963. Leadership in Postsecondary Education
Spring of even-numbered years. 3(3-0)
P: EAD 800.
Leadership as a complex social phenomenon in higher, adult, and lifelong educational settings. Theories of leadership as applied to education. Enhancing leadership diversity.

964. Women's Education and Professional Development
Fall of even-numbered years. 3(3-0)
Gateways and barriers to women's achievement in education and their careers.

965. Diversity and Equity in Postsecondary Education
Fall of even-numbered years. 3(3-0)
Promise, challenge, and management of diversity and equity in higher education. Analysis of data and policy. Management responses and strategies.

967. Policy Challenges in Postsecondary Education
Spring of even-numbered years. 3(3-0)
P: EAD 853A.
Classic and contemporary policy issues such as access, finance, excellence, and purpose. Structures for policy-making. Agencies at federal, state, and local levels.

970A. Administration and Governance of Higher Education
Spring of odd-numbered years. 3(3-0)
P: EAD 800.
Principles and patterns of organization and governance characteristic of colleges and universities. Administrative, trustee, faculty, and student roles.

970B. The Community College
Spring of odd-numbered years. 3(3-0)
History, philosophy, organization, and role of the community college in higher education. Emphasis on programs and services in comprehensive public community colleges.

971A. Institutional Research and Improvement
Fall of odd-numbered years. 3(3-0)
R: Open only to graduate students in College of Education.
Tools and methods used to conduct analyses of institutional management and policy issues.

971B. Planning, Evaluation, and Decision Making in Post-secondary Education
Spring of odd-numbered years. 3(3-0)
Analysis of planning, evaluation, and decision making in the leadership and management of post-secondary institutions. Integration of program, personnel, facility, and enrollment planning related to factors such as budgeting and accreditation.

971C. Higher Education Finance
Spring of even-numbered years. 3(3-0)
Revenue 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-numbered 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.
Advanced individual study in an area of K-12 administration or higher, adult, and lifelong education.

991A. Special Topics in K-12 Administration
Fall, Spring, Summer. 3(3-0) 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 practica, 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 ENGINEERING EE

Department of Electrical Engineering
College of Engineering

200. Electric Circuits
Fall, Spring. 4(4-0)
P: CPS 101 or CPS 131 or CPS 230; MTH 234. C: MTH 235 concurrently. R: Open only to majors in College of Engineering.
Resistive circuits. Loop and nodal analysis. Network theorems. Capacitor and inductor circuits. Transient analysis. Forced response. Sinusoidal steady-state response. Frequency response. Introduction to computer-aided analysis.

302. Electronic Circuits
Fall, Spring. 3(3-0)
P: EE 200. R: Open only to Electrical Engineering, Computer Engineering, and Computer Science majors.
Volt-ampere characteristics of diodes and transistors. SPICE modeling. Differential, multistage and integrated circuit amplifiers. High frequency effects.

303. Electronics Laboratory
Fall, Spring. 1 credit.
P: EE 200, EE 302 or concurrently. R: Open only to majors in Electrical Engineering, Computer Engineering, and Computer Science.
Electronic test equipment and measurement fundamentals. Experimental verification of topics covered in EE 200 and EE 302.

305. Electromagnetic Fields and Waves I
Fall, Spring. 3(3-0)
P: MTH 235, PHY 184. R: Open only to Electrical Engineering, and Computer Engineering majors.
Vector analysis. Static electric field and scalar potential. Dielectric materials. Electric force and energy. Potential problems. Steady currents, magnetic field and vector potential. Magnetic materials and circuits. Magnetic force and torque.

306. Electromagnetic Fields and Waves II
Spring, Summer. 3(3-0)
P: EE 305. R: Open only to Electrical Engineering and Computer Engineering majors.
Faraday's law. Maxwell's equations. EM energy conservation. Wave equations and EM waves. Transmission lines. Transient waves. Travelling and standing waves. EM plane waves. EM radiation and antennas.

