ENGINEERING (ENGR)

ENGR 101. Introduction to the Engineering Profession. (1 Credit)
Introduces students to the engineering profession. The engineering disciplines, problem solving approaches, design processes, professional practices, licensure, engineering ethics, and teamwork will be explored through discussion, reading, research, and guest visits by practicing engineers. The importance of the liberal arts and the impact of faith on the practice of engineering will be explored. Freshmen and sophomores only.

ENGR 105. Fundamentals of Engineering Graphics. (2 Credits)
Introduces students to engineering graphics, the means by which engineers communicate design and fabrication information. Topics cover: utilization of engineering graphics; information on graphics; use of the basic graphic tools; orthographic views in both third and first angle projections; auxiliary, section, isometric, and perspective views. This course acquaints students with the processes that are automated within Computer Aided Drafting and Design (CADD) software and expectations for CADD work product. Lab fee. (lin)

ENGR 125. Introduction to AutoCAD. (2 Credits)
Intro to AutoCAD with emphasis on the fundamentals of Computer-Aided Drafting and Design (CADD). Introduces concepts, techniques and procedures necessary to facilitate a basic functional understanding of AutoCAD and the process of using AutoCAD tools to create, dimension, and annotate basic engineering drawings. Lab fee. (lin)

ENGR 131. Engineering Graphics and Computer Aided Design. (4 Credits)
Introduces students to the usage of engineering graphic design tools to communicate design intent and fabrication plans to manufacturers, contractors, suppliers, and customers. Students sketch, dimension, and annotate engineering models, assemblies, and drawings in 2D and 3D for architectural, structural, and mechanical projects. Topics cover: theory and utilization of engineering graphics; hand sketching and drafting; engineering drawing techniques, angle projection and perspective views; process of using Computer-Aided Design (CAD), including AutoCAD, SOLIDWORKS, and Revit software tools. Engineering design topics and basic shop fabrication processes are introduced. Additional course fee required: $65.

ENGR 132. Engineering Graphics and Computer Aided Design. (3 Credits)
Introduces students to engineering graphics, the means by which engineers communicate design and fabrication information. Topics include: utilization of engineering graphics; information on graphics; use of the basic graphic tools; orthographic views in both third and first angle projections; and auxiliary, section, isometric, and perspective views. This course acquaints students with automated processes in Computer Aided Drafting and Design (CADD) software and expectations for CADD outputs. Additional course fee required: $65.

ENGR 201. Engineering Mechanics 1 - Statics. (4 Credits)
Systems of units; gravitation; Newton's laws of motion; equilibrium and free-body diagrams; particles, forces and moments; structures in equilibrium; centroids and center of mass; moments of inertia; friction; beam loadings; cables; fluids; virtual work and potential energy. Prerequisite: PHYS 231. Pre or Corequisite: PHYS 334.

ENGR 202. Engineering Mechanics II - Dynamics. (4 Credits)
Topics include: kinematics and kinetics of particles; Newton's laws of motion; energy, momentum, systems of particles; rigid bodies; free-body diagrams; mass, acceleration, and force; plane motion of rigid bodies; and, conservation of energy and momentum. Prerequisite: ENGR 201. Pre or Corequisite: MATH 333.

ENGR 204. Innovative Design in Engineering. (4 Credits)
Provides the student engineer with firsthand experience in moving from a stated need to a developed and proof-tested product. Topics include project logbooks and plans, evaluating concepts and selecting a design, preparing design documents, fabrication, development and testing of prototypes, stewardship of the environment, preparation of engineering reports, and principles of contract, engineering, and patent law. Prerequisites: ENGR 201.

ENGR 211. Engineering Mechanics I - Statics. (3 Credits)
Systems of units; gravitation; Newton's laws of motion; equilibrium and free-body diagrams; particles, forces and moments; structures in equilibrium; centroids and center of mass; moments of inertia; friction; beam loadings; cables; fluids; virtual work and potential energy. Lecture and Laboratory. Prerequisite: PHYS 231. Pre or Corequisite: ENGR 334.

ENGR 212. Engineering Mechanics II - Dynamics. (3 Credits)
Topics include: kinematics and kinetics of particles; Newton's laws of motion; energy, momentum, systems of particles; rigid bodies; free-body diagrams; mass, acceleration, and force; plane motion of rigid bodies; and, conservation of energy and momentum. Lecture and Laboratory. Prerequisite: ENGR 211. Pre or Corequisite: MATH 333.

