Engineering (ENGR)

Course information contained within the Bulletin is accurate at the time of publication in June 2025 but is subject to change. For the most up-to-date course information, please refer to the Course Catalog.

ENGR 5011. Engineering Mathematics I. 3 Credit Hours.
This is a survey course in essential mathematics for first-year graduate students in engineering and physical sciences. Topics include analytic methods in ordinary differential equations, complex-variable theory, the laplace transform and its inversion, and initial-value problems and boundary-value problems. Matlab, numerical methods, and introductory numerical algorithm design are introduced.

Repeatability: This course may not be repeated for additional credits.

ENGR 5012. Engineering Mathematics II. 3 Credit Hours.
This is a survey course in classical numerical and analytical methods for partial differential equations, for first-year masters and doctoral students in engineering and physical sciences. Topics include analytic methods and numerical methods for partial differential equations in cartesian and non-cartesian coordinate systems, and an introduction to perturbation theory. The course will emphasize quantitative analysis, and assignments will entail computational algorithm design.

Repeatability: This course may not be repeated for additional credits.

ENGR 5022. Engineering Analysis and Applications. 3 Credit Hours.
Vector space, basis, projection, null space, function space, L2 and space of continuous functions, Hilbert space, orthogonality, generalized Fourier series, linear transformation, adjoint transformation, eigenvalue problem, linear functional, Gateaux and Frechet differential, constrained optimization, infinite dimensional systems, complex analysis.

Repeatability: This course may not be repeated for additional credits.

ENGR 5031. Engr Prob Stats Stoc Met. 3 Credit Hours.
Repeatability: This course may not be repeated for additional credits.

ENGR 5032. Probability, Statistics, and Stochastic Methods. 3 Credit Hours.
A balanced approach to probability, statistics, stochastic models, and stochastic differential equations with special emphasis on engineering applications. Random variables, probability distributions, Monte Carlo simulations models, statistical inference theory, design of engineering experiments, reliability and risk assessment, fitting data to probability distributions, ANOVA, stochastic processes, Brownian motion, white noise, random walk, colored noise processes. Differential equations subject to random initial conditions, random forcing functions, and random parameters. Partial differential equations subject to stochastic boundary conditions. New techniques for non-linear differential equations. Computer simulation with MAPLE and other symbolic algebra software.

Repeatability: This course may not be repeated for additional credits.

ENGR 5033. Probability and Random Processes. 3 Credit Hours.
Sets and events, Random variables, Distribution and density functions, Functions of multiple random variables, Moments and conditional statistics, Information entropy, stochastic processes, wide-sense stationary process, ergodicity, correlation, and power spectrum of stationary processes. Applications to sampling theory and signal modulation and detection.

Repeatability: This course may not be repeated for additional credits.

ENGR 5116. Spacecraft Systems Engineering. 3 Credit Hours.
The concept of systems engineering is introduced using a satellite application. Systems engineering is a top-down approach to the design, implementation, testing, and deployment of large-scale systems to meet the needs of users. The topics will include systems engineering methodology, dynamics of spacecraft, and celestial mechanics. This course will also introduce the notion of invention and innovation, and how they are related to the intellectual property issues.

Repeatability: This course may not be repeated for additional credits.

ENGR 5117. Experimental Methods. 3 Credit Hours.
Application and design of experimental techniques and measurement systems used in engineering laboratories. Introduction to the DMM, digital scope, and computer-based data acquisition systems for measurements of force, motion, pressure, temperature, and flow in steady and unsteady systems. Data transmission, data analysis and presentation, and computer interfacing techniques. Statistical methods and uncertainty analysis. Hands-on experience with state-of-the-art instrumentation systems.

Repeatability: This course may not be repeated for additional credits.

