DEPARTMENT OF ENGINEERING

COLLEGE OF ARTS AND SCIENCES

Faculty

Jeannette Herring Russ (2002). Professor of Engineering and Department Chair. B.S., Mississippi State University; M.B.A., Colorado State University; Ph.D., Vanderbilt University; P.E.

Don Van (2001). Professor and Director of Accreditation. B.S. and M.S., University of Illinois in Chicago; M.S. and Ph.D., New Jersey Institute of Technology; P.E., CEM.

Jay Bernheisel (2006). Associate Professor of Engineering. B.S.M.E. and M.S.M.E., Rose-Hulman Institute of Technology; Ph.D., Northwestern University; P.E.

Georg Pingen (2010). Associate Professor of Engineering. B.A., Samford University; B.S. and M.S., Washington University; Ph.D., University of Colorado at Boulder; P.E.

Randal S. Schwindt (2004). Professor of Engineering. B.S., Hardin-Simmons University; M.S., Texas A&M University; Ph.D., University of Illinois-Champaign; P.E.

Staff

Christine Rowland (2006). Academic Secretary— Engineering, Physics, Math, and Computer Science.

Objectives

- 1. Graduates will make contributions through engineering practice, graduate school, or other professional pursuits.
- 2. Graduates will solve problems through inventive thinking.
- 3. Graduates will participate in continuing education.
- 4. Graduates will exemplify Christian principles and ethical standards.

Curriculum

Union offers the Bachelor of Science in Engineering, BSE, with concentrations in electrical and mechanical engineering. The curriculum is designed to expose students to a broad base of engineering knowledge and the basic science and math upon which that knowledge rests. In addition, the curriculum at Union includes a strong general education component that provides a greater understanding of the world in which engineering products will ultimately be used. Because engineering courses build upon one another, the prerequisite sequences that exist in the curriculum must be closely followed. Incoming freshmen will ideally be ready to begin the calculus sequence in their first semester in order to satisfy the various prerequisites and complete the degree in four years.

The engineering major must complete all General Core Requirements to include CHE 111 and MAT 211. The major must also complete the BSE Specific Core comprised of MAT 212, 213, 314 (11 hours); MAT 208 or 315 (3); CSC 255 (3); CHE 113 (2) and PHY 231-32 (10).

The student with an acceptable bachelor's degree seeking the BSE as his second baccalaureate will complete CHE 111, MAT 211 and the BSE Specific Core as prerequisites to the major as well the major requirements described below.

I. Major in Engineering-61 hours

- A. Major core requirements—47 hours + a Concentration
 - 1. EGR 101, 105, 109, 210, 240, 250, 261, 262
 - 2. EGR 330, 342, 360, 375
 - 3. EGR 475, 491, 492, 498
- B. Mechanical Engineering Concentration—14 hours 1. EGR 320, 352, 355
 - 2. EGR 455, 456
- C. Electrical Engineering Concentration—14 hours 1. EGR 361, 395 (3)
- 2. EGR 405, 416

II.Minor in Engineering – 18 hours

EGR coursework to exclude EGR 491, 492, and 498 (must include 6 upper level hours).

Assessment of Majors

Assessment of majors culminates with the Fundamentals in Engineering (FE) exam taken during the senior year. The test, prepared by the National Council of Examiners for Engineering and Surveying, is administered by the State of Tennessee as the first step toward becoming a licensed professional engineer.

Student Award

The **Service through Engineering Award** is given by the faculty of the Department of Engineering to the senior who best exemplifies the use of engineering knowledge to serve people.

Course Offerings in Engineering (EGR)

() Hours Credit; F–Fall, W–Winter; S–Spring; Su–Summer

101. Introduction to Engineering Design and Analysis (2) F

Provides an overview of the engineering profession, including technical and legal responsibilities, the design and analysis method, and application of the engineering process to problem solving.

