

ELECTRICAL ENGINEERING • EE

- 2120 Circuits I (3)** Prereq.: credit or registration in MATH 2090 and PHYS 2102 required or consent of department. Time-domain analysis of electrical networks.
- 2130 Circuits II (3)** Prereq.: EE 2120 and MATH 2090. Frequency-domain analysis of electrical networks.
- 2230 Electronics I (3)** Prereq.: EE 2120. Terminal behavior of semiconductor devices and basic circuits.
- 2231 Electronics Laboratory I (2)** Prereq.: concurrent registration in EE 2230. 1 hr. lecture; 2 hrs. lab.
- 2720 Digital Logic I (2)** Prereq.: admission to the College of Engineering. Boolean algebra; logic gates; minimization methods; analysis and synthesis of combinational logic networks; design examples.
- 2730 Digital Logic II (2)** Prereq.: EE 2720. Analysis and design of sequential circuits; practical impact of design choices.
- 2731 Digital Logic Laboratory (2)** Prereq.: EE 2730. 1 hr. lecture; 2 hrs. lab. Familiarization with conventional logic gates and flip-flops; design and testing of various combinational and sequential circuits.
- 2950 Comprehensive Electrical Engineering (3)** Prereq.: MATH 1552 or equivalent. For nonelectrical engineering majors. Elementary circuits, devices, and systems in electrical engineering.
- 3060, 3061 Special Projects (2,2)** Prereq.: consent of department. Pass-fail grading. Individual work with instructor on special project selected by instructor and student.
- 3070 Engineering Practice (3)** Prereq.: permission of department and either completion of one co-op session or six months of full time employment in an appropriate area. Pass-fail grading. Written final report required. Work experience in solving electrical and computer engineering problems in an engineering environment.
- 3140 Probability for Electrical and Computer Engineering (3)** Prereq.: MATH 2090. Basic concepts of probability theory with application to electrical and computer engineering; probability axioms; continuous, discrete, and conditional probability density and distribution functions; expectations and characteristic functions; introduction to statistical inference and stochastic processes.
- 3160 Introduction to Digital Signal Processing (3)** Prereq.: EE 3610 or equivalent. Digital processing of continuous-time signals; Discrete-time Fourier transform; z-transform, signals and systems in the transform domains; Digital filter design techniques; Discrete Fourier transform and FFT algorithm.
- 3220 Electronics II (3)** Prereq.: EE 2130, 2230, and 2231. Analysis and design of electronic circuits; emphasis on concepts and device models.
- 3221 Electronics Laboratory II (2)** Prereq.: EE 2231 and concurrent registration in EE 3220. 1 hr. lecture; 2 hrs. lab.
- 3232 Solid State Devices I (3)** Prereq.: EE 2230 and 2130. Physics and analysis of basic semiconductor devices; principles of integrated circuit fabrication.
- 3320 Electrical and Magnetic Fields (3)** Prereq.: MATH 2057 and EE 2130. Maxwell's equations; wave propagation and reflection in isotropic media; static fields.
- 3410 Electric Power (3)** Prereq.: EE 2130. Basic principles of electromechanical energy conversion and power system analysis.
- 3530 Introduction to Control Engineering (3)** Prereq.: EE 2130. Modeling, simulation, realization, analysis, and feedback control design of dynamic systems.
- 3610 Signals and Systems (3)** Prereq.: EE 2130. Methods of analysis of continuous time signals and systems.
- 3750 Microprocessor Systems (2)** Prereq.: CSC 1253 and EE 2730. Theory and design of microprocessors; semiconductor technologies, architectures, assembly language, software development, input/output design, applications, and interfacing.
- 3751 Microprocessor Laboratory (2)** Prereq.: EE 3750. 1 hr. lecture; 2 hrs. lab.