307. Electromagnetic Fields and Waves Laboratory
Spring, Summer. 1 credit.
P: EE 306 or concurrently. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major.
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: EE 303, EE 305. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major.
Power and energy. Magnetics and transformers. Elementary and induction machines. Power semiconductors. Controlled rectifiers and inverters. Power supplies and motor drives.

330. Digital Logic Fundamentals
Fall, Spring, Summer. 3(3-0)
P: CPS 101 or CPS 131 or CPS 230. R: Open only to College of Engineering majors.
Switching algebra, combinational logic, minimization. Programmable logic devices. Sequential system fundamentals, elements, circuits. Arithmetic operations and circuits. Memory elements and systems. Hierarchical structures. Design problems.

331. Microprocessors and Digital Systems
Fall, Spring. 3(3-0)
P: EE 330. C: EE 332 concurrently. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major. Not open to students with credit in CPS 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 credit.
P: EE 330 C: EE 331 concurrently. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major. Not open to students with credit in CPS 320.
A projects laboratory in a digital-logic design and microprocessor-based systems.

345. Electronic Instrumentation and Systems
Fall, Spring, Summer. 3(2-3)
P: MTH 235, PHY 184. R: Open only to College of Engineering majors except Electrical Engineering and Computer Engineering. Completion of Tier I writing requirement.
Electrical and electronic components, circuits and instruments. Circuit laws and applications, frequency response, operational amplifiers, semi-conductor devices, digital logic, counting circuits.

360. Signals and Linear Systems
Fall, Spring. 4(4-0)
P: EE 200, MTH 235. R: Open only to Electrical Engineering, Computer Engineering, and Computer Science majors.
Continuous and discrete signals and systems. Convolution, impulse response, system classifications, state variables, differential and difference equations. Fourier series, Fourier transform, Laplace transform. Z-transform. Transfer functions and stability.

381. Professionalism, Communication and Ethics (W)
Fall, Spring. 1(1-0)
P: EE 303 or concurrently. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major. Completion of Tier I writing requirement.
Examination of issues in professionalism, ethics, and technical communications related to electrical and computer engineering.
SA: EE 481

410. Digital Electronics
Fall, Spring. 3(3-0)
P: EE 303, EE 330. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering or Computer Science major.
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: CPS 320 or EE 332. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering or Computer Science major.
Electronic design hierarchy and the role of methodology. Application specific integrated circuits. Hardware descriptive languages. Behavioral and structural models. Semicustom design. Design algorithms. Design project, presentationand reports.

413. Control Systems
Fall, Spring. 3(3-0)
P: EE 360. R: Open only to Electrical Engineering, Computer Engineering, and Computer Science majors.
Analysis and design of control systems using transfer functions and state variable methods. Design of digital controllers. Microprocessor implementation.

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

415. Computer Aided Manufacturing
Fall. 3(2-3)
P: EE 413 and EE 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.

418. Algorithms of Circuit Design
Fall. 3(3-0)
P: EE 303, EE 360. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major.
Design of analog electrical circuits, filter functions, ladder synthesis, inductor simulation. Vector Newton-Raphson method. Lossy inductance and capacitance. Statistical tolerance analysis. Optimization by multi-dimensional search. Software algorithms.

421. Power System Analysis
Spring. 4(3-3)
P: EE 320. R: Open only to Electrical Engineering and Computer Engineering majors.
Synchronous machines: models and measurements of power components. Symmetrical components. Short circuit analysis and equipment protection. Load flow. Voltage and frequency control. Operation and planning of power systems.

435. Electromagnetic Waves and Applications
Fall. 4(3-3)
P: EE 307. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major.
Open and closed-boundary waveguides. Resonators. Microwave circuit theory. Scattering parameters. Electromagnetic radiation. Properties of antennas. Wave propagation. Measurement of antenna characteristics. Computer-aided design and testing.

457. Communication Systems
Spring. 3(3-0)
P: EE 302, EE 360, STT 351. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major.
Representation and processing of signals in the presence of noise. System performance. Modulation, detection, and coding of information. System design applications in radar, sonar, radio, television, satellite communications, digital telephony, and wireless systems.

458. Communication Systems Laboratory
Spring. 1 credit.
P: EE 303, EE 457 or concurrently. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major.
A projects laboratory in communication systems.

