970A. The Law of Higher Education
Fall, Spring. 3(3-0) Graduate students in College and University Administration; others, approval of instructor.
Principles and cases of law applied to problems of governance, management, and instruction in post-secondary educational institutions. Emphasis upon personnel and student administration and equity issues.

970B. Higher Education Finance
(EAC 970B.) Fall, Spring. 3(3-0) Admission to M.A. or Ph.D. programs in the College of Education.
Structures, processes and problems related to the financing of higher education in the United States. Emphasis on alternatives for the future.

971A. The Department in Higher Education
Winter. 3(3-0) Approval of instructor.
The Department is an administrative structural element of the University. The duties and responsibilities of the chairperson as they relate to the management of the Department.

971B. Management Systems in Higher Education Administration
Fall, Spring. 3(3-0) Graduate students in College and University Administration; others, approval of instructor.
The application of National Center for Higher Education Management Systems tools to decision making in higher education administration. Resource Requirement Prediction Model 1.6, student flow and faculty activity analysis are major tools investigated.

971C. Evaluation of Higher Education
Spring. 3(3-0) Graduate students in College and University Administration, EAD 872A or approval of instructor.
Ways in which evaluation takes place in higher education; current concepts, grading, comprehensive examinations, teacher evaluation, institutional evaluation, state surveys, and regional and national studies of higher education problems.

971D. Community College Administration
Winter. 3(3-0) Graduate students in College and University Administration. Others, approval of instructor.
Functional areas of community college administration with emphasis upon instruction, finance and student services including the importance of local, state and federal influences.

973A. College Student Affairs Administration I
Fall. 3(3-0) Doctoral students in Student Affairs Emphasis. Others, approval of instructor.
Emphasis on planning, organization, financing, research, evaluation and administration for programs and services which exist principally to serve individual student needs: counseling, orientation, health, placement, financial aids, etc.

973B. College Student Affairs Administration II
Winter. 3(3-0) Doctoral students in Student Affairs Emphasis. Others, approval of instructor.
Student organizations and activities; student unions; on and off-campus living environments. Emphasis on planning, organization, financing, research, evaluation and administration of these programs and services.

973C. College Student Affairs Administration III
Spring. 3(3-0) Doctoral students in Student Affairs Emphasis. Others, approval of instructor.
Analysis of student rights and responsibilities; academic freedom; regulation of student conduct; systems of governance and judicial processes; legal basis for student personnel programs and administration.

976A. Doctoral Internship in College and University Administration
Fall, Winter, Spring, Summer. 3(3-0) May require for a maximum of 12 credits. Doctoral students in College and University Administration, approval of Instructor.
Students intern in on- and off-campus offices and agencies as observers of and participants in the administration of programs particular to their major field of study.

978A. Independent Research in Higher Education Administration
Fall, Winter, Spring. 3(3-0) May require for a maximum of 6 credits. Doctoral students in College and University Administration.
Supervised and guided in-depth readings in literature and research specific to higher education administration which lead to the development of materials such as position papers, articles for publication, and grant and dissertation proposals.

982. Seminars in Administration and Curriculum
Fall, Winter, Spring. 1 to 6 credits. May require for a maximum of 15 credits.
Seminars in the various fields of emphasis.

983. Readings and Independent Study in Educational Administration
Fall, Winter, Spring. 1 to 6 credits. May require for a maximum of 15 credits.
Study on an individual or group basis in the various fields of emphasis.

984. Laboratory and Field Experience in Educational Administration
Fall, Winter, Spring. 1 to 6 credits. May require for a maximum of 15 credits.
Supervised advanced graduate practicum, observation, internships, and externships in the various areas of emphasis.

999. Doctoral Dissertation Research
Fall, Winter, Spring. Summer. Variable credit. Approval of department.

999. Doctoral Dissertation Research
Fall, Winter, Spring. Summer. Variable credit. Approval of department.

ELECTRICAL ENGINEERING
AND SYSTEMS SCIENCE

College of Engineering

Electrical Engineering

E E

230. Digital Logic Fundamentals
Fall, Winter, Spring, Summer. 4(4-0) CFS 112 or CFS 251.
Boolean algebra; combinational logic and minimization; sequential systems fundamentals and components; arithmetic operations and devices; memory devices and ensembles; data conversion principles; digital integrated circuits; practical engineering design problems.