- 3755 Computer Organization (3)** Prereq.: EE 2730 or equivalent. Structure and organization of computer systems; instruction sets; arithmetic; data path and control design.
- 3775 Data Structures and Object-Oriented Programming (3)** Prereq.: CSC 1254 or 2290. Object-oriented programming, C++, abstract data types.
- 3950 Electronics (2)** Prereq.: EE 2950. For nonelectrical engineering majors. Basic electronics and instrumentation.
- 4000 Special Topics in Electrical Engineering (3)** May be taken for a max. of 6 hrs. of credit when topics vary. Students in curricula other than electrical engineering should consult the instructor. ABET category: 3 hrs. engineering science. Selected topics of current interest.
- 4001 Special Topics in Electrical Engineering (3)** May be taken for a max. of 6 hrs. of credit when topics vary. Students in curricula other than electrical engineering should consult the instructor. ABET category: 1 hr. design; 2 hrs. engineering science. Selected topics of current interest.
- 4002 Special Topics in Electrical Engineering (3)** May be taken for a max. of 9 hrs. of credit when topics vary. Students in curricula other than electrical engineering should consult the instructor. ABET category: 2 hrs. design; 1 hr. engineering science. Selected topics of current interest.
- 4120 Network Analysis (3)** Prereq.: EE 3610 and MATH 2057. ABET category: 2 hrs. design; 1 hr. engineering science. Linear networks, with introduction to filters and network synthesis.
- 4130 Graph Theory (3)** Prereq.: EE 2130 or equivalent. Graph and subgraph properties, graph operations, enumeration techniques, and applications to analysis and synthesis of electric networks; Kirchoff's third and fourth laws.
- 4160 Algorithms and Implementations for Digital Signal Processing (3)** Prereq.: EE 3160 or equivalent. Design algorithms for FIR and IIR filters, adaptive estimation and its applications, and multirate digital signal processing; Digital signal processors and implementations for signal processors for spectrum analysis and estimation, FIR and IIR digital filters, and adaptive echo cancellation.
- 4232 Solid State Devices II (3)** Prereq.: EE 3232. Physics and analysis of advanced semiconductor devices, including photonic and high-frequency devices.
- 4240 Linear Circuit Design (3)** Prereq.: EE 3220 and 3221. Credit or registration in EE 3232. 2 hrs. lecture; 2 hrs. lab. ABET category: 2 hrs. design; 1 hr. engineering science. Fabrication and use of discrete and monolithic integrated circuits; use of building blocks for design of analog systems.
- 4242 VLSI Design (3)** Prereq.: EE 2730, 3220. 2 hrs. lecture; 2 hrs. lab. ABET category: 2 hrs. design; 1 hr. engineering science. Design and implementation of logic gates for application-specific integrated circuits; system design methodology using CMOS technology.
- 4250 Digital Integrated Circuits (3)** Prereq.: EE 3220, 3221, and 3232. 2 hrs. lecture; 2 hrs. lab. ABET category: 2 hrs. design; 1 hr. engineering science. Analysis and design of digital integrated circuit logic gates in bipolar and MOS technology; semiconductor memories and their operations.
- 4260 Semiconductor Measurements and Characterization (3)** Prereq.: consent of department. 2 hrs. lecture; 2 hrs. lab. Properties of semiconductor materials; their influence on device characteristics; bulk measurements such as resistivity, mobility, and lifetime; diffusion profiles and oxide layers; thin film characterization techniques; I-V and C-V measurements; emphasis on silicon.
- 4262 Electronic Instrumentation and Metrology (3)** Prereq.: EE 3220 and 3221 or equivalent. 2 hrs. lecture; 2 hrs. lab. ABET category: 2 hrs. design; 1 hr. engineering science. Application of electronic principles to the design and development of practical systems including instrumentation, data analysis, and metrology; design and construction of term projects.
