysis and measurements of human physiological systems. Anatomical descriptions are limited to those required to support the functional analysis. Mathematical modeling is reinforced by analog and digital computer models.

ECE 7990 HVDC Transmission 1 3 cr
Rectifier-inverter fundamentals. Compounding and regulation. Grid firing control systems. Reactive power requirements. Ground return and electrode design. Transmission lines. Economics and efficiency.

ECE 8000 HVDC Transmission 2 3 cr
Protection. Harmonics: telephone interference. Corona: radio and television interference. Analytical methods. Conversion equipment, the use of solid devices. Selected topics from current literature.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: ECE 7990.

ECE 8010 Advanced Network Synthesis 3 cr
Mathematical treatment of various approximation techniques, matrix transformation methods applied to equivalent networks of minimum sensitivity or other criteria, theory of multivariable functions, lumped-distributed network synthesis.

ECE 8050 Topics in Microelectronics 3 cr
Equilibrium and non-equilibrium processes in semiconductors, properties of junctions and thin films, carrier transport phenomena, effects of traps, and selected topics pertinent to recent literature in microelectronics.

ECE 8110 Digital Systems Design 3 cr
Fixed-instruction-set microprocessor design; microprogramming, bit-slice based design; parallel processing and multiprocessing; applications to data acquisition, data logging, and data communications.

ECE 8130 Statistical Communication Theory 3 cr
Representations of random processes; signal detection and estimation techniques.

ECE 8140 Digital Communications and Coding 3 cr
Fundamentals of information theory; source and channel coding; digital modulation techniques.

ECE 8150 Digital Signal Processing 3 cr
Discrete-time linear system theory, digital filter design techniques, discrete Fourier transforms including FFT, discrete Hilbert transform, Walsh-Hadamard transforms high-speed convolution and correlation - techniques.

ECE 8190 Topics in Antenna Theory and Design 3 cr
Antennas as a boundary value problem, antenna parameters, analysis and synthesis methods, antenna measurements.

ECE 8200 Advanced Engineering Electromagnetics 3 cr
Solution of wave equation; special theorems and concepts, computer aided analysis.

ECE 8210 Power Electronic Circuits 3 cr
Thyristor properties, ac controllers, controlled rectifiers, dc to dc converters (choppers), and inverters. Permission of instructor required. Credit not to be held with ECE 4370.

ECE 8220 Digital Image Processing 3 cr
Digital representation of images. Two-dimensional operations and transforms. Image enhancement, restoration, and coding. Reconstruction from projections.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: ECE 3580 or equivalent desirable.

ECE 8230 Pattern Recognition and Scene Analysis 3 cr
Supervised and unsupervised learning techniques. Linear discriminant analysis. Scene analysis methods.

ECE 8270 Computer Communication Networks 3 cr
Overview of existing computer networks. Elements of queueing theory. Error, delay, cost and capacity analysis. Fixed assignment schemes. Packet and switched networks. Random access. Satellite networks. Hybrid protocols.

ECE 8280 Electromagnetic Field Modelling 3 cr
Coulombian and amperian models for polarized media and magnetized media; uniqueness theorems, formulation and classical methods of analysis of static, stationary and quasistationary field problems; modelling of electromagnetic fields in the presence of moving solid conductors; elements of relativistic electrodynamics.

ECE 8300 Computer Vision 3 cr
This course is an extension of ECE 8220 "Digital Image Processing." Techniques of image modelling, segmentation, texture analysis, matching and inference will be studied.

ECE 8310 Computer-Aided Design in Biomedical Engineering 3 cr
Representation of surfaces in space. 3D display methods and hardware. 3D boundary tracing and texture. Biosterometry and stereophotogrammetry in biomedicine. Some aspects of computer-aided manufacturing of prostheses and other topics.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: an introductory course in computing or equivalent experience and one year of any physical, engineering or biological science.

ECE 8320 Advanced Topics in Power Systems 3 cr
Study of selected topics of recent advances in electrical power systems.

ECE 8360 VLSI Design Methodology 3 cr
Design of custom and semi- custom Very Large Scale Integrated (VLSI) circuits and systems including design for testability. Static and dynamic VLSI circuits; software design tools, layout, logic and timing simulation.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: ECE 2220 and ECE 4240 or equivalent.

ECE 8370 Topics in Biomedical Engineering 3 cr
A discussion of current topics in biomedical engineering. The latest in instrumentation, procedures and practices relevant both to clinical engineering and ongoing research are covered.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: ECE 4400 or consent of instructor.

ECE 8380 Reflector Antennas 3 cr
Mathematical analysis of common reflector antennas including effects of various types of feed structures.

ECE 8400 Intelligent Systems 3 cr
Continuation of ECE 7660 "Resolution Problem Solving," plan formation, default and temporal reasoning as applicable to engineering.