231. Computer Organization and Usage
Fall, Winter, Spring. 4(4-0) E E 230.
Computer structure and machine language; microprocessors addressing techniques; computer bus; program segmentation and linkage; microcomputer case studies; survey of computer science and engineering.

300. Electric Circuits I
Fall, Winter, Spring. 4(4-0) E E 300, MTH 214.

301. Electric Circuits II
Winter. Spring. 3(3-0) E E 300, MTH 215.
VOLT-ampere characteristics of diodes and transistors. Voltage, current and power amplification. Stability, transient and high frequency effects. Feedback, oscillators and operational amplifiers.

303. Electronics Laboratory I
Winter. Spring. 1(0-3) E E 300; E E 301 concurrently.
Electronic test equipment and measurement fundamentals. Experimental verification of topics covered in E E 300 and E E 301. Computer-aided circuit analysis and design.

304. Electronics Laboratory II
Fall. 1(0-2) E E 302.

305. Electromagnetic Fields and Waves I
Fall, Winter. 3(3-0) MTH 210, PHY 288.
Vector analysis. Electromagnetic fields; EM sources, scalar potential, Poisson's and Laplace's equations; dielectric media, capacitance, and energy storage. Boundary value problems for electromagnetic fields.

306. Electromagnetic Fields and Waves II
Winter. 3(3-0) E E 305.
Electromagnetic fields; EM sources, vector potential, magnetic media, inductance; energy storage; time varying fields, and Maxwell's equations; potential theory and boundary value problems.
Description — Electrical Engineering and Systems Science

of Courses

307. Electromagnetic Fields and Waves II
Spring, Summer. 3(3-0) E E 306.

308. Fields and Waves Laboratory
Fall, Spring. 1(0-3) E E 307 or concurrently.
Experimental investigation of: charged particle motion in EM fields, dielectric and magnetic properties and materials, profiling of currents and charges, and propagation of transient and steady-state waves. Digital computer solutions for EM field and wave problems.

320. Electromechanical Energy Conversion
Fall, Spring. 3(3-0) E E 301, E E 306.
Review of electromagnetics, three phase power, transformers, electromagnetic energy conversion, basic concepts of rotating machines, alternating current machines.

345. Introduction to Electronic Instrumentation Systems
Fall, Winter. 4(3-3) PHY 286.
Basic electronic concepts: passive and active components; operational amplifiers; switching devices, equivalent circuits; transducers; signal conditioning; recording; data management; basic elements of control.

355. Deterministic Communication Systems
Fall, Winter. 3(3-0) E E 301, MTH 214. Interdepartmental with Systems Science.
Communication systems. Representation of signals in time and frequency domain. Processing of signals by linear, simple nonlinear and time-variant systems. Linear and nonlinear, analog and digital modulation and demodulation; for example, AM, FM, PCM.

412. State Models, Analysis, and Simulation
Spring, 3(3-0) SYS 311, MTH 310, MTH 334. Interdepartmental with and administered by Systems Science.
Vector-matrix state-space models of dynamic systems, exponential matrix, transform solutions, convolution, stability, controllability, observability, simulation, computational techniques, extensions to nonlinear systems.

413. Analysis of Control Systems
(313.) Fall, 4(4-4) E E 301, E E 355. Interdepartmental with and administered by Systems Science.
Control system characteristics, performance criteria, transient and steady-state responses, error analysis, stability, root locus and frequency response techniques. Controller design using root locus and frequency response methods.

414. Control Systems Laboratory
Winter, Spring. 1(0-3) E E 231, E E 304, SYS 413. Interdepartmental with Systems Science.
Experimental investigations of feedback systems. Study of solid state controllers. Properties and applications of phase lock loops. Introduction to digital control.

415. Digital Control Systems
Winter. 3(3-0) E E 311, SYS 311, SYS 413. Interdepartmental with Systems Science.
Organization of digital control systems, classical and modern techniques for the design of digital control systems. Hardware and software considerations with emphasis on microprocessor implementation.

418. Introduction to Computer-Aided Circuit Design
Fall. 3(3-0) CPS 301, E E 302.
Introduces the techniques used for automatic formulation, analysis and optimization of linear and nonlinear electronic circuits. Students will write a modest but useful analysis program package.