- 4270 Optical Electronics (3)** Prereq.: EE 3320 or equivalent. 2 hrs. lecture; 2 hrs. lab. Interaction of optical radiation with various media; theory of laser oscillations and specific laser systems; modulation and detection of optical radiation; fiber optic applications.
- 4320 Microwave Engineering (4)** Prereq.: EE 3320 or equivalent. 3 hrs. lecture; 3 hrs. lab. Waveguides, cavities, signal sources, and other microwave devices.
- 4330 Antenna Theory and Design (4)** Prereq.: EE 3320 or equivalent. 3 hrs. lecture; 3 hrs. lab. Antennas and antenna arrays; measurement of impedances and far-zone radiation patterns.
- 4340 Fiber Optic and Microwave Propagation (3)** Prereq.: EE 3610 and 3320 or equivalent. Wave propagation at microwave and optical frequencies in metallic waveguides and optical fibers.
- 4410 Power System Protection (3)** Prereq.: EE 3410 or equivalent. Broad based introduction to utility and industrial power system protection. Topics of study include transmission, distribution, generation, and industrial distribution systems.
- 4422 Electric Machine Design (3)** Prereq.: EE 3410 or equivalent; 2 hrs. lecture, 2 hrs. lab. ABET category: 2 hrs. design, 1 hr. engineering science. Design and performance analysis of electric machines in steady-state and dynamic conditions using a simulation on PC and lab experiments.
- 4430 Power System Analysis (3)** Prereq.: EE 3410 or equivalent. Power system analysis using computer methods; power flow, economic power dispatch, and faults.
- 4445 Power System Operation and Control (3)** Prereq.: EE 3410 or equivalent. Introduction to operation and control of major utility interconnected power system. Control of generation and operation of interconnected utility grid, transmission systems, utility distribution systems, and large industrial power systems.
- 4450 Distribution System Design (3)** Prereq.: EE 3410 or equivalent. ABET category: 2 hrs. design; 1 hr. engineering science. Power distribution systems; emphasis on design and applications.
- 4460 Power Electronics (3)** Prereq.: EE 3220 and 3410. 2 hrs. lecture; 2 hrs. lab. ABET category: 2 hrs. design; 1 hr. engineering science. Design of power semiconductor converters including controlled rectifiers, inverters, ac voltage controllers, and DC-DC converters.
- 4470 Harmonic Filter and Compensator Design (3)** Prereq.: EE 3220 and 3410 or equivalent. ABET category: 2 hrs. engineering design; 1 hr. engineering science. Design of compensators and harmonic filters for distribution systems with nonsinusoidal voltages and currents.
- 4480 Nonsinusoidal Power System Analysis (3)** Prereq.: EE 3610 or equivalent. Analysis of nonsinusoidal systems, harmonic generation, compensation, and filtering.
- 4490 Adjustable Speed Drives (3)** Prereq.: EE 3410, EE 3530. 2 hrs. lecture, 2 hrs. lab. ABET category: 2 hrs. design, 1 hr. engineering science. Design and test of DC and AC motor variable speed drives combined with an analysis of their static and dynamic properties.
- 4560 Introduction to Modern Control (3)** Prereq.: EE 3530. State variable methods for analysis and design of control systems: realization, stability, and stabilization; observers, control design.
- 4580 Topics in Control System Design (3)** Prereq.: EE 3530. ABET category: 2 hrs. design; 1 hr. engineering science. Compensation of single loop and multiloop systems; state estimation; stability; application to industrial controllers; design using computer simulation packages.
- 4585 Discrete Control System Design (3)** Prereq.: EE 3530. ABET category: 2 hrs. design; 1 hr. engineering science. Sampling and reconstruction of signals; analysis and design of sampled data systems; discrete time systems and controllers.
- 4610 Analog Communication (3)** Prereq.: EE 3610 and 3140. Amplitude, frequency, phase and pulse modulation, noise in analog modulation, applications.