ENGR 214. Innovative Design in Engineering. (3 Credits)
Provides the student engineer with firsthand experience in moving from a stated need to a developed and proof-tested product. Topics include project logbooks and plans, evaluating concepts and selecting a design, preparing design documents, fabrication, development and testing of prototypes, stewardship of the environment, preparation of engineering reports, and principles of contract, engineering, and patent law. Prerequisite: Sophomore standing.

ENGR 223. Strength of Materials. (4 Credits)
Provides a broad range of knowledge of the behavior of materials under load. Topics include: mechanical properties; plane stress and strain; stress and strain relations; axially loaded members; Mohr's circle; stress transformation; torsion of shafts; bending and normal and shear stresses in beams; beam deflection; and combined loading. Prerequisite: ENGR 201.

ENGR 225. Materials Science. (4 Credits)
Presents the scientific principles underlying the structural analysis of ceramic, composite, metallic (including semiconductors), and polymeric materials. Topics include atomic bonding and structure, electronic structure, micro- and macrostructure. Principles of structural effects on the chemical, mechanical, and physical properties of material are also addressed. Prerequisites: ENGR 201 and CHEM 231.

ENGR 235. Materials Science for Engineering. (3 Credits)
Presents the scientific principles underlying the structural analysis of ceramic, composite, metallic (including semiconductors), and polymeric materials. Topics include atomic bonding and structure, electronic structure, micro- and macrostructure. Principles of structural effects on the chemical, mechanical, and physical properties of material are also addressed. Lecture and Laboratory. Prerequisite: ENGR 211. Pre or Corequisite: CHEM 231.

ENGR 271. Biology for Engineers. (2 Credits)
This course addresses fundamental concepts and language of biology from an engineering perspective. This course investigates the dynamic and complex systems of biology and integrates this with human design. A list of topics that will be chosen from includes: cell biology; genetics; the functions of living systems and constraints on life's boundaries; the integration of cells into tissues; organ systems; the movement of molecules, cells, and tissues; structure and function of biological tissues; engineering applications in biology, such as the design of replacement tissues and materials. Prerequisite: ENGR 101.

ENGR 302. Engineering Systems Analysis. (2 Credits)
Introduction to engineering systems analysis. This course focuses on modeling engineered system response to a set of design parameters. Application to broad disciplines including mechanical, electrical, chemical, and aerospace. Prerequisite: MATH 333.

ENGR 313. Mechanics of Materials. (3 Credits)
Provides a broad range of knowledge of the behavior of materials under load. Topics include: mechanical properties; plane stress and strain; stress and strain relations; axially loaded members; Mohr's circle; stress transformation; torsion of shafts; bending and normal and shear stresses in beams; beam deflection; and combined loading. Lecture and Laboratory. Prerequisite: ENGR 211. Pre or Corequisite: MATH 333.

ENGR 323. Design of Machine Elements. (2 Credits)
Design of machine elements based on analysis of stress, deformation and failure. Introduction to finite element method in failure analysis and design. Prerequisite: ENGR 223.

ENGR 325. Solid Mechanics. (2 Credits)
Advanced solid mechanics. Topics include elasticity, plasticity, stress distribution, energy methods, creep, fatigue, fracture mechanics. Prerequisite: ENGR 313.

ENGR 333. Mechatronics. (4 Credits)
This course covers mechatronic design including circuits, sensors, actuators, analog and digital electronics, and microcontrollers. Students integrate electronics with real-time programming. Prerequisite: PHYS 351.

ENGR 334. Computer Modeling of Physical Systems. (2 Credits)
An introduction to computer methods for the analysis, modeling and simulation of physical systems and analysis of experimental data. Applications taken from mechanics, fluids, electricity and magnetism. Cross-listed with PHYS 334. Prerequisite: PHYS 231. Pre or Corequisite: MATH 236.

ENGR 336. Fluid Mechanics. (3 Credits)
The study of fluid mechanics is essential in analyzing any physical system involving liquids and gases. The properties of a fluid and the concepts of fluid statics, the integral and differential analyses of fluid motion, and incompressible flow are presented. Applications of these concepts to various engineering situations, such as propulsion systems, aerodynamics, and piping systems, are examined. Pre or Corequisite: ENGR 313 and MATH 237.

