

GENERAL ENGINEERING (ENGR)

ENGR 701 Numerical Methods 3 Credit Hour(s)

Numerical solution of equations; error analysis; finite difference methods; numerical differentiation and integration; series expansions; difference equations; numerical solution of differential equations.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 703 Advanced Differential Equations 3 Credit Hour(s)

This course will provide general numerical methods for systems of nonlinear ordinary and partial differential equations (methods for stiff systems; basic theory in the finite difference and finite element methods; methods for parabolic, hyperbolic, and elliptic equations; analysis of stability and convergence; error estimates; current literature).

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 704 Ordinary Differential Equations 3 Credit Hour(s)

General single-step, multistep, multivalued, and extrapolation methods for systems of nonlinear equations; convergence; error bounds; error estimates; stability; methods for stiff systems; current literature.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 705 Finite Element Analysis 3 Credit Hour(s)

Introduction to the mathematical theory, formulation, and computer implementation of the finite element method. Application to one- and two-dimensional problems in engineering mechanics.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 707 Fundamentals of Mechanics 3 Credit Hour(s)

The aim of this course is to educate the student in the areas of 1) statics, 2) dynamics, and 3) strength of materials. The content will include Newton's Laws, forces, moments, torques, free body diagrams, equilibrium, kinematics of motion, velocity, acceleration, energy, momentum, stress, strain, and constitutive relationships.

Registration Restrictions: Consent of Instructor or pursuing a PhD Engineering degree

Offered: Resident

ENGR 711 Linear Optimal Control 3 Credit Hour(s)

This course discusses modern advanced graduate level control engineering techniques such as vector random process, robust stability and performance test, linear-quadratic regulator, and the linear-quadratic Gaussian controller design. The method is to provide a means of incorporating frequency domain specifications into control system designs.

Registration Restrictions: Consent of Instructor or pursuing a PhD Engineering degree

Offered: Resident

ENGR 712 Computing Languages (Python, MATLAB, C, C++, Fortran) 3 Credit Hour(s)

An introduction to programming language (Python, MATLAB, C, C++, Fortran) specification and analysis. Additional topics include control structures, data types, and structures, run-time environments, binding strategies, compilers, and interpreters.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 714 PLC Programming 3 Credit Hour(s)

This course integrates fundamental concepts in Cyber-Physical Systems (CPS) Engineering and Programmable Logic Controllers (PLCs) with an emphasis on design and application to factory automation and process control.

Registration Restrictions: Consent of instructor

Offered: Resident

ENGR 717 Advanced Thermodynamics 3 Credit Hour(s)

Postulational treatment of the physical laws of equilibrium, thermostatics. Equations of state, processes, equilibrium stability, reactive systems, phase transitions.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 721 Advanced Heat Transfer 3 Credit Hour(s)

Condensation and boiling, analytical and numerical techniques for conduction and convection, gray-body and spectral-dependent radiation, transient and steady-state thermal modeling.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 725 Continuum Mechanics 3 Credit Hour(s)

An introduction to the general theory of continuous media and its application to the theories of elasticity and fluid mechanics.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 727 Advanced Mechanics of Materials 3 Credit Hour(s)

Stress, strain, stress-strain relationships, strain energy, failure theories, curved beams, unsymmetrical bending, shear center, torsion of noncircular sections, energy principles, Castigliano's theorem, inelastic behavior.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 731 Advanced Electromagnetics 3 Credit Hour(s)

This course covers contemporary topics in advanced engineering electromagnetics. This includes topics relevant to electromagnetic field theory, radar systems, RF/microwave engineering, antenna design, and electromagnetic compatibility.

Registration Restrictions: Consent of instructor

Offered: Resident

ENGR 741 Inelasticity 3 Credit Hour(s)

This course covers plasticity, creep, viscoelasticity, and inelastic behavior in relation to microstructure-property relations, constitutive modeling at different length scales, and computational simulations.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 743 Damage and Fracture 3 Credit Hour(s)

History of fracture and development of fracture mechanics principles. Linear elastic and elastic-plastic stress analysis of cracked bodies. ASTM standards and applications.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 745 Fatigue 3 Credit Hour(s)

Prediction and prevention of fatigue in metallic material.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 747 Phase Transformations 3 Credit Hour(s)

Stress, strain, stress-strain relationships, strain energy, failure theories, curved beams, unsymmetrical bending, shear center, torsion of noncircular sections, energy principles, Castigliano's theorem, inelastic behavior.

Registration Restrictions: Consent of Instructor; Enrollment in a Doctor of Philosophy in Engineering program.

Offered: Resident

ENGR 795 Directed Individual Study in Engineering 3 Credit Hour(s)

Research-oriented project or an independently completed course of study in a specially designed area as approved and supervised by the instructor. May be repeated for up to 6 credits.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 796 Graduate Orientation/Seminar Series 3 Credit Hour(s)

Course provides a graduate program orientation and lecture series which includes visiting lecturers.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 797 Special Topics in Engineering 3 Credit Hour(s)

Title to be arranged. This course is to be used on a limited basis to offer developing subject matter areas not covered in existing courses. (Courses limited to two offerings under one title within two academic years).