419. Physical Phenomena and Electronic Instrumentation I
Winter. 4(3-3) PHY 289, PHY 298 or approval of department, MTH 215. Interdepartmental with and administered by Physics.
Concepts of electronics relative to uses in investigations of physical phenomena and their subsequent applications to provide reliable instrumentation. Nuclear radiation detectors, photometers and magnetometers are examples of specific topics covered.

421. Power System Analysis
Spring. 3(3-0) E E 320 or concurrently.
Model of power system components; analysis and planning techniques including load flow, short circuit, transient stability; voltage and frequency control; economic operation of power systems.

422. Power Electronics
Winter. 3(3-0) E E 320, E E 320.
Thyristor characteristics, commutation, AC voltage controllers; single-phase and three-phase rectifier and inverter circuits, DC-to-DC converters, cycloconverters, AC and DC motor drives.

423. Electrical Machines Laboratory
Spring. 1(0-3) E E 320.
Transformers, torque, power and speed characteristics of induction, synchronous and dc machines, steady state and transient operation of machines, machine control.

430. Digital Electronics
Fall, Winter, Spring. 3(3-3) E E 230, E E 302.
Diodes and transistors as switching elements; logic families, data conversion circuits; memory circuits; digital subsystem design.

431. Computer Interfacing
Fall, Winter, Spring. 4(3-3) E E 321; E E 430.
Case study of a small computer system. I/O controller design, bus interface requirements, interrupt structure, and data transfer. Digital system design.

435. Microwave Circuits and Systems
Fall. 3(3-0) E E 367.

436. Radiation and Reception of Electromagnetic Waves
Winter. 3(3-0) E E 307.
Radiation, propagation, scattering and reception of electromagnetic waves; circuit and radiation characteristics of wire and microwave antennas; radiation fields, self and mutual impedances of antennas and arrays; microwave aperture antennas.

438. Transmission and Radiation Laboratory
Winter. 1(0-3) E E 435; E E 436 concurrently.
Microwave transmission and radiation laboratory. Measurement of frequency, wavelength, standing waves, impedance, and power. Experiments on transmission lines, waveguides, cavity resonators, microwave circuits, and circuit and radiation properties of antennas.

456. Applied Probability in Communication Theory
Fall, Winter. 3(3-0) E E 355.

457. Statistical Communication Systems
Spring. 3(3-0) E E 456; E E 467 concurrently.
Experimental investigations on communication theory and information transmission topics from E E 455, E E 456, and E E 457.

474. Physical Principles of Electronic Devices
Fall. 4(4-4) E E 302; E E 305.
Energy levels in atoms and crystals; density of states; Fermi-Dirac and Maxwell-Boltzmann statistics; transport properties of bulk materials; metal-semiconductor contacts; the p-n junction and BJT.

475. Electronic Devices and Circuits
Winter. 3(3-0) E E 474.
Fabrication technology: models and characteristics of BJTs, JFETs, and MOS devices; application to linear and digital circuits.

476. Applications of Electronic Devices
Spring. 3(3-0) E E 474.
Power devices and applications; transistors, diodes, triacs, and SCR's; high frequency devices and applications; transistors; impact, GUNI and vacuum devices; photo-devices; solar cells and LED's.

477. Electro-optic Devices
Spring of odd-numbered years. 3(3-0) E E 306.
Atomic origin and the operational characteristics of light sources and detectors. Basic design considerations for gas and solid state lasers. Methods of optical detection, applications.
815. Architecture of Computational Systems
Winter. 3(3-0) CPS 423. Interdepartmental with administrative by the Department of Computer Science.
Overview of computer system organization; theoretical constructs of computer systems; processors; control units; memory; interconnection networks.

818. Introduction to Robotics
Spring. 3(3-0) E E 415 or approval of instructor. Interdepartmental with the Department of Computer Science.
Robot configuration and geometry. Robot drive systems, kinematics, controller design, sensors, sensor-based robots. Economic, political and social implications. Industrial application.

820. Electric Power Transmission System
Spring of odd-numbered years. 4(4-0) E E 421 or approval of instructor. Symmetrical fault currents for symmetrical and unsymmetrical faults; methods and devices used in protection; pilot wire and carrier systems, circuit interruption, grounding.

