Courses are subject to revision and final approval.

EDUCATIONAL ADMINISTRATION

940. Organizational Analysis of K-12 Schooling
Fall, 3(3-0)
P: EAD 310; R: Graduate student
Theoretical perspectives on schools as organizations. Relationship of organization theory to administrative practice in K-12 schooling.

943. Politics of Education
Fall of odd-numbered years. 3(3-0)
R: Graduate
Education as a political enterprise. Interplay of federal, state, and local politics in the administrators' daily work.

951B. Educational Finance
Spring. 3(3-0)
R: Graduate
Political and economic contexts of educational finance. Issues of equity, efficiency, and adequacy of funding. Analysis of budgeting, cost accounting, and fiscal planning.

951F*. Planning Change
Spring. 3(3-0)
P: EAD 310; R: Open only to Electrical Engineering and Computer Engineering majors.
Analysis of change in complex social systems, with emphasis on education.

960*. Electromagnetic Fields and Waves II
Spring, 4(3-3)
P: EAD 330; R: Open only to Electrical Engineering and Computer Engineering majors.
In-depth study of Maxwell's equations, vector calculus, and vector potentials in the context of field theory.

306. Electromagnetic Fields and Waves
Fall, Spring, 3(3-0)
P: EAD 330; R: Open only to Electrical Engineering and Computer Engineering majors.
Course focuses on the theory and application of electromagnetic fields and waves in engineering and science.

306B. Electromagnetic Fields and Waves
Spring, 3(3-0)
P: EAD 330; R: Open only to Electrical Engineering and Computer Engineering majors.
Continuation of study of electromagnetic fields and waves with emphasis on practical applications.

411. Electronic Design Automation
Spring, 3(3-3)
P: CPS 220 or EE 231, EE 410; R: Open only to Electrical Engineering, Computer Engineering, and Computer Science majors.
Advanced topics in electronic design automation, including computer-aided design and simulation.

413. Control Systems
Spring. 3(3-0)
P: EE 230; R: Open only to Electrical Engineering, Computer Engineering, and Computer Science majors.
Analysis and design of control systems, including feedback and control theory.

418. Algorithms of Circuit Design
Fall. 3(3-0)
P: EE 230; R: Open only to Electrical Engineering and Computer Engineering majors.
Design and analysis of digital circuits, with emphasis on computational complexity.

423. Power System Analysis
Spring. 4(3-3)
P: EE 230; R: Open only to Electrical Engineering majors.
Analysis and design of power systems, including electrical machines and power electronics.

435. Electromagnetic Waves and Applications
Fall, Spring, 3(3-3)
P: EE 230; R: Open only to Electrical Engineering majors.
Study of electromagnetic waves, including propagation and interaction with materials.

457. Statistical Communication Systems
Fall. 4(3-3)
P: EE 230, STT 251; R: Open only to Electrical Engineering and Computer Engineering majors.
Analysis of communication systems, including error correction and data compression.

466. Digital Signal Processing and Filter Design
Spring, 3(3-3)
P: EE 230; R: Open only to seniors and graduate students in Electrical Engineering and Computer Engineering.
Study of digital signal processing techniques, including discrete-time systems and filter design.

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ELECTRICAL ENGINEERING

474*. Principles of Electronic Devices  
Spring, 3(3-0)  
P: EE 302, EE 305. R: Open only to Electrical Engineering majors.  
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.  
QP: EE 302 EE 305  QA: EE 474

475*. Electro-Optics  
Fall, 3(3)  
P: EE 306, EE 474. R: Open only to Electrical Engineering and Computer Engineering majors.  
Operating principles and applications of high frequency and photonic devices including impact, Gunn, photodiode, light-emitting diode, semiconductor laser devices. Photonic device applications to fiber optic systems.  
QP: EE 474 EE 307  QA: EE 477