4625 Digital Communication and Networking (3) Prereq.: EE 3610 and 3140 or equivalent. Digital coding of analog information, baseband transmission, decision theory, modulation, design considerations, applications.

4660 Random Processes I (3) Prereq.: EE 3140 or equivalent. Probability spaces; random variables and processes; second order processes; spectral analysis; filtering.

4700 Special Topics in Computer Engineering (3) May be taken for a max. of 6 hrs. of credit when topics vary. Students in curricula other than computer engineering should consult the instructor. ABET category: 3 hrs. engineering science. Selected topics of current interest.

4701 Special Topics in Computer Engineering (3) May be taken for a max. of 6 hrs. of credit when topics vary. Students in curricula other than computer engineering should consult the instructor. ABET category: 1 hr. design; 2 hrs. engineering science. Selected topics of current interest.

4702 Special Topics in Computer Engineering (3) May be taken for a max. of 6 hrs. of credit when topics vary. Students in curricula other than computer engineering should consult the instructor. ABET category: 2 hrs. design; 1 hr. engineering science. Selected topics of current interest.

4710 Communications in Computing (3) Prereq.: EE 2730 and 3140 or equivalent. Theoretical and practical factors in designing computer communications networks; communication principles and codes; network topology and architecture; protocol layers; current and advanced applications.

4720 Computer Architecture (3) Prereq.: EE 3750 and 3755 or equivalent. Memory hierarchy; pipelining techniques; design philosophies; parallel computing fundamentals.

4740 Discrete Structures for Computer Engineering (3) Prereq.: EE 2730 or equivalent. Mathematical logic and proof methods; graph theory; complexity of algorithms; algebraic structures; applications in computer engineering.

4745 Neural Computing (3) Prereq.: EE 3750 and MATH 2090. ABET category: 2 hrs. design; 1 hr. engineering science. Neural networks and automata; network architecture; learning models; applications to signal processing, vision, speech, and robotics; VLSI implementations.

4750 Microprocessor Interfacing Techniques (4) Prereq.: EE 3751. 2 hrs. lecture; 6 hrs. lab. ABET category: 2 hrs. design; 2 hrs. engineering science. Theory and design techniques of microprocessor interfaces to memory and input/output devices.

4760 Introduction to Compiler Optimization (3) Prereq.: EE 3755 and CSC 3102. ABET category: 2 hrs. design; 1 hr. engineering science. Processor architecture, source program analysis, compiler optimization techniques, compiler design.

4770 Real Time Computing Systems (3) Prereq.: EE 3750. ABET category: 2 hrs. design; 1 hr. engineering science. Real time computing systems; systems components, architectures, I/O structure, interrupts, interfacing, A/D converters, and multitasking.

4780 Introduction to Computer Vision (3) Prereq.: EE 3750 or equivalent. ABET category: 2 hrs. design; 1 hr. engineering science. Computer processing of images, including image acquisition systems and computer systems for processing images; preprocessing techniques; image segmentation; emphasis on design of image processing software.

4785 Introduction to Expert Systems (3) Prereq.: EE 3750 or equivalent. Introduction to expert systems, including rule-based systems; search strategies; representation and logic programming.

4790 Structure of Computers and Computations I (3) Prereq.: CSC 3102 and EE 3755. Hardware and software complexity analyses; structures of both computers and computations.

4810 Senior Design I (3) Prereq.: EE 3220, EE 3751, senior standing in the College of Engineering, and one of EE 3410, 3530, 3610, or 3755. 2 hrs. lecture, 2 hrs. lab. Senior design projects.

4820 Senior Design II (3) Prereq.: EE 4810. 6 hrs. lab. Continuation of senior design projects from EE 4810. Construction and test.

7000 Advanced Topics in Electrical Engineering (3) May be taken for a max. of 12 hrs. of credit when topics vary.

7091, 7092 Electrical Engineering Research (3,3) Prereq.: permission of department and completion of 12 sem. hrs. in the graduate program. Pass-fail grading. Individual study.

7100 Advanced Topics in Signal Processing (3) May be taken for a max. of 12 hrs. of credit when topics vary.

7110 Network Analysis and Synthesis (3) Prereq.: consent of instructor. Network analysis and synthesis, network graph theory, state variable representation of networks, computer-aided analysis and design.

7120 Linear Active Network Analysis and Synthesis (3) Prereq.: consent of instructor. Active network analysis and design, multiport networks, pathological elements, inductorless filter theory.

7130 Computer-Aided Network Analysis (3) Prereq.: consent of instructor. Computer-aided circuit analysis; Gaussian elimination, LU factorization, sparse matrices, Newton-Raphson iteration, Gauss-Jacobi and Gauss-Seidel method, numerical integration; AC, DC, and transient analysis.

7150 Theory and Application of Digital Signal Processing (3) Prereq.: EE 3160 or equivalent. Digital filter design, spectrum analysis, digital hardware implementations, and applications.