823. Power System Stability and Control
Fall of even-numbered years. 3(3-0) SYS 856. 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) E E 421, SYS 413, E E 456 or STR 441. Operation planning of power systems including load flow, unit commitment, and production cost methods; on line operation and control including automatic generation control, economic dispatch, security assessment, and state estimations.

831. Active Network Synthesis
Winter. 3(3-0) Approval of department. S-domain network synthesis. Root-locus design techniques for practical analog signal processors, including sensitivity and stability considerations. Pseudo components, calculated functional properties of operational amplifiers.

855. Electromagnetic Theory
Fall. 3(3-0) Approval of department. Electromagnetic field laws, constitutive relations, EM waves, Maxwell's equations. Green's functions. TEM waves: propagation in rectangular coordinates, transmission and scattering coefficients. Transmission lines: variational methods, microstrip.

847. Communication Engineering

848. Communication Theory

849. Microwave Electronics
Spring of odd-numbered years. 3(3-0) E E 835, E E 875. Microwave gaseous, solid-state and vacuum devices, active microwave integrated circuits and systems, waves in solid-state plasmas and their applications, parametric amplifiers, design of microwave amplifiers, oscillators and communication systems.
Description — Electrical Engineering and Systems Science

Courses

850. *Electrodynamics of Plasmas I*
Winter. 3(3-0) E E 835 or EEE 410; E E 836.
Interdepartmental with and administered by the Department of Physics and Astronomy.
Boltzmann equation; moment equations; two-fluid theory of plasma, waves in cold, warm and anisotropic plasmas; waves in bounded plasma structures, energy flow in anisotropic plasmas.

857. *Microprocessor-based System Design*
Spring. 4(2-6) E E 431 or EEE 423.
Microprocessor-based system design methodologies, performance measures, single-chip computer organization alternatives; local networks of processors; applications in signal processing and control and instrumentation.

863. *Analysis of Stochastic Systems*
Winter. 3(3-0) SYS 826, STT 441, MTH 454. Interdepartmental with and administered by Systems Science.
Analysis and modeling of stochastic signals and systems. Topics include stochastic models, description of processes, stationarity, ergodicity, correlation and power spectrum, linear stochastic systems, harmonic analysis, Markov processes, Poisson processes.

871. *Integrated Circuit Engineering*
Winter. 3(3-0) E E 474.
Fabrication and design of integrated circuits. Physics and chemistry of processing. Comparison of current bipolar and MOS technologies, and their limitations. VLSI design methodology and layout examples.

874. *Physical Electronics*
Fall. 4(4-0) Approval of department.
Application of quantum mechanics in solids, band theory of semiconductors, electrical transport phenomena, induced current concept, charged particle dynamics, electron optics.

875. *High Speed Solid-State Devices*
Winter. 3(3-0) E E 474.
Formulation of operating properties and appropriate models of devices formed with semiconductors and solid state materials. Emphasis is on performance limitations of high speed integrated circuit unipolar and bipolar devices.

876. *Semiconductor Power Devices*
Spring of even-numbered years. 3(3-0) E E 474.
Formulation of operating properties and appropriate models of devices formed with semiconductors and solid state materials. Performance limitations of semiconductor power devices due to voltage, temperature and power considerations.

880. *Digital Signal Processing*
Winter. 3(3-0) E E 458 or STT 441. Interdepartmental with Systems Science.
Discrete time signals and systems, random discrete time signals. Basic principles of estimation theory, spectral estimation. Digital filter design techniques.

889. *Master's Thesis Research*
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

911. *General Automata Theory I*
Fall of odd-numbered years. 3(3-0) CPS 433 or SYS 827 or approval of department. Interdepartmental with and administered by the Department of Computer Science. Characterization of machines and programs as automata; mathematical decomposition of finite automata.

920. *Advanced Topics on Power*
Winter. 3(3-0) E E 823 or E E 824.
Current research topics in power system planning, operation and control. Topics may include AC/DC systems, computational methods for balanced and unbalanced systems, stability, and security.

921. *Advanced Computer Systems I*
Fall. 3(3-0) Two graduate-level courses in computer system design (hardware or software). Interdepartmental with and administered by the Department of Computer Science.
Models of single and multiple processors, their construction and programming of performance. Interconnection networks, data driven machines, and pipelines.