481*. Capstone: Professionalism, Communication and Ethics  
Spring, 1(1-0)  
C: EE 482 or EE 483 or EE 484 or EE 485  
R: Open only to seniors in Electrical Engineering and Computer Engineering majors.  
Reinforces capstone design course with examination of issues in professionalism and ethics. Technical writing.  
QP: NONE  QA: NONE

482*. Capstone: Computer System Design  
Spring, 4(3-3)  
P: EE 302; EE 331 or CPS 320; C: EE 481  
R: Open only to Electrical Engineering and Computer Engineering majors.  
QP: EE 302 CPS 311  QA: EE 451

483*. Capstone: Integrated Circuit Design and Fabrication  
Spring, 4(3-3)  
P: EE 474; C: EE 481 R: Open only to Electrical Engineering and Computer Engineering majors.  
QP: EE 474  QA: EE 871 EE 478

484*. Capstone: Applications of Analog Integrated Circuits  
Spring, 4(3-3)  
P: EE 302; C: EE 481 R: Open only to Electrical Engineering and Computer Engineering majors.  
Circuit design using analog integrated circuits. SPICE macromodeling. Operational amplifiers, comparators, timers, regulators, multipliers and converters. Design project with hardware and software verification.  
QP: EE 302  QA: EE 475 EE 480 EE 304

485*. Capstone: Digital Control and Robotics  
Spring, 4(3-3)  
P: EE 413, EE 330; C: EE 481; R: Open only to Electrical Engineering and Computer Engineering majors.  
Robot classification, kinematics, trajectory planning, digital controller design. Design and implementation of sensor-based robots.  
QP: EE 415 EE 380  QA: EE 416

490*. Independent Study  
Fall, Spring, Summer. 1 to 3 credits.  
May enroll for a maximum of 3 credits.  
R: Approval of department.  
Independent study of a topic in electrical engineering or computer engineering.  
QA: EE 496

491*. Special Topics  
Fall, Spring, Summer. 1 to 4 credits.  
May enroll for a maximum of 6 credits.  
R: Approval of department.  
Investigation of special topics in electrical engineering or computer engineering.  
QA: EE 499

499*. Undergraduate Research  
Fall, Spring, Summer. 1 to 3 credits.  
May enroll for a maximum of 4 credits.  
R: Approval of department.  
Independent undergraduate research in contemporary areas of electrical engineering or computer engineering.  
QA: EE 499

801*. Selected Topics and Special Problems  
Fall, Spring, Summer. 1 to 4 credits.  
May enroll for a maximum of 9 credits.  
R: Approval of Department R: NONE  
Investigation of a topic in electrical engineering compatible with the student's prerequisites, interest, and ability.  
QP: NONE  QA: EE 801

809*. Algorithms and Their Hardware Implementation  
Fall, 3(3-0)  
R: NONE  
QP: NONE  QA: EE 809

815*. Logic Design Principles  
Spring, 3(3-0)  
Interdepartmental with the Department(s) of Computer Science and Electrical Engineering.  
R: NONE  
QP: NONE  QA: EE 813

823*. Power System Stability and Control  
Fall of even-numbered years. 3(3-0)  
P: EE 489 R: NONE  
Analysis and simulation of small and large disturbances in power systems. Generator, exciter, valve regulator models. Design of excitation systems and power system stabilizers.  
QP: EE 825  QA: EE 821 EE 820

824*. Power System Operation and Control  
Fall of odd-numbered years. 3(3-0)  
P: EE 421, EE 486 or SIT 411 R: NONE  
Operation planning of power systems including load-flow, unit commitment, and production cost methods. On-line computer control including automatic generation control, economic dispatch, security assessment, and state estimation.  
QP: EE 421 EE 486 SIT 411  QA: EE 824

825*. Alternating Current Electrical Machines and Drives  
Spring of even-numbered years. 3(3-0)  
P: EE 461, EE 492  QA: EE 825  
Analysis, modeling and design aspects of synchronous, induction, and switched reluctance machines. Design of each machine for motion control and power systems applications.  
QP: MTH 424 EE 320  QA: EE 825