466. Digital Signal Processing and Filter Design
Fall. 3(3-0)
P: EE 360. R: Open only to seniors and graduate students in Electrical Engineering and Computer Engineering.
Discrete Fourier transforms, sampling theorem, circular convolution, Z-transforms. Design of infinite impulse resistance filters using prototypes and algorithmic methods. Design of finite impulse resistance filters by windowing, frequency sampling.

474. Principles of Electronic Devices
Fall, Spring. 3(3-0)
P: EE 303, EE 305. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major.
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.

476. Electro-Optics
Fall, Summer. 3(2-3)
P: EE 303, EE 305, EE 474. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major.
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.

482. Capstone: Computer System Design (W)
Fall, Spring. 4(3-3)
P: EE 332 or CPS 320; EE 381. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major. Completion of Tier I writing requirement.
Design of single board computers. Microprocessor emulation systems. Bus interface requirements. Data transfer. I/O controller design. Interrupt structure. Analog/digital interfacing. Logic analyzers.

483. Capstone: Integrated Circuit Design and Fabrication (W)
Fall. 4(3-3)
P: EE 381, EE 474. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major. Completion of Tier I writing requirement.
Processing fundamentals and process simulations. Comparison of current metal oxide semiconductors and bipolar technologies and their limitations. Layout design rules and methodology. Packaging and yield.

484. Capstone: Applications of Analog Integrated Circuits (W)
Spring. 4(3-3)
P: EE 302, EE 303, EE 381. R: Open only to Electrical Engineering and Computer Engineering majors. Completion of Tier I writing requirement.
Circuit design using analog integrated circuits. SPICE macromodeling. Operational amplifiers, comparators, timers, regulators, multipliers and converters. Design project with hardware and software verification.

485. Capstone: Digital Control and Robotics (W)
Spring. 4(3-3)
P: EE 332, EE 381, EE 413. R: Open only to juniors or seniors or graduate students in the Electrical Engineering or Computer Engineering major. Completion of Tier I writing requirement.
Robot classifications, kinematics, trajectory planning, digital controller design. Design and implementation of sensor-based robots.

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.

491. Special Topics
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course.
R: Open only to Electrical Engineering and Computer Engineering majors.
Investigation of special topics in electrical engineering or computer engineering.

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.

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 prerequisites, interest, and ability.

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.

807. Computer System Performance and Measurement

Spring of odd-numbered years. 3(3-0) Interdepartmental with Computer Science. Administered by Computer Science.
P: CPS 410, STT 441. R: Open only to Computer Science or Electrical Engineering majors.
Queueing network modelling, general analytic techniques, workload characterization, representing specific subsystems, parameterization. Software and hardware monitors, performance measures. Case studies, software packages.

808. Modelling and Discrete Simulation

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

809. Algorithms and Their Hardware Implementation

Spring. 3(3-0) Interdepartmental with Computer Science.
Arithmetic, signal processing, and image processing algorithms. Array structures: systolic architecture, data flow structure, neural network architecture. Performance analysis.

813. Logic Design Principles

Fall. 3(3-0) Interdepartmental with Computer Science.
Behavioral modeling. Combinational circuit analysis and design. Sequential-circuit analysis and synthesis. Design for testability. Semicustom and MSI design.

818. Robotics

Fall. 3(3-0)
P: EE 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.

820. Advanced Computer Architecture

Fall, Spring. 3(3-0) Interdepartmental with Computer Science. Administered by Computer Science.
P: CPS 410, CPS 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.

822. Parallel Processing Computer Systems

Spring. 3(3-0) Interdepartmental with Computer Science. Administered by Computer Science.
P: CPS 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.

823. Power System Stability and Control

Fall of even-numbered years. 3(3-0)
P: EE 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.

824. Power System Operation and Control

Fall of odd-numbered years. 3(3-0)
P: EE 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.

825. Alternating Current Electrical Machines and Drives

Spring of even-numbered years. 3(3-0)
P: EE 320.
Analysis, modeling and design of synchronous, induction, and switched reluctance machines. Design drives for motion control and power system applications.

