ENGINEERING (ENGR)

ENGR 100 Introduction to Engineering (Unit: 1)
Prerequisites: High school algebra and trigonometry.
Description of the major engineering fields and their subfields. Day to day activities of engineers. Engineering professionalism, ethics, communication skills, lifelong learning and career planning. Survival skills. Safety issues and School of Engineering policies. (Plus-minus letter grade only)

ENGR 101 Engineering Graphics (Unit: 1)
Prerequisite: Must be taken concurrently with ENGR 100.

ENGR 102 Statics (Units: 3)
Prerequisites: MATH 227, PHYS 220.
Vector treatment of force systems acting on particles and rigid bodies. Centroids and moments of inertia. Trusses, machines, fluid statics, shear and moment diagrams for beams, and friction. Applications to structural and mechanical problems. (Plus-minus letter grade only)

ENGR 103 Introduction to Computers (Unit: 1)
Prerequisite: MATH 226.
Introductory course on programming, using a high-level language. Use of algorithms. Program organization, formulation, and solution of engineering problems. Laboratory.

ENGR 120 Introduction to Computer Engineering (Units: 3)
Prerequisites: High school algebra and trigonometry.
Introduction to the profession, areas of study, university rules and regulations, curriculum requirements, time management and study skills, critical thinking, problem solving skills, ethics, introduction to computers and basic computer skills including graphics, spreadsheet, database, Internet, and web page design. Classwork, 2 units; activity, 1 unit. (ABC/NC grading only)

ENGR 121 Gateway to Computer Engineering (Unit: 1)
Prerequisites: High school algebra and trigonometry.
Hands-on introduction to embedded computer systems. Basic laboratory instrumentation, electronic circuit assembly, measurement, and testing. Introduction to hardware and software of robots. Laboratory. (Plus-minus letter grade only)

ENGR 200 Materials of Engineering (Units: 3)
Prerequisite: CHEM 115 or CHEM 180.
Application of basic principles of physics and chemistry to engineering materials; their structures and properties and the means by which these materials can be made of better service to all fields of engineering. Classwork, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)

ENGR 201 Dynamics (Units: 3)
Prerequisite: ENGR 102.
Vector treatment of kinematics and kinetics of particles, systems of particles and rigid bodies. Methods of work, energy, impulse, and momentum. Vibrations and time response. Applications to one- and two-dimensional engineering problems. (Plus-minus letter grade only)

ENGR 202 Engineering Mechanics (Units: 3)
Prerequisites: MATH 227, PHYS 220.

ENGR 203 Materials of Electrical and Electronic Engineering (Units: 3)
Prerequisite: CHEM 115 or CHEM 180.
Application of basic principles of physics and chemistry to electrical and electronic engineering materials. Conductors, insulators, and semiconductors; electrical conductors; mechanical properties of conductors; manufacturing conductors; electrochemistry; electrical insulators; plastics; magnetic materials; superconductors and optical fibers. (Plus-minus letter grade only)

ENGR 204 Engineering Mechanics (Units: 3)
Prerequisites: MATH 227, PHYS 220.

ENGR 205 Electric Circuits (Units: 3)
Prerequisites: PHYS 230 and MATH 245; MATH 245 may be taken concurrently.
Circuit analysis, modeling, equivalence, circuit theorems. PSpice simulation. Ideal transformers and operational amplifiers. Transient response of 1st-order circuits. AC response, phasor analysis, impedance, power. (Plus-minus letter grade only)

ENGR 206 Circuits and Instrumentation Laboratory (Unit: 1)
Prerequisite: ENGR 205 (may be taken concurrently).
Electrical measurements and laboratory instrumentation. Verification of circuit laws and theorems. Operational amplifier circuits. AC steady-state behavior and frequency response. Transient characteristics of first-order circuits. Introduction to PSpice. Extra fee required.

ENGR 212 Introduction to Unix and Linux for Engineers (Units: 2)
Prerequisite: Priority enrollment for computer engineering students. Other students may enroll on a space available basis by consent of instructor.
Introduction to software development and program development in the Unix/Linux environment. File system organization and management, editors, utilities, network environment, pattern and file searching, command line interface, scripting languages. Classwork, 1 unit; laboratory, 1 unit. (Plus-minus letter grade only)

ENGR 213 Introduction to C Programming for Engineers (Units: 3)
Prerequisite: MATH 226 with a grade of C- or better.
Introduction to C programming; defining and analyzing problems; design of algorithms; implementation, testing, debugging, maintenance and documentation of programs; coverage of basic algorithms, programming concepts and data types; C programming of microcontrollers. (Plus-minus letter grade only)

ENGR 220 Energy: Resources, Alternatives, and Conservation (Units: 3)
Prerequisite: High school level mathematics or consent of instructor.
Energy, natural and renewable resources. Conversion to usable forms of energy. Demand reduction. Effect on resource conservation and environment. Every day usage of energy (in automobiles, homes, and work place) is emphasized. [CSL may be available; consult index for page reference.]