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 798 Teaching Practicum in Engineering 3 Credit Hour(s)

Ph.D. Graduate student teaches an undergraduate engineering course with faculty guidance.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 806 Computational Fluid Dynamics 3 Credit Hour(s)

Elementary aspects of computational fluid dynamics (CFD); review of numerical analysis and fluid mechanics as pertinent to CFD; numerical solution to selected fluid dynamic problems.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 808 Multiphase Flows 3 Credit Hour(s)

The aim of this course is to educate the student about the many facets of jointly flowing immiscible phases, in terms of 1) physics, 2) applications, and 3) simulations. The content will span the four possible combinations of gas-liquid (g-l), liquid-solid (l-s), gas-solid (g-s), and gas-liquid-solid (g-l-s). In the case of solids, the focus is on the behavior of particulate matter as an aggregate and not solid mechanics. For the first three (g-l, l-s, and g-s), course material will cover both volume fraction extrema e.g., nearly all gas g-l and nearly all liquid g-l. Interphase turbulence will be discussed.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 809 Advanced Compressible Flows 3 Credit Hour(s)

The aim of this course is to educate the student about the diverse world of compressible flows with respect to 1) physics, 2) applications, and 3) simulations. We will discuss foundations subjects, such as shock waves and the effects of friction and heat transfer. Additionally, we will address complex components of compressible flows, including shock-capturing in CFD along with shock-turbulence interactions. Material in this course will synergize with other graduate course offerings at LU, most specifically advanced thermodynamics, computational fluid dynamics, and the physics and modeling of turbulence.

Registration Restrictions: Consent of the instructor

Offered: Resident

ENGR 810 Physics and Modeling of Turbulence 3 Credit Hour(s)

This course will demystify "turbulence" and train students in the art of turbulence assessment and quantification. We will provide a foundation in the nature of turbulence, along with an appreciation of the impacts of turbulence in nearly limitless fluid mechanics scenarios.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 815 Bio-Inspired Design 3 Credit Hour(s)

Provides an overview of non-conventional mechanical approaches in nature and shows how this knowledge can lead to more creativity in mechanical design and to better (simpler, smaller, more robust) solutions than with conventional technology.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 816 Design Optimization 3 Credit Hour(s)

Introduction to optimality criteria and optimization techniques for solving constrained or unconstrained optimization problems. Sensitivity analysis and approximation. Computer application in optimization. Introduction to MDO.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 822 Cyber-Physical Systems Engineering 3 Credit Hour(s)

Cyber-physical systems (CPS) are engineered systems that are built from, and depend upon, the seamless integration of computation and physical components. The integration of artificial intelligence with CPS, especially for real-time operation, creates new research opportunities with major societal implications. This course is not feasible for remote students.

Registration Restrictions: Consent of instructor; Proficiency in Numerical Methods and Differential Equations is required.

Offered: Resident

ENGR 824 Robotics Software Engineering 3 Credit Hour(s)

This course integrates fundamental concepts in Cyber-Physical Systems (CPS) Engineering and Robotics with an emphasis on the design and development of software applications for robotics systems control and development. This course is not feasible for Remote Students.

Registration Restrictions: Consent of instructor; Proficiency in C++ or Python programming language is required.

Offered: Resident

ENGR 831 Composite Materials 3 Credit Hour(s)

Stress, strain, constitutive relations for anisotropic material, lamina properties, laminate properties, composite beams and plates.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 833 Polymers and Polymer Nanocomposites 3 Credit Hour(s)

To provide an introductory exposition to the composition-process-structure-property relationships related to polymers and polymer nanocomposites. This course will be divided in two parts: (I) starting with a review on electron configuration and bonding, the first part will cover polymer chemistry, structure, and configuration. Mechanical, electrical, optical, thermal, magnetic, ion transport, and other properties of polymers will be discussed. (II) The second part of the course will focus solely on polymer nanocomposites, particularly on, (a) the multiplicative contributions of matrix and dispersed phases, and (b) the factors that affect the interaction between the two phases: dispersion, interfacial region, solubility, loading, size and geometrical effects. Applications and manufacturing processes for PNCs will be outlined as well.

Registration Restrictions: Consent of Instructor or pursuing a PhD Engineering degree

Offered: Resident

ENGR 835 Materials Processing Methods 3 Credit Hour(s)

The fundamental linkages between processing, structure and properties will be addressed with emphasis on micro- and nano-structural impacts on properties.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 837 Materials Characterization Methods (SEM, OM) 3 Credit Hour(s)

Characterization of advanced material behaviors for pavement subgrades, bases and surface courses, Stress dependency, viscoelasticity, repeated load moduli, and stabilization are central behaviors of interest.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 839 Mechanical Metallurgy 3 Credit Hour(s)

The mechanical and metallurgical fundamentals of metals are discussed. Mechanical fundamentals cover the stress and strain relationships and metallurgical fundamentals cover the microstructure.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 851 Integrated Computational Materials Engineering (ICME) 3 Credit Hour(s)

Survey course of various length scale computational analysis related to materials modeling. Emphasis upon projects and exercises.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 987 Dissertation Research in Engineering 3 Credit Hour(s)

Dissertation research and proposal development.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 988 Dissertation Research in Engineering 6 Credit Hour(s)

Dissertation research and proposal development.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 989 Dissertation Research in Engineering 9 Credit Hour(s)

Dissertation research and proposal development.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 990 Dissertation Defense in Engineering 0 Credit Hour(s)

Students will publicly defend the dissertation research project.

Registration Restrictions: Consent of Instructor

Offered: Resident

ENGR 995 Directed Research 3 Credit Hour(s)

Offered: Resident