826*. Linear Control Systems  
Fall, 3(3-0)  
R: NONE  
QP: EE 826 EE 829

827*. Nonlinear Systems Analysis  
Spring, 3(3-0)  
P: EE 826 R: NONE  
QP: EE 826 MTH 424  QA: EE 827

829*. Optimal Multivariable Control  
Spring, 3(3-0)  
P: EE 826 R: NONE  
Discuss performance and robustness; develop minimum time, minimum energy and regulator; introduce optimal control; develop IAE, ISE, and H-infinity design methods.  
QP: EE 413 EE 826 SIT 441  QA: EE 829

831*. Analog Circuit Theory  
Fall of even-numbered years. 3(3-0)  
R: NONE  
QP: NONE  QA: EE 831

832*. Analog Integrated Circuit Design  
Fall of odd-numbered years. 3(3-0)  
R: NONE  
QP: EE 475  QA: EE 832 EE 475

833*. Electromagnetic Fields and Waves I  
Fall, 3(3-0)  
R: NONE  
QP: EE 835

834*. Electromagnetic Fields and Waves II  
Spring, 3(3-0)  
P: EE 835 R: NONE  
QP: EE 835  QA: EE 836
ELECTRICAL ENGINEERING

Courses are subject to revision and final approval.

841*. Fourier Optics
Spring of odd-numbered years. 3(3-0)
P: EE 361 and EE 435 or EE 835 R:
NONE
QP: EE 355 EE 880E/EE 307EE 835 QA: EE 841

842*. Quantum Electronics
Fall of even-numbered years. 3(3-0)
P: EE 874, EE 835 R:
NONE
QP: NONE

847*. Analog and Digital Communications
Spring of even-numbered years. 3(3-0)
P: EE 457, EE 863 R:
NONE
Optimum signal design in noisy channels, matched filters, quadrature sampling of band-pass signals in noise. Coherent and non-coherent binary modulation such as PSK, FSK, DPSK. M-ary modulation, inter-symbol interference, spectrum.
QP: EE 457 EE 863 QA: EE 847 EE 848

850*. Electrodynamics of Plasmas
Spring of odd-numbered years. 3(3-0)
Interdepartmental with the Department(s) of Physics, Astronomy and Astrophysics.
P: EE 835 or PHY 488 R:
NONE
QP: EE 835 PHY 488 QA: EE 850

863*. Analysis of Stochastic Systems
Fall. 3(3-0)
P: EE 496 R:
NONE
Advanced topics in random variable theory. Stochastic processes and stochastic calculus. Optimal systems for filtering and detection.
QP: EE 456 QA: EE 863

866*. Digital Signal Processing
Spring. 3(3-0) Interdepartmental with the Department(s) of Computer Science.
P: EE 496 or EE 863, EE 466 R:
NONE
P: EE 456 EE 456 QA: NONE

874*. Physical Electronics
Fall. 3(3-0)
P: NONE
QP: NONE QA: EE 874 EE 875

875*. Electronic Devices
Spring. 3(3-0)
P: EE 874 R:
NONE
Operating properties of semiconductor devices including DC, AC, transient and noise models of FET, BJT, metal-semiconductor contact, heterostructure, microwave and photonic devices.
QP: EE 474 QA: EE 875 EE 876

885*. Artificial Neural Networks
Fall. 3(3-0) Interdepartmental with the Department(s) of Computer Science.
R: NONE
QP: NONE QA: NONE

899*. Master's Thesis Research
Fall, Spring, Summer. 1 to 8 credits.
P: Approval of the Department R: Major, Electrical Engineering
Master's thesis research
QP: NONE QA: EE 899

921*. Advanced Topics in Digital Circuits and Systems (MTC)
Fall. May enroll for a maximum of 6 credits.
Interdepartmental with the Department(s) of Computer Science.
P: EE 809, EE 813 R:
NONE
QP: EE 809 EE 813 QA: EE 818