ENGR 235 Surveying (Units: 3)
Prerequisites: ENGR 100 and MATH 226.
Surveying: distance, elevation, and direction measurements; traverse analysis; contours; topography; areas calculations. Introduction to GPS and GIS. The US public lands system. Class work, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)
ENGR 200 Modular Elective (Unit: 1)
Prerequisite: Engineering students in sophomore year or later.

Topic to be specified in Class Schedule. May be repeated for a total of 3 units when topics vary. (Plus-minus letter grade only)

ENGR 300 Engineering Experimentation (Units: 3)
Prerequisites: ENGR 200 or ENGR 206, ENGR 205, ENG 214 with grade of C- or better.


This course is first in a series of courses (ENGR 300, ENGR 301 or ENGR 302, ENGR 696, and ENGR 697GW) that when completed with a C or better will culminate in the satisfaction of the University Written Eng Proficiency/GWAR if taken Fall 2009 or later. (Plus-minus ABC/NC grading only)

ENGR 301 Microelectronics Laboratory (Unit: 1)
Prerequisites: ENGR 300 and ENGR 353 (may be taken concurrently).

Measurement techniques, device characterization, experimental verification, and PSpice simulation. 2nd-order transient and frequency responses. Characterization of diodes, BJTs, and FETs. Diode circuits, transistor amplifiers, simple logic gates. Laboratory. Extra fee required.

This course is second in a series of courses (ENGR 300, ENGR 301 or ENGR 302, ENGR 696, and ENGR 697GW) that when completed with a C or better will culminate in the satisfaction of the University Written English Proficiency/GWAR if taken Fall 2009 or later. (Plus-minus ABC/NC grading only)

ENGR 302 Experimental Analysis (Unit: 1)
Prerequisites: ENGR 300, ENGR 304 (maybe taken concurrently), and ENGR 309.

Experimental investigation and analysis of engineering systems: structural elements, fluid devices, and thermal systems. Use of computers for data acquisition. Laboratory. Extra fee required.

This course is second in a series of courses (ENGR 300, ENGR 301 or ENGR 302, ENGR 696, and ENGR 697GW) that when completed with a C or better will culminate in the satisfaction of the University Written Eng Proficiency/GWAR if taken Fall 2009 or later. (Plus-minus ABC/NC grading only)

ENGR 303 Engineering Thermodynamics (Units: 3)
Prerequisite: PHYS 240.

Application of thermodynamics to a variety of energy exchanging devices; properties of the pure substance, ideal gases, and mixtures; power and refrigeration cycles. (Plus-minus letter grade only)

ENGR 304 Mechanics of Fluids (Units: 3)
Prerequisites: ENGR 201 and PHYS 240.

Statics and dynamics of incompressible fluids, dimensional analysis, and similitude; fluid friction, laminar, and turbulent flow in pipes; forces on submerged structures; fluid measurements. (Plus-minus letter grade only)

ENGR 305 Linear Systems Analysis (Units: 3)
Prerequisites: MATH 245 and ENGR 205 with a grade of C- or better.


ENGR 306 Electromechanical Systems (Units: 3)
Prerequisite: ENGR 205 with grade of C- or better.

Electromechanical energy conversion. Operating characteristics of transformers; DC and AC rotating machines: speed, torque, and profile control. Motion control system using stepper motors. System design, specifications, and simulation. (Plus-minus letter grade only.)

ENGR 309 Mechanics of Solids (Units: 3)
Prerequisites: ENGR 102 and ENGR 200 (may be taken concurrently).


ENGR 315 Systems Analysis Lab (Unit: 1)
Prerequisite: ENGR 305 (may be taken concurrently).


ENGR 323 Structural Analysis (Units: 3)
Prerequisite: ENGR 309.

Structural engineering, including standards and codes. Determination of loads, discussion of load path. Analysis of statically determined structures. Forces within statically indeterminate structures. Structural analysis software. Classwork, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)

ENGR 350 Introduction to Engineering Electromagnetics (Units: 3)
Prerequisites: MATH 245 and PHYS 240 with grades of C- or better.


ENGR 353 Microelectronics (Units: 3)
Prerequisites: ENGR 205 and ENGR 206 with grades of C- or better.