7200 Advanced Topics in Electronics (3) May be taken for a max. of 12 hrs. of credit when topics vary.

7210 Semiconductor Device Modeling (3) Systematic modeling of active and passive solid-state devices; modeling theory to relate device physics to circuit performance; selected circuit applications.

7220 Semiconductor Devices I: Bipolar (3) Prereq.: EE 3232 or equivalent. Semiconductor material properties, equilibrium and nonequilibrium processes, physical principles of p-n junctions, and quasi-neutral material; modeling of diodes and bipolar transistors.

7222 Semiconductor Devices II: Field Effect (3) Prereq.: EE 3232 or equivalent. Surface effects; metal-insulator-semiconductor structure; modeling of MOS capacitors and IGFETs.

7230 Physics of Device Electronics (3) Semiconductor physics and necessary assumptions for tractable device analysis; elements of statistical physics, transport phenomena in solids, band theory of solids, and semiconductor junctions.

7232 Small-Geometry and High-Speed Devices (3) Prereq.: EE 7230 or equivalent. Charge carrier transport in small and high-electron mobility semiconductor devices, hot-electron effects, size effects and heterojunction boundaries, heterostructure devices, tunneling devices, ballistic transport devices, and surfaces and interfaces in heterostructures.

7240 Integrated Circuit Engineering (3) Fabrication processes and device design for monolithic integrated circuits; relation to circuit performance; thin- and thick-film circuits.

7242 VLSI Systems (3) Prereq.: consent of instructor. Design and implementation of very large scale integrated systems; structured design methodology using MOS technology.

7244 Advanced Lithography and Metrology (3) Prereq.: EE 7240 or consent of instructor. Physical principles used in state-of-the-art microlithography; optical systems, x-rays, e-beams, resists, measurement and inspection techniques.

7246 Integrated Sensors and Actuators (3) Prereq.: EE 7240 and EE 4242 or consent of instructor. Sensor principles and design considerations; bulk and surface micromachining fabrication technologies including LIGA; microactuators and microelectromechanical devices; integration of sensors/actuators and electrical circuitry on the same chip.

7248 Mixed-Signal Integrated Circuit Design (3) Prereq.: EE 4240 and 4242 or consent of instructor. Design and technology of analog and mixed analog-digital integrated circuits for signal processing including applications; mixed-signal integrated circuit testing and measurements.

7250 Semiconductor Power Devices (3) Prereq.: EE 3232 or equivalent. Operation and characteristics of semiconductor energy conversion devices with emphasis on physical mechanisms involved; fabrication of energy conversion devices.

7260 Semiconductor Materials (3) Theory and application of crystal growth from melt and chemical vapor deposition; preparation and purification of elemental and compound semiconductors; structural properties and their effect on electrical and physical parameters; amorphous semiconductors.

7270 Magnetic Materials and Devices (3) Prereq.: EE 3320 or equivalent. Theory of magnetism, domain structures, and magnetic memory; current developments and applications of magnetic devices.

7310 Electromagnetic Theory and Techniques (3) Electromagnetic theory applied to radio propagation, waveguides, and microwave systems.

7350 Boundary Value Problems in Engineering (3) Prereq.: consent of instructor. Separation of variables method for solving certain classical partial differential equations, including properties of special functions and their applications to engineering problems.

7400 Advanced Topics in Power (3) May be taken for a max. of 12 hrs. of credit when topics vary.

7410 Faulted Power System Analysis (3) Development of positive, negative, and zero sequence parameters of power system components and their application in a variety of power system fault conditions.

7420 Power System Dynamics (3) Modern approach to power system transient and dynamic stability studies; detailed synchronous machine models; their linearizations, excitation systems, and multimachine system stability analysis.

7422 Advanced Electric Machines Prereq.: EE 4422 or consent of instructor. Topics on special purpose electric motors used in automation, robots, and electric or magnetically levitated vehicles.

7430 Power System Reliability (3) Reliability analysis of power systems, including generation, transmission, and distribution.

7440 Power Transmission and Control (3) Prereq.: EE 4460 or equivalent. Analysis of HVDC transmission systems; high power switches and limitations; converter circuits, modeling control, and stability analysis of dc transmission; misoperation of converters; protection, harmonics, and filters.

