971C. Higher Education Finance  
Spring of even years. 3(3-0)  
Revenues sources of institutions of higher education. Restrictions and conditions placed upon funds. Administrative structures used to obtain and manage funds.

971D. Institutional Advancement in Higher Education  
Fall of odd years. 3(3-0)  
Issues and strategies affecting institutional development. Governmental relations, admissions, alumni relations, and general administration.

990. Independent Study  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course.

991B. Special Topics in Higher, Adult, and Lifelong Education  
Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.

994. Laboratory and Field Experience in Educational Administration  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to doctoral students. Supervised advanced graduate practice, observations, internships, or externships in K-12 administration and in higher, adult, and lifelong education.

995. Research Practicum in Educational Administration  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course. R: Open only to doctoral students. Approval of department. Supervised research practicum. Design, execution, analysis, presentation, critique, and revision of research projects.

999. Doctoral Dissertation Research  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open only to Ph.D. students.

ELECTRICAL AND COMPUTER ENGINEERING—Descriptions of Courses

302. Electronic Circuits  
Fall, Spring. 3(3-0) P: (ECE 200) or CSE 230 or (MTH 234 or LBS 220) and (MTH 235 or concurrently) or LBS 119 or concurrently)  

303. Electronics Laboratory  
Fall, Spring. 1(0-3) P: (ECE 200) R: Open only to students in the Department of Electrical and Computer Engineering or Department of Computer Science and Engineering. C: ECE 302 concurrently.

305. Electromagnetic Fields and Waves I  
Fall, Spring. 3(3-0) P: (MTH 235 or LBS 119) and (PHY 184) R: Open only to students in the Department of Electrical and Computer Engineering or Department of Computer Science and Engineering. C: ECE 302 concurrently.

306. Electromagnetic Fields and Waves II  
Spring, Summer. 3(3-0) P: (ECE 305)  

307. Electromagnetic Fields and Waves Laboratory  
Spring, Summer. 1(0-3) P: (ECE 306 or concurrently)  
Experimental investigation of topics in electromagnetic fields and waves. Experimental verification of material in EE 306.

320. Energy Conversion and Power Electronics  
Fall, Spring. 3(3-0) P: (ECE 303 and CSE 305)  

330. Digital Logic Fundamentals  
Fall, Spring, Summer. 3(3-0) P: (CSE 131 or CSE 230)  

331. Microprocessors and Digital Systems  
Fall, Spring. 3(0-3) P: (ECE 330) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering. Not open to students with credit in CSE 320. Microcomputers. Microprocessor architecture. Addressing modes. Assembly language programming. Parallel and serial input and output. Interfacing to memory. Interrupts. Direct Memory Access. Coprocessors. Peripheral device controllers. Applications, design.

332. Microprocessors and Digital Systems Laboratory  
Fall, Spring. 1(0-3) P: (ECE 330) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering. Not open to students with credit in CSE 320. C: ECE 331 concurrently.

345. Electronic Instrumentation and Systems  
Fall, Spring. 3(3-0) P: (MTH 235 or LBS 119) and (PHY 184) and completion of Tier I writing requirement. R: Open only to students in the College of Engineering with the exception of students in the Department of Electrical and Computer Engineering.

360. Signals and Linear Systems  
Fall, Spring. 4(4-0) P: (ECE 200) and (MTH 235 or LBS 119) R: Open only to students in the Department of Electrical and Computer Engineering or Department of Computer Science and Engineering.

381. Professionalism, Communication and Ethics (W)  
Fall, Spring. 3(2-3) P: (MTH 235 or LBS 119) R: Open only to students in the Department of Electrical and Computer Engineering or Department of Computer Science and Engineering.