105. Engineering Graphics (3) S

Graphical communication methods through one of the widely used software packages—ProE; covers 2-D projections and views, 3-D surface and solid modeling, and general concepts such as object dimensions and tolerances.

109. Introduction to Matlab and Computer Programming (2) S

Pre- or Corequisite: MAT 211.

Introduces computer programming using Matlab as a high-level programming language and as an engineering computational tool. Includes general computer programming principles and structures and the unique features of Matlab, such as vector and matrix operations, with application to engineering.

210. Materials Engineering (3) S

Prerequisites: CHE 111, PHY 231.

Examines the structure of material at the atomic level, including how physical, thermal, and mechanical properties affect the behavior of materials.

240. Mechanical Engineering Fundamentals I: Mechanics (3) F

Prerequisites: MAT 212; PHY 231.

Introduces vector analysis of forces and torques. Examines rigid bodies and determinate structures at equilibrium. Covers kinematics of a particle and of a rigid body. Presents kinetic analysis using force-acceleration, work-energy, and impulse-momentum techniques.

250. Mechanical Engineering Fundamentals II: Thermo-fluid Dynamics I (4) S

Prerequisite: PHY 232; Pre- or Corequisites: EGR 109; MAT 314.

Introduces macroscopic concepts of thermodynamics, including first and second laws, properties of a pure substance, and energy analysis; also introduces hydrostatics and fluid dynamics, including pressure distribution, relations for fluid particles, and development of conservation theorems. Includes weekly lab.

261. Electrical Engineering Fundamentals I: Digital Logic (3) F

Basic principles of logic design, including Boolean algebra, number systems, combinational and sequential logic, and programmable logic devices. Introduces computer simulation techniques for logic circuits. Credit toward the engineering major or minor will not be granted for both EGR 261 and CSC 160.

262. Electrical Engineering Fundamentals II: Electric and Electronic Circuits (4) S

Prerequisites: PHY 232; MAT 212; Pre- or Corequisite: EGR 109.

Fundamental concepts of circuits and electronics, including basic concepts, theorems, and laws of ds and ac circuits. Introduces power sources, passive circuit devices, op amps, and selected semiconductor devices. Includes weekly lab.

320. Mechanics of Materials (3) S

Prerequisites: EGR 210, 240; MAT 314.

The relationship between internal stresses and changes of form produced by external forces acting on solid bodies; also covers normal and shear stresses, strain, elasticity and plasticity, deformations, and loading.

330. Engineering Economy (3) S

Prerequisite: 7 EGR credit hours at the 200 level. Presents basic principles of economic analysis related specifically to the realm of engineering; covers methods of developing engineering alternatives to capital investment projects using economic and financial principles.

342. Engineering Experimental Methods (3) F

Prerequisite: 7 EGR credit hours at the 200 level. Teaches computer-based tools for engineering data analysis and experimental design; includes probability, statistical analysis, measurement errors, and graphical presentation methods.

352. Mechanical Engineering Laboratory (1) S Prerequisite: EGR 342.

Demonstrates laboratory experimentation as a design and modeling tool. Emphasizes design of experiments and communicating engineering results. Includes planning, executing, and reporting on an area chosen by the students.

355. Thermo-fluid Dynamics II (4) F

Prerequisites: EGR 250; MAT 314.

Covers the 2nd law of thermodynamics, reversible/ irreversible processes, entropy, steady-flow devices, power and refrigeration cycles, conduction, convection, and radiation heat transfer, as well as an application of the Navier-Stokes equations to internal and external viscous fluid flows. Includes weekly lab.

360. Modeling and Analysis of Linear and Dynamical Systems (3) F

Prerequisites: EGR 240, 262; MAT 314.

Presents analysis of linear time-invariant (LTI) systems using time-domain and frequency-domain techniques. Electrical and mechanical system dynamics are characterized and modeled using differential equations, impulse response, and Laplace and Fourier techniques. Includes extensive use of Matlab.