PN Diodes, BJTs, and MOSFETs. Semiconductor device basics, characteristics and models. Diode applications. Transistor biasing, basic amplifier configurations, and basic logic circuits. PSpice simulation. (Plus-minus letter grade only)

ENGR 356 Digital Design (Units: 3)
Prerequisite: ENGR 205 with grade of C- or better.

Number systems. Design of combinational and sequential circuits. Logic simplification. Digital functional units such as adders, decoders, multiplexers, registers, and counters. State-machine design. Storage and programmable devices. Register transfer level.

ENGR 357 Digital Design Laboratory (Unit: 1)
Prerequisite: ENGR 356 (may be taken concurrently).

Circuit construction and trouble shooting techniques. EDA tools and simulation. Combinational and sequential circuits. Semiconductor memory. Extra fee required.

ENGR 364 Materials and Manufacturing Processes (Units: 3)
Prerequisites: ENGR 201 and ENGR 309.

Integration of stress analysis and failure theories with knowledge of materials and manufacturing processes in machine design. Classwork, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)
ENGR 378 Digital Systems Design (Units: 3)
Prerequisite: ENGR 356 with a grade of C- or better.

CMOS digital circuits and their electrical properties. Logic circuit design with functional units. Algorithmic sequential machine design. Design with programmable logic devices. Hardware description and simulation language. Classwork, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)

ENGR 410 Process Instrumentation and Control (Units: 3)
Prerequisites: ENGR 300 and ENGR 305.


ENGR 411 Instrumentation and Process Control Laboratory (Unit: 1)
Prerequisite: ENGR 410 (may be taken concurrently).

Instrumentation for measurement of flow, temperature, level and pressure. Experiments on level, flow, and temperature control. P, PI, PID, and programmable logic controllers.

ENGR 415 Mechatronics (Units: 3)
Prerequisite: ENGR 305.

Basics of a multidisciplinary field that combines electronics, mechanical design and simulation, and control systems. Simulation and design of systems with sensors, controllers and actuators. System elements including common sensors, actuators and various electronic controllers. (Plus-minus letter grade only)

ENGR 416 Mechatronics Lab (Unit: 1)
Prerequisite: ENGR 415 (may be taken concurrently).

Experiments connected with mechatronics concepts. Programming microcontrollers, PLCs, computer-based controllers and their selection for mechatronic systems. Sensor and actuator experiments. Mechatronics project.

ENGR 421 Structural Engineering Laboratory (Unit: 1)
Prerequisite: ENGR 323.

Hands-on experimentation to verify theories and concepts. Develop an understanding of why design specifications are written to avoid detrimental structural behaviors. Laboratory, 1 unit.

ENGR 425 Reinforced Concrete Structures (Units: 3)
Prerequisite: ENGR 323 (may be taken concurrently).

Design of reinforced concrete structural systems. Elements of systems including beams, slabs, columns, connections. Ultimate strength approach to safety and serviceability: bending, shear, and axial loads. (Plus-minus letter grade only)

ENGR 426 Steel Structures (Units: 3)
Prerequisite: ENGR 323 (may be taken concurrently).

Design of steel structures, members, and connections. Effects of loads causing flexure, shear and axial force, and their combinations on design choices. Steels and sections used in structural design. Use of design specifications. (Plus-minus letter grade only)

ENGR 427 Wood Structures (Units: 3)
Prerequisite: ENGR 323 (may be taken concurrently).

Design of wood structures. Design procedures and specifications of the wood structural members subjected to tension, compression, flexure, and combined bending with axial forces. Design building codes and seismic provisions of wood structures. (Plus-minus letter grade only)

ENGR 429 Construction Management (Units: 3)
Prerequisite: ENGR 235.

Construction engineering and management: professional practice and ethics; bidding and contracting; planning and scheduling, network diagrams, scheduling computations, resource management, computer applications; cost estimating; construction safety. (Plus-minus letter grade only)

ENGR 430 Soil Mechanics (Units: 3)
Prerequisite: ENGR 309.

Soil as an engineering material with emphasis on identification, physical and mechanical properties. Evaluation of water flow through soil, settlement, soil strength, earth pressure, pile pullout capacity, and basic slope stability. Laboratory-based term project. Classwork, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)

ENGR 431 Foundation Engineering (Units: 3)
Prerequisite: ENGR 430.

Settlement of structures on deep and shallow foundations. Evaluation of undrained and drained soil strength. Analysis and design of gravity, cantilever and anchored walls. Ultimate capacity of deep and shallow foundations. (Plus-minus letter grade only)

ENGR 432 Finite Element Methods in Structural and Continuum Mechanics (Units: 3)
Prerequisite: ENGR 309.