922. *Advanced Computer Systems II*
Winter. 3(3-0) CPS 921. Interdepartmental with and administered by the Department of Computer Science.
Design and characterization of parallel algorithms. Matching of algorithms with appropriate hardware configurations. Programming languages which support parallel computation.

926. *Antenna Theory I*
Winter of even-numbered years. 3(3-0) E E 835.
Wire antennas as radiating, receiving and scattering elements; analytical and numerical integral equation methods;偶极 antennas and arrays; transient phenomena.

927. *Antenna Theory II*
Spring of even-numbered years. 3(3-0) E E 926.
Radiation by equivalent aperture surfaces; aperture antennas, slot antennas, horn and reflexor antennas, frequency independent antennas; pattern theory; scattering from various objects.

929. *Advanced Topics in Electromagnetics*
Winter. 2 to 4 credits. May recur for a maximum of 4 credits. E E 835 and approval of department.
Topics will be drawn from contemporary research areas such as transient electromagnetics (SEM solutions), open-boundary waveguides, solid-state lasers, and microwave plasmas.

931. *Electronic Properties of Semiconductors*
Winter of odd-numbered years. 3(3-0) E E 874.
Advanced treatment of phenomena basic to semiconductor materials and devices. Electronic transport, high field effects, recombination theory, electro-optical phenomena, experimental characterization techniques.

932. *Topics in Solid State Device Research*
Spring of odd-numbered years. 3(3-0) E E 874.
Relationship of solid state theory and material properties to device performance. Topics selected from current device research areas and vary with year. Examples are photovoltaic, amorphous semiconductor, and piezoelectric devices.

980. *Electrodynamic of Plasmas II*
Winter of odd-numbered years. 3(3-0) E E 850. Interdepartmental with the Department of Physics and Astronomy.
One fluid plasma model, magnetohydrodynamics, Maxwell's stress tensor, low frequency waves, transport phenomenon, Landau damping, collision and rate coefficients. Diffusions in a magnetic field; investigation of dc, rf and microwave discharges.

999. *Doctoral Dissertation Research*
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

Systems Science

311. *Discrete-Time Systems*
Fall. Winter. 3(3-0) MTH 415.
Discrete-time system modeling, discrete-time signals, difference equations, convolution summations, z-transform, transfer functions, stability analysis, digital filters.

355. *Deterministic Communication Systems*
(455) Fall, Spring. 3(3-0) E E 301, MTH 214. Interdepartmental with and administered by Electrical Engineering.
Communication systems. Representation of signals in time and frequency domain. Processing of signals by linear, simple nonlinear and time-variant systems. Linear and nonlinear, analog and digital modulation and demodulation; for example, AM, FM, PCM.

410. *Systems Methodology*
Winter. 3(3-0) MTH 113, SYS 115 or CSP 120.
The systems approach in multidisciplinary large scale problem solving. The development of useful systems analysis tools; systems design; feasibility study; computer simulation for feasibility evaluation.

411. *Systems Project*
Spring. 2(3-0) SYS 410.
Completion of a systems study initiated in SYS 410. The project may involve design of hardware, simulation of a solution to an interdisciplinary problem, or development of a solution concept.

412. *State Models, Analysis, and Simulation*
Spring. 3(3-0) SYS 311, MTH 310, MTH 334. Interdepartmental with Electrical Engineering.
Vector-matrix space models of dynamic systems, exponential matrix, transform solutions, convolution, stability, controllability, observability, simulation, computational techniques, extension to nonlinear systems.

413. *Analysis of Control Systems*
Fall. 4(4-0) E E 301, E E 355. Interdepartmental with Electrical Engineering.
Control system characteristics, performance criteria, transient and steady-state responses, error analysis, stability, root locus and frequency response techniques. Controller design using root locus and frequency response methods.

414. *Control Systems Laboratory*
Winter, Spring. 1(0-3) E E 321, E E 304, SYS 413. Interdepartmental with and administered by Electrical Engineering.
Experimental investigations of feedback systems. Study of solid state controllers. Properties and applications of phase lock loops. Introduction to digital control.

415. *Digital Control Systems*
Winter. 3(3-0) E E 321, SYS 311, SYS 413. Interdepartmental with and administered by Electrical Engineering.
Organization of digital control systems, classical and modern techniques for the design of digital control systems. Hardware and software considerations with emphasis on microprocessor implementation.
442. Systems Concepts for Biologists  
Winter. 3(3-0) Approval of department.  
Basic concepts of systems science important to formal analysis and control of biological communities, with emphasis on modeling and analysis of behavior through numerical solutions.