921A*. Testable and Fault-tolerant Digital Systems
Spring. 3(0-3) Interdepartmental with the Department(s) of Computer Science.
P: EE 809, EE 813 R:
NONE
Embedded computers and architectures for real-time computation and/or robust control. ASICs. Bit-slice architecture. VLSI: Digital Integrated System design. Genetic algorithms. Implementation techniques and design issues relating to implementation.
QP: NONE QA: NONE

922*. Advanced Topics in Power (MTC)
Spring. 3(0-3)
P: EE 823, EE 824, EE 825 R:
NONE
P: EE 823 EE 824 QA: EE 920

925C*. Advanced Topics in Machine Drives
Spring of odd-numbered years. 3(3-0)
P: EE 823, EE 824, EE 825 R:
NONE
Advanced machine nonlinear drives based on state reconstruction and nonlinear and adaptive control. Sensors, implementation, special computer architectures.
QP: EE 823 EE 825 QA: EE 920

929*. Advanced Topics in Electromagnetics (MTC)
Fall. 3(0-3) May enroll for a maximum of 10 credits.
P: EE 835 R:
NONE
QP: EE 837 QA: EE 929

929A*. Planar Waveguides and Circuits
Fall of odd-numbered years. 3(3-0)
P: EE 835 R:
NONE
QP: EE 837 QA: EE 929

929B*. Antenna Theory
Fall of even-numbered years. 4(4-0)
P: EE 835 R:
NONE
QP: EE 837 QA: EE 927

929C*. Geometrical Theory of Diffraction
Spring of odd-numbered years. 3(3-0)
P: EE 835 R:
NONE
QP: EE 837 QA: EE 801

931*. Advanced Topics in Electronic Devices and Materials (MTC)
Fall, Spring. 1 to 4 credits. May enroll for a maximum of 12 credits.
P: EE 875 R:
NONE
Subtitles: VLSI Technology, Microdevices and Microsystems, Properties of Semiconductors.
QP: EE 874 QA: EE 833

931A*. VLSI Technology
Fall of odd-numbered years. 1 to 4 credits.
P: EE 875 R:
NONE
Oxidation, doping techniques, simulation techniques, film deposition and etching, epitaxial growth, lithography, passivation, and packaging.
QP: EE 874 QA: EE 932

931B*. Microdevices and Microsystems
Spring of odd-numbered years. 1 to 4 credits.
P: EE 875 R:
NONE
QP: EE 874 QA: EE 932

931C*. Properties of Semiconductors
Fall of even-numbered years. 1 to 4 credits.
P: EE 874 R:
NONE
Advanced treatment of phenomena basic to semiconductor materials and devices. Carrier scattering, single particle and collective transport, quantum effects, hot electron effects, electron-phonon and electron-phonon interactions.
QP: EE 874 QA: EE 931
Courses are subject to revision and final approval.

**ELECTRICAL ENGINEERING**

**963A**. Advanced Topics in Analog Circuits (MTC)  
Spring of odd-numbered years. 3(3-0)  
P: EE 827 R: NONE  
Subtitle: Advanced Circuit Analysis.

**963B**. Advanced Circuit Analysis  
Spring of odd-numbered years. 3(3-0)  
P: EE 827 R: NONE  

**964**. Advanced Topics in Control (MTC)  
Fall. 3(3-0) May reenroll for a maximum of 6 credits.  
P: EE 827 R: NONE  
Subtitle: Adaptive Control, Nonlinear Control  
QP: EE 826

**964A**. Adaptive Control  
Fall. 3(3-0)  
P: EE 827 R: NONE  
QP: EE 827 QA: EE 963

**966A**. Advanced Topics in Signal Processing (MTC)  
Fall, Spring. 3(3-0) May reenroll for a maximum of 9 credits.  
P: EE 863, EE 866 R: NONE  
QP: NONE QA: NONE