Fundamental concepts of the finite element method for one- and two-dimensional elements. Applications in the areas of structural analysis, plane stress and plane strain, and two-dimensional groundwater flow. Computer implementation of finite element techniques. (Plus-minus letter grade only)

ENGR 433 Soil Mechanics Laboratory (Unit: 1)
Prerequisite: ENGR 430, or may be taken concurrently.

Standard commercial soil testing including basic soil properties, in situ density, compaction, permeability, consolidation, grain size, evaluation, and others. Reduction and interpretation of test results. (Plus-minus letter grade only)

ENGR 434 Principles of Environmental Engineering (Units: 3)
Prerequisites: CHEM 115 or CHEM 180; and ENGR 304 (may be taken concurrently).

Fundamentals of environmental engineering: water quality, water chemistry, water treatment, air quality, and solid waste management. (Plus-minus letter grade only)

ENGR 435 Environmental Engineering Design (Units: 3)
Prerequisite: CHEM 115 or CHEM 180.

Design concepts for environmental engineering systems relating to municipal and industrial wastewater treatment, disposal, and reuse. (Plus-minus letter grade only)

ENGR 436 Transportation Engineering (Units: 3)
Prerequisites: ENGR 235 and ENGR 430 (may be taken concurrently).

Principles, theories, and practice of transportation planning and design.
ENGR 437 Water and Energy Recovery from Liquid and Solid Waste (Units: 3)
Prerequisite: CHEM 115 or CHEM 180.
Definitions, liquid waste (wastewater, sludge), solid waste, physical processes, chemical processes, biological (aerobic, anaerobic) processes, chemical reaction kinetics, biological reaction kinetics, fundamentals of process design, conservation of mass, conservation of energy, oxidation-reduction reactions, energy content of organic matter natural processes. (Plus/Minus Letter grade only)

ENGR 439 Construction Engineering (Units: 3)
Prerequisites: ENGR 309 and ENGR 430 (may be taken concurrently).
Topics in construction engineering; construction methods and equipment, excavating, loading, hauling, and finishing; production of construction materials; compressed air and water systems; concrete form design; quality control. (Plus-minus letter grade only)

ENGR 440 Ethical Issues in Science and Technology (Units: 3)
Prerequisites: Upper division standing; ENG 214 or equivalent.
Ethical dimensions of science and technology. Conceptual and theoretical frameworks from the humanities and the life sciences. (This course is offered as BIOL 440 and ENGR 440. Students may not repeat the course under an alternate prefix.)

ENGR 441 Fundamentals of Composite Materials (Units: 3)
Prerequisites: MATH 245 and ENGR 309; major/minor.

ENGR 442 Operational Amplifier Systems Design (Units: 3)
Prerequisite: ENGR 305 with a grade of C- or better.

ENGR 445 Analog Integrated Circuit Design (Units: 4)
Prerequisites: ENGR 301 and ENGR 353 with grades of C- or better.
Integrated circuit technology, transistor characteristics and models. Analysis and design of monolithic op amps. Frequency response, negative feedback, stability, PSpice simulation. Classwork, 3 units; laboratory, 1 unit. Extra fee required. (Plus-minus letter grade only)

ENGR 446 Control Systems Laboratory (Unit: 1)
Prerequisite: ENGR 447 (may be taken concurrently).
Simulation and modeling of control systems using Matlab and Simulink. Control experiments using servomotors and industrial emulators. Control project.

ENGR 447 Control Systems (Units: 3)
Prerequisite: ENGR 305 with a grade of C- or better.

ENGR 448 Electrical Power Systems (Units: 3)
Prerequisite: ENGR 306 with a grade of C- or better.
Operating characteristics of transmission lines, transformers, and machines. Symmetrical component theory and sequence network method. Use commercial programs to conduct load flow study, short circuit analysis, and economic dispatch problems. State estimation, unit commitment, and system transient and stability issues. (Plus-minus letter grade only)

ENGR 449 Communication Systems (Units: 3)
Prerequisite: ENGR 305 with a grade of C- or better.
Review of linear systems. Amplitude (AM), frequency (FM), and phase (PM) modulation systems. Transmitter and receiver design. Frequency and time-domain multiplexing. Digital modulation techniques: line coding, pulse shaping, channel equalization techniques. Error correcting techniques.

ENGR 451 Digital Signal Processing (Units: 4)
Prerequisites: ENGR 305 and either ENGR 213, CSC 210 or ENGR 290 (Matlab), all with grades of C- or better.