465. Process Optimization Methods  
Spring. 3(3-0) MTH 310. Interdepartmental with and administered by the Department of Chemical Engineering.  
Methods for determining optimum design and operating policies of systems of varying complexity. Includes classical methods, mathematical programming and modern methods. Flow sheet optimization with process simulation packages.

495. Independent Study  
Fall, Winter, Spring, Summer, 1 to 3 credits. May reenroll for a maximum of 3 credits in SYS 495 and E E 495 combined. Approval of department.  
Independent study of a topic in systems science of particular interest to the student.

499. Undergraduate Research  
Fall, Winter, Spring, Summer, 1 to 3 credits. May reenroll for a maximum of 6 credits in SYS 499 and E E 499 combined. Approval of department.  
Independent undergraduate research in contemporary areas of systems science.

501. Special Problems  
Fall, Winter, Spring, Summer, 1 to 4 credits. May reenroll for a maximum of 8 credits. Approval of department.

820. Linear Multivariable Control Systems  
Winter. 4(4-0) SYS 826, STT 441, SYS 413.  
Linear continuous time and discrete time multivariable control systems; state and output feedback; observers; eigenstructure assignment; asymptotic tracking; optimal linear control; stochastic processes; Kalman filter; LQG optimal control.

835. Static Optimization Methods  
Summer. 4(4-0) MTH 424. Students may not receive credit for both MATH 835 and MGT 835.  
Linear and nonlinear optimization examples and applications; Kuhn-Tucker theory; saddle point optimality conditions; algorithms for problems with constraints; unconstrained optimization; introduction to search methods.

841. Optimization of Urban Traffic Flow  
Fall of even-numbered years. 3(3-0) CEE 348, STT 351 or approval of department.  
Interdepartmental with and administered by Civil Engineering.  
Traffic flow models used in design of computerized traffic control systems. Optimal freeway ramp metering algorithms. Offline and online optimization of traffic signal timing.

843. Ecosystem Analysis, Design and Management  
Spring. 3(3-0) SYS 442 or ZOL 494. Interdepartmental with the Department of Zoology.  
Groups of students from various biological and non-biological disciplines will synthesize and analyze models of selected biological systems. Project should yield information relevant to solution of contemporary ecological problems.

847. Communication Engineering  
Fall. 4(4-0) E E 457. Interdepartmental with and administered by Electrical Engineering.  

848. Communication Theory  
Spring. 3(3-0) SYS 663. Interdepartmental with and administered by Electrical Engineering.  
Hypothesis testing, decision theory and parameter estimation in large simulation models. Application to economic, social and biological systems; other topics of current interest.
Description — Electrical Engineering and Systems Science of Courses

954. Large Scale Dynamic Systems
Spring of even-numbered years. 3(3-0)
SYS 827, SYS 828.
Topics will be drawn from: model reduction and aggregation; stability of interconnected systems; multiple time scale decomposition; decentralized control; hierarchical control.

955. Adaptive Control
Spring of odd-numbered years. 3(3-0)
SYS 827, SYS 829, SYS 863.
Model reference adaptive control in continuous time and discrete time; Kalman and H2/H∞ approaches; adaptive observers; self-tuning regulators; design using pole-zero assignments, minimum variance control and LQG control.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

ENGINEERING EGR

College of Engineering

150. Engineers and the Engineering Profession
Winter. 3(3-0)

200. Technology, Society and Public Policy
Winter. 3(3-0)
Twelve credits from natural science or engineering. Interdepartmental with the Department of Natural Science. Description and analysis of current technologies and their consequences; exploration of avenues for assessing such consequences as an aid to formulation of public policy.

290. Selected Topics
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 6 credits if different topics are taken.

344. Engineering Cooperative Education
Fall, Winter, Spring, Summer. 3(3-0) May reenroll for a maximum of ten terms. Employment assignment approved by College of Engineering.
Pre-professional employment in industry and government related to student's major.

390. Value Engineering
Fall. 4(4-0) Engineering Arts juniors. Open to freshmen, approval of department.
The basis of value engineering is function, value, and a group of special techniques developed to aid in isolating and identifying problems created by our complex society and technology.

