Department of Engineering
College of Arts and Sciences

Faculty

Don Van (2001). Associate Professor and Department Chair. 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). Assistant Professor of Engineering. B.S.M.E. and M.S.M.E., Rose-Hulman Institute of Technology; Ph.D., Northwestern University.

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

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

Objectives

1. To provide a solid engineering education that is built on a strong liberal arts and science foundation.
2. To foster an instructional environment that promotes engineering design skills and inventive thinking.
3. To prepare students for successful careers or advanced study in engineering or other professional fields.
4. To prepare students to think employing Christian principles and to act ethically in providing service to their employers, communities, and churches.

Curriculum

Union offers the Bachelor of Science in Engineering, BSE, with concentrations in electrical and mechanical engineering.

Students begin their preparation for engineering by enrolling in prerequisites and introductory engineering courses in the Fall Semester, assuring them an adequate foundation for engineering. These prerequisites provide students with a strong background in the physical sciences and mathematics, as well as the humanities. Incoming students are expected to have completed the necessary requirements that will allow them to begin mathematics at the level of calculus. Ideally, engineering students will have been introduced to calculus in high school. These courses are combined with engineering courses to fully prepare the student for a successful professional engineering career. Students who do not have the appropriate math and science background will be carefully advised to take the proper courses to build the required foundation. This track will require approximately 5 years to finish, instead of a usual 4 years.

The engineering major must complete all General Core Requirements to include CHE 111, ECF 211 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 or 245 (3); CHE 113 (2) and PHY 231-32 (10).

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

Engineering Major Requirements—58 hours

I. **Major core requirements - 45 hours + a Concentration**
   A. EGR 101, 105, 210, 250, 262, 275, 290
   B. EGR 330, 342, 352, 360, 375
   C. EGR 491, 492, 498

II. **Mechanical Engineering Concentration—13 hours**
   A. EGR 320, 385
   B. EGR 450, 456

III. **Electrical Engineering Concentration—13 hours**
   A. EGR 340, 376
   B. EGR 405, 475

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. Throughout the program, however, the student is monitored by a portfolio tracking system to ensure he/she will have attained all expected educational outcomes.

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
Teaches graphical communication methods through two widely used software packages—AutoCAD and ProE; covers 2-dimensional projections and views, 3-dimensional surface and solid modeling, and general concepts such as object dimensions and tolerances.

210. Materials Engineering (3) S
Prerequisite: 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.

250. Thermo-fluid Dynamics I (4) S
Prerequisite: CHE 111, PHY 232; Corequisite: 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.

262. Electric Circuit Analysis and Design (4) F
Prerequisite: PHY 232; MAT 212. Reciprocal credit: PHY 262.
Covers basic concepts, theorems, and laws of DC and AC circuits, including techniques for analyzing first- and second-order systems. Weekly lab included.

275. Engineering Statics (3) F
Prerequisite: MAT 212, PHY 231.
General principles of engineering mechanics, including analysis of force vectors, equilibrium of rigid bodies, and an examination of trusses, centroids, work, and moments of inertia.

290. Engineering Dynamics (3) S
Prerequisite: EGR 275.
Kinematics and kinetics of particles with respect to force, acceleration, work, energy, impulse, and momentum; also covers planar kinematics and kinetics.

320. Mechanics of Materials (3) F
Prerequisite: CHE 111, PHY 231, 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
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.

340. Digital Logic (4) S
Prerequisite: EGR 262.
Basic principles of logic design, including Boolean algebra, number systems, combinational and sequential logic, and programmable logic devices; introduces system-level topics such as computer organization and digital logic families. Includes weekly lab.

342. Engineering Experimental Methods (3) F
Prerequisite: Jr. Standing.
Teaches computer-based tools for engineering data analysis and experimental design; includes probability, statistical analysis, measurement errors, and graphical presentation methods.

352. Engineering Laboratory (3) S
Prerequisite: Jr. Standing.
Provides an opportunity to build on knowledge gained in EGR 342 through in-depth data analysis in the student's chosen area of emphasis. Includes individual, comprehensive design project.

360. Computational Engineering (3) S
Prerequisite: Jr. Standing. Reciprocal credit: PHY 360.
Teaches computer skills for conducting research and performing engineering analysis; fosters the development of proficiency in software packages and Matlab.

375. Power Systems and Electrical Machines (3) S
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.

376. Power Systems and Electrical Machines Lab (1) S
Pre or co-requisite: EGR 375
Demonstrates through laboratory experiments the principles of electrical machines studied in EGR 375. Experiments investigate the operations of DC motors, DC generators, AC motors, and AC generators.

385. Energy Conversion (3) S
Prerequisite: EGR 250.
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.

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
Prerequisite: EGR 210. Reciprocal credit: PHY 416.
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.

450. Thermo-fluid Dynamics II (4) F
Prerequisite: EGR 250.
Properties of the ideal gas, models of incompressible and corresponding states, gas-vapor mixtures, availability and irreversibility, power and refrigeration cycles, viscous and boundary-layer flow, inviscid incompressible flow, compressible flow, and turbo-machinery. Includes weekly lab.

456. Machine & Mechanism Theory & Design (3) F
Prerequisite: EGR 290.
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 450.
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.

475. Control Theory and Design (4)
Prerequisite: EGR 262.
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
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.

492. Major Project Design II (3) S
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.

498. Engineering Seminar (2) F
Prerequisite: Senior Standing.
Provides a comprehensive review of all engineering fundamentals, including mathematics, physics, chemistry, and economics, to prepare engineering seniors for the national Fundamentals of Engineering (FE) examination; also provides a review of engineering ethics and Christian conduct in the workplace.

499. Seminar (1-3) As Needed
To be used at the discretion of the department.

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.

395-6-7. 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.