ENGR 453 Digital Integrated Circuit Design (Units: 4)
Prerequisites: ENGR 301, ENGR 353, and ENGR 356 with grades of C- or better.
Integrated circuit technology, transistor characteristics and models. MOS and bipolar logic families, noise margins, speed, power, fanout, interfacing, PSpice simulation. Regenerative circuits and memories. Classwork, 3 units; laboratory, 1 unit. Extra fee required. (Plus-minus letter grade only)

ENGR 455 Power Electronics (Units: 4)
Prerequisites: ENGR 301, ENGR 306, and ENGR 353, all with grades of C- or better.
Power device characteristics. Circuit and component design and analysis concepts. Uncontrolled and phase controlled rectifier circuits. DC to DC converters. Switching DC power supply. Pulse width modulation. DC to AC inverter. Utility interface and harmonic issues. Classwork, 3 units; laboratory, 1 unit. Extra fee required.

ENGR 456 Computer Systems (Units: 3)
Prerequisites: ENGR 356 and either ENGR 213 or CSC 210, all with grades of C- or better.

ENGR 458 Renewable Electrical Power Systems and Smart Grid (Units: 3)
Prerequisite: ENGR 306 with a grade of C or better.
Introduction to electric power industry; electric circuit and electric power; transmission lines; transformers; synchronous generators; photo-voltaic systems; wind power systems; smart grid. (Plus-minus letter grade only)
ENGR 461 Mechanical and Structural Vibrations (Units: 3)
Prerequisites: ENGR 201, ENGR 309, and MATH 245.

Dynamic excitation and response of mechanical and structural systems. Frequency and time domain; energy methods, Rayleigh's principle, modal analysis. Vibration damping, resonance, isolation, absorption parametric excitation, and influence coefficients. (Plus-minus letter grade only)

ENGR 463 Thermal Power Systems (Units: 3)
Prerequisites: ENGR 302 and ENGR 467.

Application of thermodynamics, fluid mechanics, and heat transfer to design of energy systems. Economic and environmental aspects stressed as design criteria. Classwork, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)

ENGR 464 Mechanical Design (Units: 3)
Prerequisite: ENGR 364.

Application of principles of mechanics, materials science, and stress analysis to design of components and machines. Mechanical behavior of materials. Synthesis and analysis of major machine design project. Classwork, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)

ENGR 465 Principles of HVAC (Units: 3)
Prerequisites: ENGR 303 and ENGR 304.

Air requirements in buildings, heating and cooling load calculation methods and computer software, heating and cooling equipment, flow in pipes and ducts, and clean room technology. (Plus-minus letter grade only)

ENGR 466 Gas Dynamics and Boundary Layer Flow (Units: 3)
Prerequisites: ENGR 303 and ENGR 304.

Review of the fundamentals of fluid dynamics, formulation and application of compressible fluid flow, shock waves. Concept and formulation of laminar and turbulent boundary layers, external flows, flow around immersed bodies.

ENGR 467 Heat Transfer (Units: 3)
Prerequisites: ENGR 303 and ENGR 304.

Fundamental principles of heat transfer with applications to design. Conduction, transient and steady state; free and forced convection; radiation. Heat exchangers. (Plus-minus letter grade only)

ENGR 468 Applied Fluid Mechanics and Hydraulics (Units: 3)
Prerequisite: ENGR 304.

Fluid mechanics: incompressible flow to steady and transient flow problems in piping networks, turbo-machines, and open channels. (Plus-minus letter grade only)

ENGR 469 Alternative and Renewable Energy Systems (Units: 3)
Prerequisite: ENGR 303.

Theory and practical applications of renewable energy systems, including solar, hydro, and wind power. Biomass and biofuels. Environmental, social, and economic factors related to energy conversion processes. (Plus-minus letter grade only)

ENGR 470 Biomechanics (Units: 3)
Prerequisites: ENGR 300 and ENGR 309. Restricted to Mechanical and Civil Engineering major and minor.

Understanding and characterizing the mechanical behavior of biological tissues and systems with emphasis on the fundamentals of biomechanics including force analysis, mechanics of deformable bodies, stress analysis, and viscoelasticity. (Plus-minus letter grade only)

ENGR 476 Computer Communications Networks (Units: 3)
Prerequisites: ENGR 356 and either ENGR 213 or CSC 210, all with grades of C- or better.

Technological precedence and alternatives in setting up a computer communication network. OSI, DSL, cable modems, PPP, Ethernet, TCP/IP, wireless LANs, Frame Relay, ATM, and SONET topics. Classwork, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)

ENGR 478 Design with Microprocessors (Units: 4)
Prerequisites: ENGR 356 and either ENGR 213 or CSC 210, all with grades of C- or better.