826. Linear Control Systems

Fall. 3(3-0)
P: MTH 314.
Vector spaces, representation, system description, solution to the state equations, stability, controllability and observability. Adjoints of linear maps. Eigenstructure assignment. Partial and full order observers. Disturbance decoupling.

827. Nonlinear Systems Analysis

Spring. 3(3-0)
P: EE 826.
Existence, uniqueness and continuity of solutions. Phase portraits. Limit cycles. Linearization. Stability of equilibria and periodic orbits. Lyapunov stability. Describing functions. Perturbation. Averaging. Singular perturbation. Control applications.

829. Optimal Multivariable Control

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

831. Analog Circuit Theory

Fall of even-numbered years. 3(3-0)
Positive real functions. Filter approximations. Passive and active network synthesis. Nullor network analysis and synthesis. Active filters. Stability. Sensitivity.

832. Analog Integrated Circuit Design

Fall of odd-numbered years. 3(3-0)
Technology. Device modeling. Circuit simulation. Integrated circuit building blocks. Amplifiers, comparators, converters. Switched-capacitor filters. Analog signal processing circuits.

835. Advanced Electromagnetic Fields and Waves I

Fall. 3(3-0)
Electrostatics, magnetostatics, electrodynamics and Maxwell's equations. Potential functions. Eigenfunction expansion. Green's functions. Radiation of EM waves. EM boundary-value problems. TEM waves. Maxwell's equations with magnetic sources.

836. Advanced Electromagnetic Fields and Waves II

Spring. 3(3-0)
P: EE 835.
Theory of guided transmission system. Microstrip lines, metallic and dielectric waveguides. EM cavities. Excitation and discontinuities of waveguides. Surface wave and radiation modes. Integrated optics. Scattering of EM waves.

841. Fourier Optics

Spring of odd-numbered years. 3(2-3)
P: EE 360; EE 435 or EE 835.
Scalar diffraction theory. Fourier expansion of optical fields. Spatial linear systems and information processing. Lenses. Optical imaging systems. Holgraphy. Measurements of optical systems.

842. Quantum Electronics

Fall of even-numbered years. 3(3-0)
P: EE 835, EE 874.
Quantum and electromagnetic theory of lasers. Optical resonators. Laser oscillation and amplification. Characterization of lasers. Specific laser examples.

847. Analog and Digital Communications

Fall of odd-numbered years. 3(3-0)
P: EE 457, EE 863.
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, intersymbol interference, spread spectrum.

850. Electrodynamics of Plasmas

Spring of odd-numbered years. 3(3-0) Interdepartmental with Physics, and Astronomy and Astrophysics.
P: EE 835 or PHY 488.
Plasma kinetic and macroscopic plasma transport theory. Electromagnetic wave propagation and charged particle diffusion processes in plasma. Electromagnetic energy absorption via elastic and inelastic collisions. Dc, rf, and microwave discharges.

863. Analysis of Stochastic Systems

Fall. 3(3-0)
P: STT 441.
Advanced topics in random variable theory. Stochastic processes and stochastic calculus. Optimal systems for filtering and detection.

865. Analog and Digital Communications

Fall of odd-numbered years. 3(3-0)
P: EE 457, EE 863
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, intersymbol interference, spread spectrum.

874. Physical Electronics

Fall. 3(3-0)
Applications of quantum mechanics and statistical mechanics in solids. Band theory of semiconductors. Electrical transport phenomena. Pn junctions.

875. Electronic Devices

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

885. Artificial Neural Networks
Fall. 3(3-0) Interdepartmental with Computer Science.
Overview of neuro-engineering technology. Basic neural network architectures. Feedforward and feedback networks. Temporal modeling. Supervised and unsupervised learning. Implementation. Basic applications to pattern recognition.

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.

920. Selected Topics in High Performance Computer Systems
Spring of odd-numbered years. 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. Interdepartmental with Computer Science. Administered by Computer Science.
P: CPS 822. R: Open only to Computer Science or Electrical Engineering majors.
Design of high performance computer systems. Seminar format.