361. Digital Electronics (4) F

Prerequisite: EGR 261 or CSC 160

Design and simulation techniques for digital systems, including optimal state assignment and state reduction for sequential circuits, circuit fault analysis, and higher level conceptual modeling. Covers system level topics such as computer organization and design test techniques. Includes weekly lab.

375. Power Systems and Electrical Machines (3) F Prerequisite: EGR 262.

Introduces the basic principles of power systems and electrical machines with an emphasis on 3-phase power, theory of machinery, and principles of machine operation. Topics include transformers, electro-mechanics, synchronous machines, induction motors, and DC motors and system-level topics such as power flow, faulty analysis, and economic operation.

405. Electronic Circuit Analysis and Design (4) S

Prerequisite: EGR 262.

Introduces fundamental principles of electronics, including analysis and design techniques for circuits containing diodes, field effect transistors, and bipolar junction transistors. Includes weekly lab.

416. Physical Principles of Solid State Devices (3) S Prerequisites: EGR 262; MAT 314.

Introduces concepts in material science and quantum physics, including modern theory of solids, magnetic and optical properties of materials, semi-conductors and semi-conductor devices, dielectric materials, and superconductivity.

455. Energy Conversion (3) F

Pre- or Corequisite: EGR 355.

Provides a comprehensive analysis of current energy systems, including fossil power plants, nuclear plants, and other forms of renewable energy sources; covers the Rankine cycle, steam generators, combustion, and turbines; presents information on the environmental impact of energy generation.

456. Machine and Mechanism Theory and Design (3) S Prerequisite: EGR 360.

Covers design, selection, and evaluation of mechanisms for various applications, including planar and spatial linkages, cams, gears, planetary and non-planetary gear systems, linkage synthesis, and linkage dynamics.

470. Heat Transfer (3) S

Prerequisite: EGR 355.

The analysis of various heat transfer modes, including conduction, natural and forced convection, and radiation; introduces industrial applications of heat transfer such as heat exchangers, waste heat recovery, and steam generators in a nuclear plant or in a gas turbine electrical generator.

179-279-379-479. External Domestic Study Programs (1-3) As Needed

All courses and their applications must be defined and approved prior to registering.

180-280-380-480. Study Abroad (1-4)

All courses and their application must be defined and approved prior to travel.

195-6-7. Special Studies (1-4)

295-6-7. Special Studies (1-4)

Lower-level group studies which do not appear in the regular department offerings.

475. Control Theory and Design (4) F Prerequisite: EGR 360.

Introduces analysis and design of linear control systems using root locus and frequency response techniques; includes system representation and control system characteristics. Includes weekly lab.

491. Major Project Design I (3) F

Prerequisite: 30 EGR credit hours.

Allows a student to work individually on a real-world engineering problem assigned by either the instructor or a sponsoring industry; requires the student to solve the problem by applying the engineering design and analysis method; involves oral and written presentations, where the written presentation is in the form of a design portfolio that documents a full engineering study of the project. This course must be taken the last full academic year in the program.

492. Major Project Design II (3) S

Prerequisite: EGR 491.

Allows a team of students to work on a real-world engineering problem assigned by either the instructor or a sponsoring industry; requires the student to solve the problem by team effort via project management; involves oral written presentations, where the written presentation is in the form required for EGR 491. The oral presentation will be a publicly announced event. This course must be taken the last full academic year in the program.

498. Engineering Seminar (1) S

Prerequisite: 30 EGR credit hours.

Provides an opportunity for students to discuss professional ethics and Christian conduct as engineers through case studies. Includes also presentations by engineers from local industry on current topics. This course must be taken the last full academic year in the program.

499. Seminar (1-3) As Needed

To be used at the discretion of the department.

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395. Special Studies (3)

Upper-level group studies applicable to electrical engineering which do not appear in the regular department offerings.

396-7. Special Studies (1-4)

Upper-level group studies which do not appear in the regular department offerings.

495-6-7. Independent Study (1-4)

Individual research under the guidance of a faculty member.