410. Digital Electronics  
Fall, Spring. 3(3-0) P: (ECE 303 and CSE 330) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering or Department of Computer Science and Engineering. Transistor switch models. Device simulation models. Logic family characteristics. Latches, flip-flops, timers, memory circuits, standard cells. Gate arrays, programmable logic devices.
411. Electronic Design Automation
Spring, 3(3-0) P: (CSE 329 or ECE 332) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering or Department of Computer Science and Engineering.
SA: EE 411

413. Control Systems
Fall, Spring, 3(3-0) P: (ECE 360) Analysis and design of control systems using transfer functions and state variable methods. Design of digital controllers. Microprocessor implementation.
SA: EE 413

414. Control Systems Laboratory
Fall, 1(0-3) P: (ECE 413 or concurrently) R: Open only to juniors or seniors in the Department of Manufacturing Engineering major. Data acquisition systems, control system analysis, and system identification.
SA: EE 414

415. Computer Aided Manufacturing
Fall, 3(2-3) P: (ECE 413 and ECE 414) or (ME 451) R: Open only to juniors or seniors in the Manufacturing Engineering major. CAD/CAM fundamentals, programmable controllers, numerical control, NC part programming, sensors, data acquisition systems.
SA: EE 415

418. Algorithms of Circuit Design
Fall, 3(3-0) P: (ECE 303 and ECE 360) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering.
SA: EE 418

421. Power System Analysis
SA: EE 421

435. Electromagnetic Waves and Applications
SA: EE 435

457. Communication Systems Laboratory
Spring, 3(3-0) P: (ECE 302 and ECE 360 and STT 351) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering.
SA: EE 457

458. Communication Systems
Spring, 1(0-3) P: (ECE 303 and ECE 457 or concurrently) A projects laboratory in communication systems.
SA: EE 458

466. Digital Signal Processing and Filter Design
Fall, 3(3-0) P: (ECE 360) R: Open only to seniors or graduate students in the Department of Electrical and Computer Engineering.
SA: EE 466

474. Principles of Electronic Devices
Fall, Spring, 3(3-0) P: (ECE 302 and ECE 305) Energy levels in atoms. Crystal properties, energy bands and charge carriers, semiconductors, transport properties of bulk materials. P-n junction diodes, bipolar transistors, field effect transistors.
SA: EE 474

476. Electro-Optics
Fall, Summer, 3(2-3) P: (ECE 303 and ECE 360) Operating principles and applications of high frequency and photonic devices including impatt, Gunn, photodetector, light-emitting diodes, semiconductor laser devices. Photonic device applications to fiber optic systems.
SA: EE 476

485. Capstone: Digital Control and Robotics (W)
Spring, 4(3-3) P: (ECE 302 and ECE 381 and ECE 413) or graduate students in the Department of Electrical and Computer Engineering.
Robot classifications, kinematics, trajectory planning, digital controller design. Design and implementation of sensor-based robots.
SA: EE 485

490. Independent Study
Fall, Spring, Summer, 1 to 3 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: Approval of department.
Independent study of a topic in electrical engineering or computer engineering.
SA: EE 490

491. Special Topics
Fall, Spring, Summer, 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course. R: Approval of department.
Investigation of special topics in electrical engineering or computer engineering.
SA: EE 491

499. Undergraduate Research
Fall, Spring, Summer, 1 to 3 credits. A student may earn a maximum of 4 credits in all enrollments for this course. R: Approval of department.
Independent undergraduate research in contemporary areas of electrical engineering or computer engineering.
SA: EE 499

801. Independent Study
Fall, Spring, Summer, 1 to 3 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: Approval of department.
Independent investigation of a topic in electrical engineering compatible with the student's pre-requisites, interest, and ability.
SA: EE 801

802. Selected Topics
Fall, Spring, Summer, 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.
Investigation of special topics in electrical engineering.
SA: EE 802
807. **Computer System Performance and Measurement**  
Spring of odd years. 3(3-0) Interdepartmental with Computer Science and Engineering. Administered by Computer Science and Engineering. P: CSE 410, STT 441. R: Open only to Computer Science or Electrical Engineering majors.  
SA: EE 807