ENGR 5121. Design of Experiments. 3 Credit Hours.
The practice of modern science and engineering is synonymous with the ability to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions in applications ranging from new product design and development to phenomenological/basic science studies. In this course we will focus primarily on methodological and design issues in planning experiments rather than on statistical analysis of the data. Nevertheless, we will briefly review various statistical analysis approaches required for fully designed experiment. Case studies involving single factor experiments, factorial designs, manipulation checks, etc. will be used to develop hands on skills for designing your own experiments. The course will have a focus on engineering approach to design of experiments with a particular emphasis on problem definition, system identification, data collection, statistical analysis, and hypothesis testing. For the final project, you will prepare a fellowship or grant (e.g. NSF GRFP or AHA Predoctoral) application ready for submission to a funding agency.

Repeatability: This course may not be repeated for additional credits.

ENGR 5201. Multiscale Design of Materials and Structures. 3 Credit Hours.
All materials and structures have a multiscale nature spanning from atoms to molecules, microstructures, and finally to structures with real-world functionality and applications. This course is important for a comprehensive and project-based understanding of computational techniques that enable high-fidelity, simulation-driven design across multiple length scales. Students will learn the theory and practice of several computational techniques including molecular dynamics, micromechanics, and structural optimization. Students will apply computational tools to extract material properties based on atomic structures or microstructures, design atomic structures or microstructures of materials to achieve desired properties, and optimize engineering structures based on material properties fed from lower-scale calculations. Students will become independently competent in atomistic modeling and simulation of fluids and solids, microstructural analysis and design of hybrid composites and structured materials, and the optimal design of engineering structures for maximum performance and weight savings.

Repeatability: This course may not be repeated for additional credits.

ENGR 5314. Continuum Mechanics. 3 Credit Hours.
This course covers tensors, kinematics of a continuum, stress, integral formulations, linear isotropic elastic solid, and an introduction to Newtonian Fluid (CLO 3).

Repeatability: This course may not be repeated for additional credits.

ENGR 5334. Dynamical Systems. 3 Credit Hours.
This course focuses on the algebraic and differential equations governing the static and dynamic 3D motion of 3D bodies, including vectors, vector differentiation, and dyads. The equations of motion for multibody systems will be derived using Newton-Euler, Lagrange, and Kane's methods. Computational tools for 3D force and motion analysis will be used to simulate physical systems.

Repeatability: This course may not be repeated for additional credits.

ENGR 5511. Fluid Dynamics. 3 Credit Hours.
Navier-Stoke's equation, Laminar and turbulent flow, boundary layer phenomena, compressible fluid flow including isotropic flow, shock waves, friction flow, and flow with heat transfer.

Repeatability: This course may not be repeated for additional credits.

ENGR 5576. Computational Fluid Dynamics. 3 Credit Hours.
This course introduces the fundamentals of numerical solution methods for thermal and fluid dynamics applications. Focus is placed on the development of explicit and implicit methods for solving linear and nonlinear partial differential equations for heat conduction, wave propagation, and potential flow. Important topics pertaining to the use of commercial and research grade CFD software are included. As a final course objective, students will develop a solution method for 2D incompressible flow using MATLAB or a similar programming environment.

Repeatability: This course may not be repeated for additional credits.

ENGR 9185. Experience in Engineering Profession I. 1 to 3 Credit Hour.
This course involves work experience in industry on current industrial practices of advanced engineering concepts under the supervision of a faculty advisor and an industrial mentor. At the end of the internship period, the student submits a technical report that is suitable for general public release. The report is graded by the faculty advisor in consultation with the industrial mentor. Students already employed in the industry are not eligible to register for this course.

Repeatability: This course may be repeated for additional credit.

ENGR 9282. Independent Study II. 3 Credit Hours.
Special study in a particular aspect of engineering under the direct supervision of a graduate faculty member. May be taken once by Ph.D. students.

Repeatability: This course may be repeated for additional credit.

ENGR 9285. Exper Engineer Prof II. 1 to 3 Credit Hour.
Repeatability: This course may be repeated for additional credit.

ENGR 9990. Engineering Seminar. 1 to 3 Credit Hour.
Students present their research results at an open seminar. The seminars may be arranged on a biweekly basis over the semester. Active participation of all graduate students is expected.

Repeatability: This course may be repeated for additional credit.

ENGR 9995. Project. 1 to 3 Credit Hour.
Repeatability: This course may be repeated for additional credit.