7450 Power System Protection (3) Identification of conditions requiring protection; special problems associated with protection of various system components; protection devices, and their application.

7460 Static Power Converters (3) Prereq.: EE 4460 or equivalent. Design of power converters and ac drives, including voltage controllers, PWM inverters, cycloconverter and switched-mode power supplies.

7470 Power Generation and Control (3) Prereq.: EE 4430 or equivalent. Economic dispatch for thermal and hydroelectric power generation systems; control of power generation.

7480 Harmonics in Power Systems (3) Prereq.: EE 4480 or equivalent. Power flow in nonsinusoidal systems, measurements, compensation, symmetrization, and harmonic suppression.

7490 Advanced Electrical Drives (3) Prereq.: EE 4420, 4490, or consent of instructor. Advanced topics in electric drives including vector control of induction motor drives and permanent magnet synchronous motor drives.

7500 Advanced Topics in Controls (3) May be taken for a max. of 12 hrs. of credit when topics vary.

7510 Advanced Linear Systems (3) Prereq.: EE 4560 or equivalent. Modern approaches for the analysis and identification of linear, discrete and continuous time, control systems; state variable and fractional description techniques, functional analytic methods.

7520 Optimal Control Theory (3) Prereq.: EE 4560 or equivalent. Dynamic optimization applied to control systems; minimum principle, Hamilton-Jacobi-Bellman theory, dynamic programming, gradient algorithms, and functional analytic methods.

7525 Robust Control (3) Prereq.: EE 4560 and 4580. Internal stability, model uncertainty, robust stability, robust performance, controller parameterizations, design limitations, loop shaping H_{∞} control and other optimal robust control design techniques.

7530 System Identification (3) Prereq.: EE 4560, 4660 or equivalent. Conventional parameter estimation and adaptive modeling; control oriented identification; model uncertainties; model validation; review of research literature on system identification.

7540 Optimization of Stochastic Dynamic Systems (3) Prereq.: EE 4560 and 4660 or equivalent. Optimal estimation problem, optimal control problem, and the separation principle of optimal stochastic control theory; Kalman filters, diffusion models, nonlinear filtering, optimal control discrete-time and continuous-time stochastic systems.

7560 Topics in Modern System Science (3) Prereq.: EE 4560 or equivalent. Research literature, operator theory and functional analysis applied to control engineering problems.

7570 Nonlinear System Analysis (3) Prereq.: EE 4560. Systems approach to study of nonlinear systems; includes limit cycles, analytical approximation methods, singular perturbations, describing functions, Liapunov's stability, Lure's problem, Popov criteria, and input-output stability.

7580 Computer Process Control (3) Prereq.: EE 4585 or equivalent. Theory and equipment for the implementation of computer-based control systems; includes supervisory, DDC, and hierarchical configurations, process and operator interface, real-time operations, industrial computer control systems; implementation of advanced control algorithms, time series analysis, and online process optimization.

7585 Advanced Digital Control Systems (3) Prereq.: EE 4585 and EE 4560. Theory and design of sampled-data control systems: including discretization of continuous-time systems and lifting of sampled-data systems; performance analysis in frequency and time domain; design techniques based on optimal controls; robustness analysis of sampled-data feedback control systems under plant perturbations.

7600 Advanced Topics in Communications (3) May be taken for a max. of 12 hrs. of credit when topics vary.

7610 Analog Communication (3) Prereq.: EE 4660 or equivalent. Random waveforms, receiver design, linear and nonlinear modulation; pulse modulation.

7620 Digital Communication (3) Prereq.: EE 4660 or equivalent. Optimal receiver principles and design; modulation schemes; digital coding of information; transmission requirements; channel capacity and cutoff rate; intersymbol interference; fading, spread-spectrum systems.

7630 Detection and Estimation Theory (3) Prereq.: EE 4660 or equivalent. Hypothesis testing, detection of known and unknown signals, estimation of signal parameters, signal resolution.

7640 Information Theory, Coding, and Cryptography (3) Prereq.: EE 4660 or equivalent. Measures of information, channel capacity, Shannon and Huffman coding, rate-distortion theory, linear codes, cyclic codes, BCH and Goppa codes, convolutional codes, problems of data security, probabilistic ciphers, computational complexity ciphers.