ENGR 338. Thermodynamics and Heat Transfer. (3 Credits)
This course introduces the fundamental concepts of thermodynamics and heat transfer. Thermodynamics is the study of energy and its conversion among various forms, particularly heat and work. Laws of thermodynamics are presented in the context of mass and energy conservation using properties such as internal energy, enthalpy, and entropy. Study of the different modes of heat transfer through the development and application of rate equations for quantifying conduction, convection, and thermal radiation heat transfer. Prerequisite: MATH 237 and MATH 333.

ENGR 346. Fluid Mechanics. (4 Credits)
The study of fluid mechanics is essential in analyzing any physical system involving liquids and gases. The properties of a fluid and the concepts of fluid statics, the integral and differential analyses of fluid motion, and incompressible flow are presented. Applications of these concepts to various engineering situations, such as propulsion systems, aerodynamics, and piping systems, are examined. Pre or Corequisite: MATH 237.

ENGR 348. Thermodynamics & Heat Transfer. (4 Credits)
This course introduces the fundamental concepts of thermodynamics and heat transfer. Thermodynamics is the study of energy and its conversion among various forms, particularly heat and work. Laws of thermodynamics are presented in the context of mass and energy conservation using properties such as internal energy, enthalpy, and entropy. Study of the different modes of heat transfer through the development and application of rate equations for quantifying conduction, convection, and thermal radiation heat transfer. Theory and applications are reinforced and complemented by a laboratory component of the course. Prerequisite: MATH 237, MATH 333.

ENGR 351. Analog Electronics. (2 Credits)
Basic principles of electronic circuits and devices. AC and DC circuit fundamentals, filters, diodes, transistors, amplifiers, and operational amplifiers. Four hours lecture, three hours laboratory. Cross-listed with PHYS 351. Prerequisite: PHYS 232. Pre or Corequisite: ENGR 334.

ENGR 352. Fundamentals of Environmental Engineering. (3 Credits)
This course introduces fundamental concepts, practices, and designs of environmental engineering relevant to water and wastewater, air pollution, solid waste management, and other environmental hazards. A focus on sustainability will run throughout the course. Pre or Corequisite: Math 333 and CHEM 231.

ENGR 354. Water Resources Engineering. (3 Credits)
Introduces the fundamental concepts of hydrology and the application of hydraulics in the natural and built environment. Topics include the hydrologic cycle, infiltration and runoff, surface water and groundwater flow, pipe networks and water distribution systems, open channel flow and design, and drainage and stormwater infrastructure. Prerequisite: ENGR 336.

ENGR 356. Structural Analysis and Design. (3 Credits)
This course introduces the basic tools of structural analysis and design for buildings, bridges, and other structures. Topics include: design loads; equilibrium of external and internal forces; shear and moment diagrams in beams and frames; truss analysis; influence line diagrams; the slope-deflection method; the consistent deformation method; and matrix stiffness methods for beams, frames, and trusses. Prerequisite: ENGR 313.

ENGR 358. Groundwater Hydrology and Well Hydraulics. (2 Credits)
In this course students will study the movement and properties of groundwater and its environs, focusing on quantitative analysis, modeling, and design. The course will pay particular attention to macro and micro-level sustainable extraction and development of groundwater resources through appropriate well and pump design and operation. Prerequisite: ENGR 354.

ENGR 359. Geotechnical Engineering. (2 Credits)
With a focus on how soil and rock support and affect structures built on or below the surface of the earth, this course introduces students to principles that govern the behavior of soils, foundations, and other geotechnical engineering works. Prerequisite: ENGR 313.

ENGR 371. Biomaterials. (3 Credits)
This course introduces the field of biomaterials used in the design of medical devices and replacement of soft and hard tissues. The interactions between cells and the surfaces of biomaterials will be presented. In-depth coverage will be focused on basic material sciences, bulk properties, characterization techniques, applications, and in vivo behavior of different classes of natural and synthetic biomaterials. Course topics will be selected from the following list: surface chemistry of selected metals, polymers, and ceramics; surface characterization methodology; modification of biomaterials surfaces; quantitative assays of cell culture; biosensors and microarrays; bulk properties of implants; and immune response to implanted biomaterials. Prerequisite: ENGR 211.