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.
Topics vary each semester. Topics such as testable and fault-tolerant digital systems, embedded architectures.

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.

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.

931. Advanced Topics in Electronic Devices and Materials (MTC)
Fall, Spring. 1 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.

932. Advanced Topics in Analog Circuits (MTC)
Spring of odd-numbered years. 3(3-0) A student may earn a maximum of 3 credits in all enrollments for this course.
Topics vary each semester. Topics such as advanced circuit analysis.

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.

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.

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.

989. Advanced Topics in Plasma (MTC)
Fall of odd-numbered 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.

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.

ENGINEERING EGR

College of Engineering

101. Preview of Science
Fall. 1(1-0) Interdepartmental with Natural Science, Agriculture and Natural Resources, and Social Science. Administered by Natural Science.
R: Approval of College
Overview of natural sciences. Transitional problems. Communications and computer skills. Problem solving skills. Diversity and ethics problems in science. Science and society.

150. Engineers and the Engineering Profession
Spring. 2(2-0)
R: Open only to freshmen and sophomores.
Overview of the engineering profession. Historical background. Engineering specialities. Engineers at work. Professionalislm and ethics. Communication skills. Future trends and challenges.

160. Minority Engineering Education Seminar
Fall. 2(2-0)
R: Open only to freshmen in the College of Engineering and to freshmen no-preference students.
Issues relevant to underrepresented engineering minority groups. Diversity in engineering. Transitional problems. Communication skills. Career options.

192. Environmental Issues Seminar
Fall, Spring. 1(1-0) A student may earn a maximum of 4 credits in all enrollments for this course. Interdepartmental with Natural Science, Agriculture and Natural Resources, and Social Science. Administered by Natural Science.
R: Open only to students in the College of Agriculture and Natural Resources, College of Engineering, College of Natural Science, and College of Social Science. Approval of College.
Environmental issues and problems explored from a variety of perspectives, including legal, scientific, historical, political, socio-economic, and technical points of view.

200. Technology, Society and Public Policy
Fall. 2(2-0)
P: 2 courses in mathematics or engineering or science.
R: Not open to freshmen.
Description and analysis of certain technologies and their consequences. Development of techniques for assessing consequences as an aid to formulation of public policy.

290. Independent Study
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course.
R: Students in College of Engineering, approval of department.
Independent undergraduate research in engineering.

291. Selected Topics
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 freshmen, sophomores.
Experimental course development or special topics appropriate for freshmen and sophomores.

393. Engineering Cooperative Education
Fall, Spring, Summer. 1(1-0) A student may earn a maximum of 6 credits in all enrollments for this course.
R: Open only to students in College of Engineering. Educational employment assignment approved by College of Engineering.
Pre-professional educational employment experiences in industry and government related to student's major.

400. Special Problems in International Engineering
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 juniors, seniors, and graduate students in the College of Engineering.
Supervised study of selected topics in engineering using laboratories, equipment , and engineering design techniques. Given at various international universities and institutes.

475. Special Topics in International Engineering
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 juniors, seniors, and graduate students in the College of Engineering.
Topics selected to supplement regular courses. Given at various international universities and institutes.

888. Capstone Project in Manufacturing
Spring. 3(1-6) Interdepartmental with Marketing and Supply Chain Management.
R: Open only to juniors or seniors in the Manufacturing Engineering major or to students in the Business Management of Manufacturing major.
Problem solving in manufacturing. Design of products and processes for manufacturing using a systems approach. Teaming and communication skills are emphasized.

ENGLISH ENG

Department of English
College of Arts and Letters

090A. Intensive English for Non-Native Speakers
Fall, Spring. 0 credit. [12(20-0) See page A-2, item 3.]
R: Approval of English Language Center.
Explanation and intensive practice of English skills. Focus on beginning grammar, speaking, listening, reading, and writing.

090B. Intensive English for Non-Native Speakers
Fall, Spring. 0 credit. [12(20-0) See page A-2, item 3.]
R: Approval of English Language Center.
Explanation and intensive practice of English skills. Focus on intermediate grammar, speaking, listening, reading, and writing.