7660 Random Processes II (3) Prereq.: EE 4660 or equivalent. Sequences of random variables, renewal processes, Markov chains, and queueing models.

7670 Communication Networks (3) Prereq.: EE 7660. Protocols, performance, and implementation of the data link layer and the network layer of communication networks.

7672 Switching and Broadband Networks (3) Prereq.: EE 7660. Theory, implementation, and performance analysis of switch architectures and broadband integrated networks; traffic and congestion control.

7674 Wireless Communication Networks (3) Prereq.: EE 7620. Theory, implementation, standards, and security issues in mobile wireless communication networks.

7700 Advanced Topics in Computer Engineering (3) May be taken for a max. of 12 hrs. of credit when topics vary.

7710 Advanced Digital Logic (3) Prereq.: EE 3750 or equivalent. Mathematical foundations of Boolean algebra; vector switching functions, Boolean differential calculus, and fault detection.

7715 Computer Arithmetic (3) Prereq.: EE 3755 or equivalent. Number systems; arithmetic algorithms; high performance adders, multipliers, dividers; floating-point arithmetic; residue number systems; hardware implementation.

7720 Advanced Computer Architecture (3) Prereq.: EE 4720 or equivalent. High performance computer architectures; vector processing; parallel processing and interconnection networks.

7725 Interconnection Networks (3) Prereq.: EE 4720 or equivalent. Interconnection network theory, analysis, and implementation; shared memory, coherent caches, and related topics.

7730 Image Analysis I (3) Prereq.: EE 3120 or equivalent. Basic fundamentals and techniques of digital image processing; hardware and software, applications, 2 D transforms, preprocessing, texture analysis, and edge detection; emphasis on application of theory to practical problems.

7740 Image Analysis II (3) Prereq.: EE 4660 and 7730. Continuation of EE 7730. Formal mathematical treatment of image segmentation, shape analysis, texture analysis, and scene analysis.

7745 Neural Networks and Iterative Maps (3) Prereq.: EE 4745 or equivalent. Neural network approach to artificial intelligence; general properties of iterative maps; mapping networks for pattern recognition; optimization; genetic algorithms; implementation issues.

7750 Machine Recognition of Patterns (3) Prereq.: EE 4660 or equivalent and knowledge of programming language. Decision functions; Bayesian decision theory; cluster analysis; design of deterministic, stochastic, and fuzzy classifiers; unsupervised learning; feature selection.

7760 Logic Testing and Testable Design (3) Prereq.: EE 3755 and EE 3140 or equivalent. Switch level fault models, test generation for combinational and sequential circuits, VLSI testing, design for testability.

7765 Distributed Computing System Reliability (3) Prereq.: EE 3140 and 4720 or equivalent. Reliability measures, standards, evaluation, and bounds; multimode and statistical dependent failure analysis; distributed and parallel system reliability and availability, graceful degradation, performance; software reliability.

7770 Internetworking Principles (3) Prereq.: EE 4710 or equivalent. Internet concepts, networks, and transport layers, IP switching, Routing techniques, Internet security, Firewalls.

7780 Software Design Principles (3) Prereq.: CSC 3102 or equivalent. Engineering approach to computer software development; structured and modular programming concepts; software design and management; program testing and correctness proofs; diagnostic tools; software measures; other topics from software engineering.

7785 Program Parallelization (3) F Prereq.: EE 3755 or equivalent. Analysis and optimization of programs for a variety of architectures; impact on architectural design.

7790 Structure of Computers and Computations II (3) Prereq.: EE 4790 or consent of instructor. Mathematical treatment of space and time complexity of computations; formal models of computers and computations.

7795 Models and Methods for Parallel Computation (3) Prereq.: EE 4740 or consent of instructor. Abstract models of parallel computation; algorithms, complexity, and simulations.

8000 Thesis Research (1-12 per sem.) Prereq.: permission of department. "S"/"U" grading.

9000 Dissertation Research (1-12 per sem.) Prereq.: permission of department. "S"/"U" grading.