ENGR 696 Engineering Design Project I (Unit: 1)
Prerequisites: Senior standing with 21 upper division units in engineering; ENGR 301 or ENGR 302.
Selection of design project, methods of research, time management, engineering professional practice and ethics. This course is 3rd in a series of courses (ENGR 300, ENGR 301 or ENGR 302, ENGR 696, and ENGR 697GW) that when completed with a C or better will culminate in the satisfaction of the University Written English Proficiency/GWAR if taken Fall 2009 or later. (Plus-minus ABC/NC grading only)

ENGR 697GW Engineering Design Project II-GWAR (Units: 2)
Prerequisite: ENGR 696.
Continue work on design project with maximum independence under supervision of a faculty adviser. Oral and written project reports required. May be repeated in the case of a double major. This is the final course in a series (ENGR 300, ENGR 301 or ENGR 302, ENGR 696, and ENGR 697GW) that when completed with a C or better will culminate in the satisfaction of the University Written English Proficiency/GWAR if taken Fall 2010 or later. (Plus-minus ABC/NC grading only)

Course Attributes:
• Graduation Writing Assessment

ENGR 699 Independent Study (Units: 1-3)
Prerequisite: Approval of division and instructor.
Special study in the laboratory, field, or library under the direction of a member of the division. The student must present a detailed written report of the work accomplished. May be repeated.

ENGR 800 Engineering Communications (Units: 3)
Prerequisite: Graduate status in engineering.
Types and modes of communications used by engineers in professional practice. Learning models for effective communications, both oral and written. (Plus-minus letter grade only)

ENGR 801 Engineering Management (Units: 3)
Prerequisite: Graduate standing or consent of instructor.
History and evolution of engineering, ethics and professionalism, business aspects of contracts and specifications, litigation and arbitration, planning and scheduling, quality control, personnel management. (Plus-minus letter grade only)

ENGR 820 Energy Resources and Sustainability (Units: 3)
Prerequisites: Graduate standing or consent of instructor; ENGR 303.
Overview of conventional and renewable energy resources. Energy conversion processes, flow pathways, and end uses. Environmental impacts, sustainability, and economics of energy systems.

ENGR 823 Introduction to Seismology (Units: 3)
Prerequisite: Graduate standing or consent of instructor.
Fundamentals of seismic wave propagation using physical approaches, application of wave propagation theory in studying earth structure, thus earthquake evolution; seismometry fundamentals, applications to societal issues; foundation in theoretical seismology and earthquake engineering. (Plus-minus letter grade only)

ENGR 825 Bridge Engineering and Prestress Reinforced Concrete Structures (Units: 3)
Prerequisites: Graduate standing; ENGR 425.
Application of structural theory in the design of complete systems for bridges. Focus on prestressed concrete, bridge engineering and others innovative design subjects in structural engineering. (Plus-minus letter grade only)

ENGR 826 Seismic Hazard Analysis (Units: 3)
Prerequisites: Graduate standing; ENGR 425 or ENGR 426.
Review of fundamentals of seismic hazard analysis, strong ground motions, attenuation relations; probabilistic and deterministic methods; seismic code provisions and ground motions. Introduction of appropriate selection of acceleration records for dynamic analysis. (Plus-minus letter grade only)

ENGR 827 Structural Design for Fire Safety (Units: 3)
Prerequisites: Graduate or senior standing; ENGR 323, ENGR 425 or ENGR 426.
Standard fire time-temperature curve and its limitations, properties of concrete, steel and fire protection materials at elevated temperature engineering; load capacity of structural components under fire; fire resistance design of steel, composite, concrete and timber structures. (Plus-minus letter grade only)

ENGR 828 Seismic Isolation and Energy Dissipation (Units: 3)
Prerequisite: ENGR 461 (or equivalent); restricted to graduate students in structural/earthquake engineering.
Concepts of base isolation and energy dissipation for seismic hazard mitigation.

ENGR 829 Advanced Topics in Structural Engineering (Units: 3)
Prerequisites: Graduate standing in Engineering or consent of instructor; ENGR 323 and ENGR 461.

ENGR 830 Finite Element Methods in Structural Continuum Mechanics (Units: 3)
Prerequisites: Graduate standing in engineering or consent of instructor; ENGR 309 and MATH 245.
Matrix methods of stress analysis; concepts of the finite element methods; bar elements; two-dimensional elasticity; plate bending; axisymmetrical problems; modeling; solution validation; dynamics using FEM; problems in nonlinear material and geometry.

ENGR 831 Advanced Concrete Structures (Units: 3)
Prerequisites: Graduate standing in engineering; ENGR 425.
Advanced design of reinforced concrete structural systems. Design of reinforced concrete frames considering seismic loads. (Plus-minus letter grade only)

ENGR 832 Advanced Topics in Seismic Design (Units: 3)
Prerequisites: Graduate standing in engineering or consent of instructor; ENGR 425, ENGR 426, and ENGR 461.