ENGR 372. Cell and Tissue Engineering. (3 Credits)
This course is designed to familiarize current and future researchers with tissue engineering concepts and current practice. A selected list of topics will be chosen from: tissue morphogenesis and homeostasis, stem cells, cell signaling, cell nutrition, cryopreservation, biomaterials, tissue engineering scaffolds, biocompatibility, and ethics. Prerequisite: ENGR 211 and ENGR 271.

ENGR 373. Biomechanics. (3 Credits)
This semester-long course is the introduction to biomechanics concepts. Concepts will project the current mechanics knowledge (drawing from statics, dynamics, solid mechanics) to navigate applying deformations in biomaterials. This course will focus on the theory behind engineering design, predicting failure, and professional practice while providing students with a brief overview of how biomedical engineers apply mechanics in the real world. Course topics will be chosen from the following: stress and strain relations; constitutive equations; stress transformation; bending and normal and shear stresses in biological materials; fatigue failure; and viscoelasticity. Prerequisite: ENGR 313.

ENGR 374. Biomedical Device Design. (3 Credits)
This course gives exposure to the entire biomedical design process from problem definition to prototype validation. The course is organized like a biomedical engineering company, with projects sponsored by real clients from research labs and local industry partners. This semester comprises the following biomedical design components: Problem Definition, Concept Generation and Evaluation, Detailed Design, FDA Approval and Clinical Trials, Validation, Project Management, and Technical Communication. Prerequisite: ENGR 271 and ENGR 313.

ENGR 375. Biomedical Imaging. (3 Credits)
This course introduces fundamentals of the state-of-the-art clinical medical imaging modalities: X-ray, Ultrasound, Radionuclide, Optical Microscopy Techniques, and MRI. The primary focus is on the physical principles, instrumentation methods, and imaging algorithms. Additionally, the medical interpretation of images, with clinical, research and ethical issues in medical imaging are also included where possible to give students a deeper understanding of the development and applications of medical imaging. Topics will be chosen from: Basic concepts of medical imaging; Generation and detection of x-rays, x-ray methods; Computed Tomography; Ultrasound: Acoustic fundamentals, generation and detection, diagnostic methods, biological effects; Radionuclide methods, Nuclear Magnetic Resonance (NMR/MRI), MRI methods; Biological effects of EM fields; Emerging areas in medical imaging. Prerequisite: ENGR 211 and ENGR 271.

ENGR 394. Engineering Ethics Capstone. (2 Credits)
Engineering ethics and vocation; connections between the liberal arts educational experience and the practice of engineering. Prerequisite: Junior standing in the major. Seminar format meeting once per week for the full semester. (lin)
General Education: SHAR

ENGR 396. Internship. (1 to 4 Credits)
Supervised off-campus experience with departmental approval. Graded pass/fail. Prerequisite: junior or senior standing with Liberal Arts Engineering major.

ENGR 451. Senior Design I. (4 Credits)
Engineers create products, systems, and processes to solve problems and meet societal needs. Students work in collaborative teams to solve a real-world problem for a client. Students learn how to utilize the engineering design process to understand and define user needs, develop prototypes, generate drawings, and carry out experimental tests. They learn oral and written communication skills needed in engineering design and build creativity, independent thinking, and the ability to overcome unexpected problems. Prerequisite: ENGR 214.

ENGR 452. Senior Design II. (2 Credits)
Engineering students build upon the design experiences of ENGR 451 to deliver a product, system, or process to market. Students are introduced to advanced design processes including design for reliability, design for manufacturing, design for the environment, industrial design, and human factors. Students learn the basics of patent law and conducting prior art searches. They consider ethical and justice issues in engineering outputs as well as potential policy and societal interactions. Students develop a well-defined business plan. Focus is given to collaboration, project management, working with customers, and refining written and oral communication skills. Prerequisite: ENGR 451.

ENGR 494. Engineering Ethics Capstone. (2 Credits)
Engineering ethics and vocation; connections between the liberal arts educational experience and the practice of engineering. Seminar format meeting once per week for the full semester. Prerequisite: Junior or senior standing in the major.
General Education: SHAR

ENGR 495. Independent Study. (1 to 4 Credits)
Independent research.

ENGR 496. Internship. (0 to 4 Credits)
Supervised off-campus experience with departmental approval. Graded pass/fail.

ENGR 499. Honors Thesis. (2 to 4 Credits)
An independent project providing original engineering research developed in a scholarly paper and culminating in an oral examination.