808. **Modelling and Discrete Simulation**  
Fall of even years. 3(3-0) Interdepartmental with Computer Science and Engineering. Administered by Computer Science and Engineering. P: CSE 330, STT 441. R: Open only to Computer Science or Electrical Engineering majors.  
Simulation examples, and languages. Mathematical models, petri nets, model validation, random variant generation. Analysis of simulation data. Case studies.  
SA: EE 808

809. **Algorithms and Their Hardware Implementation**  
Spring. 3(3-0) Interdepartmental with Computer Science and Engineering.  
Arithmetic, signal processing, and image processing algorithms. Array structures: systolic architecture, data flow structure, neural network architecture. Performance analysis.  
SA: EE 809

813. **Logic Design Principles**  
Fall. 3(3-0) Interdepartmental with Computer Science and Engineering.  
SA: EE 813

818. **Robotics**  
Fall. 3(3-0) P: ECE 413 or ME 451 R: Open only to graduate students in the College of Engineering.  
Robot geometry, kinematics, dynamics, trajectory planning, robot programming, sensors, controller design.  
SA: EE 818

820. **Advanced Computer Architecture**  
Fall, Spring. 3(3-0) Interdepartmental with Computer Science and Engineering. Administered by Computer Science and Engineering. P: CSE 410, CSE 420. R: Open only to Computer Science or Electrical Engineering majors.  
Instruction set architecture. Pipelining, vector processors, cache memory, high bandwidth memory design, virtual memory, input and output. Benchmarking techniques. New developments related to single CPU systems.  
SA: EE 820

822. **Parallel Processing Computer Systems**  
Spring. 3(3-0) Interdepartmental with Computer Science and Engineering. Administered by Computer Science and Engineering. P: CSE 820. R: Open only to Computer Science or Electrical Engineering majors.  
Massively parallel SIMD processors, multiprocessor architectures, interconnection networks, synchronization and communication. Memory and address space management, process management and scheduling. Parallel compilers, languages, performance evaluation.  
SA: EE 822

823. **Power System Stability and Control**  
Fall of even years. 3(3-0) P: ECE 826.  
Analysis and simulation of small and large disturbance stability of power systems. Generator, exciter, voltage regulator models. Design of excitation systems and power system stabilizers.  
SA: EE 823

824. **Power System Operation and Control**  
Fall of odd years. 3(3-0) P: ECE 421; STT 351.  
Operation planning of power systems including loadflow, unit commitment, production cost methods. On line operation and control including automatic generation control, economic dispatch, security assessment, state estimation.  
SA: EE 824

825. **Alternating Current Electrical Machines and Drives**  
Spring of even years. 3(3-0) P: ECE 320.  
Analysis, modeling and design of synchronous, induction, and switched reluctance machines. Design drives for motion control and power system applications.  
SA: EE 825

826. **Linear Control Systems**  
Fall. 3(3-0) P: MTH 314.  
SA: EE 826

827. **Nonlinear Systems Analysis**  
Spring. 3(3-0) P: ECE 826.  
SA: EE 827

829. **Optimal Multivariable Control**  
Spring. 3(3-0) P: ECE 826.  
Performance and robustness. Minimum time, minimum energy and regulator. Optimal control and minimum principle. LQG, Nyquist, and H-infinity design methods.  
SA: EE 829

831. **Analog Circuit Theory**  
Fall of even years. 3(3-0)  
SA: EE 831

832. **Analog Integrated Circuit Design**  
Fall of odd years. 3(3-0)  
SA: EE 832

835. **Advanced Electromagnetic Fields and Waves I**  
Fall. 3(3-0)  
SA: EE 835

836. **Advanced Electromagnetic Fields and Waves II**  
Spring. 3(3-0) P: ECE 835.  
SA: EE 836

841. **Fourier Optics**  
Spring of odd years. 3(3-0) P: ECE 436; ECE 437.  
SA: EE 841

842. **Quantum Electronics**  
Fall of even years. 3(3-0) P: ECE 835, ECE 874.  
SA: EE 842