ENGR 833 Principles of Earthquake Engineering (Units: 3)
Prerequisites: Graduate standing in engineering or consent of instructor; ENGR 461.
Earthquake ground motions; development of response spectra and effects of local site conditions on spectra. Dynamic response of single and multi-degree of freedom systems to earthquakes. Seismic damage to buildings. Earthquake resistant design. (Plus-minus letter grade only)
ENGR 835 Advanced Steel Structures (Units: 3)
Prerequisites: Graduate standing in engineering; ENGR 426.
Advanced design of steel structures, plate girders, and connections. Steel structural design considering effects of torsion and combined bending and axial load. Design of steel frames considering seismic loads. Steel design emphasizing Load and Resistance Factor Design. (Plus-minus letter grade only)

ENGR 836 Structural Design for Earthquakes (Units: 3)
Prerequisites: ENGR 425, ENGR 426 or graduate status in engineering.
Earthquake resisting systems in buildings; seismic design criteria for structures; seismic upgrade and retrofit; computer applications in structural modeling and analysis for seismic forces.

ENGR 837 Geotechnical Earthquake Engineering (Units: 3)
Prerequisites: ENGR 430; ENGR 461 (may be taken concurrently).

ENGR 838 Smart Structures Technology (Units: 3)
Prerequisites: ENGR 323 and ENGR 461; or consent of instructor; restricted to graduate students in structural/earthquake engineering or civil engineering seniors.
Focus on smart structure technologies in the applications to structures including areas of structural control, structural health monitoring, and smart sensing. Topics include structural system identification, stability analysis, sensor data acquisition systems, and signal processing tailored specifically for structural engineering. (Plus-minus letter grade)

ENGR 844 Embedded Systems (Units: 3)
Prerequisite: Graduate standing or consent of instructor.
Trends and challenges of embedded systems. Introduction of design and use of single-purpose processors (hardware) and general-purpose processors (software). Discussion of memories and buses, advanced computation models, control systems, chip technologies, and modern design tools.

ENGR 846 Power Quality Issues: Problems and Solutions (Units: 3)
Prerequisites: ENGR 306 and ENGR 455.
Harmonics problems in power transmission and distribution systems. Causes of voltage and current harmonics; identification of problems; mitigation techniques to problems.

ENGR 848 Digital VLSI Design (Units: 3)
Prerequisite: ENGR 353.

ENGR 849 Advanced Analog IC Design (Units: 3)
Prerequisites: ENGR 353, ENGR 442, and ENGR 445; graduate standing or consent of instructor.
Fundamentals of analog integrated circuits design along with the nanometer CMOS technology; introduction of the mixed-signal IC design theories and practices; advanced analog IC blocks; practice of the analog design using state-of-art CAD tools. (Plus-minus letter grade only.)

ENGR 850 Digital Design Verification (Units: 3)
Prerequisites: ENGR 378; engineering majors.
Concepts and methodologies established for verification of complex digital designs, based on the language of System Verilog that has evolved as a standard language for verification and testbench design. Verification methodologies include random stimulus generation with automatic self-checking features to detect design bugs, and with coverage features as a measure of level of confidence in verification.

ENGR 851 Advanced Microprocessor Architectures (Units: 3)
Prerequisite: ENGR 456.
Microprocessor architecture and register organization. Multiprogramming, process scheduling and synchronization, and multitasking. Memory management and privileged machine states. Examples of 32-bit machines. Reduced architectures: RISC approach, MIPS. (Plus-minus letter grade only)

ENGR 852 Advanced Digital Design (Units: 3)
Prerequisite: ENGR 356 or equivalent.
Design of fundamental and pulse mode circuits, design with programmable logic devices, computer simulation of digital circuits, reliable digital system design techniques, testing and design for testability. (Plus-minus letter grade only)

ENGR 853 Advanced Topics in Computer Communication and Networks (Units: 3)
Prerequisite: ENGR 476 with a grade of C or better.
Computer communication networks for broadband services; current networking and communication technologies; new technologies and their utilization in emerging broadband multimedia applications.

ENGR 854 Wireless Data Communication Standards (Units: 3)
Prerequisite: Background in communication systems or consent of instructor.
Characteristics of wireless channels. Wireless local area networks, Bluetooth, high-rate and low-rate wireless personal area networks, and wireless broadband access. Medium-access control layers, security and quality of service.

ENGR 855 Advanced Wireless Communication Technologies (Units: 3)
Prerequisites: Graduate standing; ENGR 449 and ENGR 451.