401. Engineering and Public Policy
Spring. 3(3-0) Senior or approval of department. Interdepartmental with the Department of Natural Science. Sociotechnical assessment of impact of technology on society, with analysis of the role of engineering and natural science in contributing to public policy formulation.

ENGLISH ENG

College of Arts and Letters

091. English for Foreign Students—Structures
Exploration and intensive practice of basic grammatical structures of English. Students are tested and then placed in small groups, from beginning to advanced, depending on their need.

092. English for Foreign Students—Speaking and Listening
Intensive speaking and listening practice of spoken English in small groups (determined by proficiency). For beginners, practice is largely drill. Advanced groups use drill, films, discussion, and practical conversations.

093. English for Foreign Students—Language Laboratory
Language laboratory practice in small groups (determined by proficiency). Beginners review and supplement ENG 001, ENG 002. Advanced groups use carefully prepared lectures, speeches, and presentations to practice structures and vocabulary.

094. English for Foreign Students—Reading
Intensive and extensive reading in small groups (determined by proficiency). Beginners emphasize vocabulary development and practice in basic structures. Advanced classes include reading skills, wider reading, and specialized vocabulary.

095. English for Foreign Students—Writing
Frequent controlled and free writing in small groups to reduce errors and practice using structures and vocabulary to express ideas. Advanced classes include writing styles used in academic course work.

101. Responses Through Writing
Fall. 4(4-0) Arts and Letters freshmen only. Students must enroll in and complete ENG 101 satisfactorily to make a substitution for the American Thought and Language requirement.
A writing workshop that concentrates on the students' personal writing voice and on their responses to the things, people, and institutions central to their experience.

102. Writing and Composing
Winter. 5(5-0) ENG 101; Arts and Letters freshmen only.
A continuation of ENG 101 that develops the emphasis of ENG 101 and encourages students to write in more public and objective forms—narrative, critical analysis, and issue-oriented essays.

104. Writing for Science Majors
Fall. 3(3-0) Satisfactory grade in English proficiency exam; College of Natural Science majors. Interdepartmental with the Department of American Thought and Language.
Writing workshop for science students that develops and refines composition ability.

105. The Scientist as Writer
Winter. 3(3-0) ENG 104. Interdepartmental with the Department of American Thought and Language.
Study of various types of writing by scientists—fiction, poetry, and autobiography as well as professional papers and books. Students will write frequently about the readings.

106. Introductory Scientific Writing
Spring. 3(3-0) ENG 105. Interdepartmental with the Department of American Thought and Language.
Writing of popular essays, scientific papers and reports, and other papers related to science.

200H. Honorary Work
Fall, Winter, Spring. 1 to 16 credits. Approval of department.

201. Nature of Language
Fall, Winter, Spring, Summer. 3(3-0)
Various aspects of language—phonology and orthography; morphology, semantics and the lection; syntax; and dialects—with special reference to American English.

205. Introduction to Shakespeare
Fall, Winter, Spring. 3(3-0) Not applicable to major or minor requirements.
A study of selected plays illustrating the powers of England's greatest writer.

206. Forms of Literature: Fiction
Fall, Winter, Spring, Summer. 3(3-0)
Open to freshmen.
Major forms of prose fiction, designed to reveal artistic problems met and solved by these forms. Prepares students for advanced literary study by acquainting them with the conventions of various literary forms, by providing a critical vocabulary and by furnishing experience in reading and writing critical evaluations of outstanding literary works from all historical periods.

207. Forms of Literature: Drama
Fall, Winter, Spring, Summer. 3(3-0)
Open to freshmen.
Major forms of drama, designed to reveal artistic problems met and solved by these forms.

208. Forms of Literature: Poetry
Fall, Winter, Spring, Summer. 3(3-0)
Open to freshmen.
Major forms of poetry, designed to reveal artistic problems met and solved by these forms.

210. Introduction to the Study of Literature I
Fall, Winter. 4(4-0) English majors or prospective English majors.
Exploration of the major forms of literature, the aims and process of literary study, the cultural and personal functions of literature, and the role of literary study in the University.

211. Introduction to the Study of Literature II
Winter, Spring. 4(4-0) ENG 210.
A continuation of ENG 210.