847. **Analog and Digital Communications**  
Fall of odd years. 3(3-0) P: ECE 457, ECE 863.  
Optimum signal design in noisy channels, matched filters, quadrature sampling of bandpass signals in noise. Coherent and non-coherent binary modulation such as PSK, FSK, DPSK. Memory modulation, intersymbol interference, spread spectrum.  
SA: EE 847
850. Electrodynamics of Plasmas  
Spring of odd years. 3(3-0) Interdepartmental with Astronomy and Astrophysics; and Physics. P: ECE 835 or PHY 488.  
SA: EE 863

863. Analysis of Stochastic Systems  
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 24 credits in all enrollments for this course. Interdepartmental with Computer Science and Engineering. Administered by Computer Science and Engineering. P: CSE 822. R: Open only to Computer Science or Electrical Engineering majors. Design of high performance computer systems. Seminar format.  
SA: EE 890

864. Detection and Estimation Theory  
Spring. 3(3-0) P: ECE 863  
Analysis and implementation of statistical estimation and detection methods used in signal processing, communications, and control applications. Bayesian, Neyman-Pearson, and minimax detection schemes. Bayesian, mean-square-error, and maximum-likelihood estimation methods.  
SA: EE 864

865. Analog and Digital Communications  
Fall of odd years. 3(3-0) P: ECE 457, ECE 863  
Optimum signal design in noisy channels, matched filters, quadrature sampling of bandpass signals in noise. Coherent and non-coherent binary modulation such as PSK, FSK, DPSK, M-ary modulation, intersymbol interference, spread spectrum.  
SA: EE 865

874. Physical Electronics  
Fall. 3(3-0)  
SA: EE 874

875. Electronic Devices  
Spring. 3(3-0) P: ECE 874  
Operating properties of semiconductor devices including DC, AC, transient and noise models of FET, BJT, metal-semiconductor contact, heterostructure, microscopic and photonic devices.  
SA: EE 875

885. Artificial Neural Networks  
Fall. 3(3-0) Interdepartmental with Computer Science and Engineering.  
SA: EE 885

899. Master's Thesis Research  
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 24 credits in all enrollments for this course.  
SA: EE 899

920. Selected Topics in High Performance Computer Systems  
Spring of odd years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. Interdepartmental with Computer Science and Engineering. Design of high performance computer systems. Seminar format.  
SA: EE 920

921. Advanced Topics in Digital Circuits and Systems (MTC)  
Fall, Spring. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. Interdepartmental with Computer Science and Engineering. Topics vary each semester. Topics such as testable and fault-tolerant digital systems, embedded architectures.  
SA: EE 921

925. Advanced Topics in Power (MTC)  
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. Topics vary each semester. Topics such as advanced stability and control of power systems, power system planning, or advanced machine drives.  
SA: EE 925

929. Advanced Topics in Electromagnetics (MTC)  
Fall, Spring. 3 to 4 credits. A student may earn a maximum of 10 credits in all enrollments for this course. Topics vary each semester. Topics such as planar waveguides and circuits, antenna theory, geometrical theory of diffraction.  
SA: EE 929

931. Advanced Topics in Electronic Devices and Materials (MTC)  
Fall, Spring. 3 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. Topics vary each semester. Topics such as VLSI technology, microdevices and microstructures, properties of semiconductors.  
SA: EE 931

960. Advanced Topics in Control (MTC)  
Fall. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. Topics vary each semester. Topics such as adaptive control, or nonlinear control.  
SA: EE 960

963. Advanced Topics in Systems (MTC)  
Fall, Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. Topics vary each semester. Topics such as system identification and adaptive filtering, robot dynamics and control, or learning in artificial neural networks.  
SA: EE 963

966. Advanced Topics in Signal Processing (MTC)  
Fall, Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. Topics vary each semester. Topics such as discrete time processing of speech signals, multidimensional signal processing, or detection and estimation theory.  
SA: EE 996

989. Advanced Topics in Plasma (MTC)  
Fall of odd years. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. Topics vary each semester. Topics such as plasma processing for IC fabrication, plasma diagnostic techniques.  
SA: EE 989

999. Doctoral Dissertation Research  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 72 credits in all enrollments for this course.  
SA: EE 999