ENGR 856 Nanoscale Circuits and Systems (Units: 3)
Prerequisites: ENGR 378, ENGR 453, and ENGR 890 or equivalent or consent of instructor.
Advanced topics in VLSI device, circuit and system design including high-performance and low-power design issues, challenges of technology scaling, technologies and solutions at different levels of abstraction. Requires class project. (Plus-minus letter grade only)

ENGR 863 Advanced Thermal-fluids (Units: 3)
Prerequisites: Graduate standing, ENGR 303, ENGR 304 or equivalents.
Development of thermodynamics and fluid mechanics concepts at the graduate level. Topics include chemical reactions, chemical and phase equilibrium, and compressible flow. Emphasis on use of software tools for engineering analysis. (Plus-minus letter grade only)
ENGR 865 Energy-Efficient Buildings (Units: 3)
Prerequisites: Graduate standing or consent of instructor; ENGR 467.

Theory and implementation of energy-efficient building technologies. Topics include energy-efficient systems for HVAC, lighting, and water heating, building thermal management, and building energy simulation. (Plus-minus letter grade only)

ENGR 866 Air Quality Engineering (Units: 3)
Prerequisite: Graduate standing or consent of instructor.

Review of air quality standards and environmental and human health impacts of airborne pollutants. Analysis of pollutant formation mechanisms, atmospheric fate and transport, and engineering strategies for emissions measurement and control.

ENGR 867 Energy Auditing and Measurement and Verification (Units: 3)
Prerequisites: ENGR 205 and ENGR 467; engineering majors.

Focus on detailed methods for energy audit and measurement and verification of energy savings in commercial and industrial facilities; details on utility rate schedules, benchmarking, and various energy efficiency and conservation measures and methods.

ENGR 868 Advanced Control Systems (Units: 3)
Prerequisite: ENGR 447 or equivalent.

Advanced feedback control and simulation techniques. Sensor filtering and estimation. State space control and modern control topics. Real time control and implementation in embedded systems. (Plus-minus letter grade only)

ENGR 869 Robotics (Units: 3)
Prerequisite: Graduate standing or senior undergraduate students who had passed ENGR 201, ENGR 305, and ENGR 447 with grade of B or better.

Kinematics and kinetics of robotic manipulators including serial manipulators, parallel manipulators and legged robots. (Plus-minus letter grade only)

ENGR 871 Advanced Electrical Power Systems (Units: 3)
Prerequisite: MATH 245 or equivalent; restricted to MS in Engineering.

Theoretical and practical aspects of transients in electric power systems, with a focus on the integration of renewable energy systems into the existing electrical grid. Topics include switching transients and commutation effects, surge phenomena and system protection, and reactive power. (Plus-minus letter grade only)

ENGR 890 RF Devices and Transceiver Principles and Design (Units: 3)
Prerequisite: ENGR 350.

RF devices: filter, duplexer, combiner, divider, coupler; baseband/RF devices: I/Q modulator and demodulator, mixer, ADC, DAC; receiver design: noise figure, IMD products, dynamic range, synthesizer, phase locked loop; transmitter design: amplifier classes, linearization techniques. (Plus-minus letter grade only)

ENGR 895 Applied Research Project (Units: 3)
Prerequisites: Classified graduate status with 12 units of graduate work and passing score on GET, SCI 614; consent of instructor and approval of Advancement to Candidacy (ATC) and Culminating Experience (CE) forms by Graduate Studies. Comprehensive research-based engineering study detailing the objectives, methods, and findings of the research. Oral presentation is required. Advancement to Candidacy and Proposal for Culminating Experience Requirement forms must be approved by the Division of Graduate Studies before registration. (Plus-minus letter grade, CR/NC, RP)

ENGR 897 Research (Units: 3)
Prerequisites: ENGR 800 and ENGR 801 and completion of nine units of graduate work.

Independent investigation or significant design project under supervision of an Engineering faculty member. Intended as the research investigation leading to the master's thesis. May be repeated for a total of 6 units. (Plus-minus AB/NC, RP)

ENGR 898 Master's Thesis (Units: 3)
Prerequisite: Consent of instructor and approval of Advancement to Candidacy (ATC) for the Master of Science in Engineering and Culminating Experience (CE) forms by Graduate Studies. ATC and Proposal for Culminating Experience Requirement Forms must be approved by the Graduate Division prior to registration. (Plus-minus AB/NC, RP)

ENGR 899 Independent Study (Units: 1-3)
Prerequisites: Approval of department and consent of instructor.

Special study of a particular problem or subject under the direction of a member of the department. Open only to graduate students in engineering. Students must present a detailed written report of the work accomplished to the department faculty. May be repeated for a total of 6 units.