**966B**. Multidimensional Signal Processing  
Spring. 3(3-0)  
P: EE 866 R: NONE  
QP: EE 880 QA: NONE

**966C**. Determination and Estimation Theory  
Spring. 3(3-0)  
P: EE 847, EE 863 R: NONE  
Communication channels, noise models, hypothesis testing of signals by Bayesian minmax, and Neyman-Pearson criteria. Performance evaluation using ROC. Bayesian and maximum likelihood parameter estimation. Kalman-Bucy filtering.  
QP: EE 847 EE 863 QA: EE 845

**989**. Advanced Topics in Plasma (MTC)  
Fall of odd-numbered years. 3(3-0)  
P: EE 855, EE 850 R: NONE  
QP: EE 850 QA: EE 869

**989A**. Plasma Processing for IC Fabrication  
Fall of odd-numbered years. 3(3-0)  
P: EE 855, EE 850 R: NONE  
Process requirements. Plasma reactors. Etching and deposition applications. Broad ion beam processing.  
QP: EE 850 EE 855 QA: EE 989

**999**. Doctoral Dissertation Research  
Fall, Spring, Summer. 1 to 7 credits.  
P: Approval of Department R: Major, Electrical Engineering  
QP: NONE QA: EE 999

**ENGINEERING**

**150**. Engineers and the Engineering Profession  
Spring. 3(3-0)  
P: Open only to freshmen.  

**169**. Minority Engineering Education Seminar  
Fall, Spring. 2(2-0)  
P: Open only to freshmen in the College of Engineering and to freshmen of minority groups. Issues relevant to underrepresented engineering minority groups. Diversity in engineering. Transition problems. Communication skills. Career options.  
QA: EGR 290

**209W**. Technology, Society and Public Policy  
Fall, Winter. 3(3-0)  
P: 2 courses in mathematics or engineering science R: Sophomores and above Engineering students  
Description and analysis of certain technologies and their consequences. Development of techniques for assessing consequences as an aid to formulation of public policy.  
QA: EGR 200

**290**. Independent Study  
Fall, Spring, Summer. 1 to 4 credits.  
P: Open to freshmen.  
May reenroll for a maximum of 6 credits.  
R: Students in College of Engineering, approval of department.  
Independent undergraduate research in engineering.

**291**. Selected Topics  
Fall, Spring. 1 to 4 credits.  
P: Open only to freshmen.  
Experimental college course development or special topics appropriate for freshmen and sophomores.  
QP: EGR 290

**392**. Engineering Cooperative Education  
Fall, Spring, Summer. 1(1-0)  
P: Open only to students in College of Engineering.  
Pro-fessional educational employment experiences in industry and government related to student's major.  
QA: EGR 344

**ENGLISH**

**090**. Intensive English for International Students  
May reenroll for a maximum of 45 credits.  
P: Permission of English Language Center  
Explanation and intensive practice of basic English skills. Students are tested and placed in groups from beginning to advanced, depending on their need.  
QA: ENG 091 ENG 092 ENG 093 ENG 094 ENG 095

**091**. English Structure for International Students  
Fall, Spring. 3(3-0)  
P: Permission of English Language Center  
Explanation and practice of advanced grammatical structures of English in relation to written communication. Heavy emphasis on editing skills.  
QA: ENG 091

**092**. Academic Communication Skills for International Students  
Fall, Spring. 3(3-0)  
P: Permission of English Language Center  
Intensive speaking and listening practice of spoken academic English, lecture-listening and note-taking strategies developed. Oral communication skills improved through discussion and classroom presentations.  
QA: ENG 092

**093**. Academic English for International Students  
Fall, Spring. 3(3-0)  
P: Permission of English Language Center  
Integrative reading and writing strategies for academic purposes. Includes vocabulary development, intensive and extensive reading and critical reading skills. Develops academic writing style and editing strategies.  
QA: ENG 094 ENG 095

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