Computational Engineering (COE)

COE 301 Introduction to Computer Programming 3 Hours
Basic computer programming concepts applied to engineering computations. Development of structured solutions to engineering and mathematical problems and an understanding of coding practices. Programming in MATLAB and C++.

COE 311K Engineering Computation 3 Hours
Fundamental numerical methods and software tools used in engineering computation. Subjects include linear systems of equations, matrix computations, nonlinear equations, least squares approximations, interpolation, numerical integration and numerical solution of differential equations.

COE 119, 219, 319, 419, 519, 619, 719, 819, 919 Topics in Computational Engineering 1-9 Hours

COE 119S, 219S, 319S, 419S, 519S, 619S, 719S, 819S, 919S Topics in Computational Engineering 1-9 Hours
This course is used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office. Credit is recorded as assigned by the study abroad adviser in the Department of Aerospace Engineering and Engineering Mechanics. University credit is awarded for work in an exchange program; it may be counted as coursework taken in residence. Transfer credit is awarded for work in an affiliated studies program.

COE 321K Computational Methods for Structural Analysis 3 Hours
Matrix structural analysis of systems that can be idealized as being comprised of axial bar elements, beam elements, and frame elements. Notion of element-by-element assembly of the governing system of algebraic equations. A systematic introduction to (and use of) the fundamental idea of a weak statement of a boundary value problem, particularly as concerns the numerical treatment/approximation of such problems. Interpretation of the weak-statement in terms of the principle of virtual work. Galerkin's method as applied to structural analysis. An introduction to the classical Galerkin finite element method with application to structures and plane elasticity. Energy principles and their utility in solving problems in solid mechanics, as well as their connection to the finite element method.

COE 322 Scientific Computation 3 Hours
Explores the basic tools needed for developing scientific computing software. These include advanced programming languages (e.g. C, C++, python), object oriented programming and data structures. Subjects may include abstract data types; creation, initialization, and destruction of objects; class hierarchies; polymorphism, inheritance and dynamic binding; generic programming using templates, linked lists, queues, stacks, trees and algorithms such as searching, sorting, and hashing.

COE 129S, 229S, 329S, 429S, 529S, 629S, 729S, 829S, 929S Topics in Computational Engineering 1-9 Hours
Used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office or the school's International Engineering Education Programs. Credit is recorded as assigned by the study abroad adviser in the Department of Aerospace Engineering and Engineering Mechanics. University credit is awarded for work in an exchange program; it may be counted as coursework taken in residence.

COE 332 Software Engineering and Design 3 Hours
Covers methods and tools for planning, designing, implementing, validating and maintaining large software systems. May include project work to build a software system as a team, using appropriate software engineering tools and techniques.

COE 347 Introduction to Computational Fluid Dynamics 3 Hours
Development and implementation of finite-difference schemes for numerical solution of subsonic, transonic, and supersonic flows. Emphasis on convection and diffusion equations of fluid dynamics. Evaluation of accuracy, stability, and efficiency.

COE 352 Topics in Advanced Scientific Computations 3 Hours
Topics in advanced numerical methods and scientific computation. Subject matter may vary.

COE 362 Engineering Probability and Statistics 3 Hours
Introduction to mathematical representations and computations to qualitatively and quantitatively describe data, compare data, ascribe distributions to apparent patterns and structure in data via inference methods. Describe and model discrete and continuous random variables.

COE 371 Applied Mathematics I 3 Hours
Subjects include real analysis of functions of one variable, linear operator theory, and ordinary differential equations.

COE 372 Applied Mathematics II 3 Hours
Subjects include elements of complex analysis, Fourier and Laplace transforms, partial differential equations, perturbation methods, analysis of functions of several variables.

COE 374 Senior Design Project 3 Hours
Design projects from multiple engineering disciplines done with teams of students, using computational methods for analysis and experimental data for validation; ethics of design for safety and reliability; emphasis on written and oral reporting of engineering projects.

COE 374D Computational Systems Senior Design I 3 Hours
Introduction to computational systems engineering: the systems engineering process, requirements, design fundamentals, trade studies, cost and risk analyses, integration, technical reviews, case studies, and ethics. Produce written reports and oral presentations.

COE 374E Computational Systems Senior Design II 3 Hours
Produce design projects from multiple engineering disciplines done in teams, using computational methods for analysis and experimental data for validation; ethics of design for safety and reliability; and with emphasis on written and oral reporting of engineering projects.

COE 679H Undergraduate Honors Thesis 6 Hours
Research performed during two consecutive semesters under the supervision of an engineering faculty member; topics are selected jointly by the student and the faculty member with approval by the director of the Engineering Honors Program. Entails an oral presentation and a written thesis.

COE 179K, 279K, 379K Research in Computational Engineering 1-3 Hours
Directed study or research in a selected area of computational engineering.

COE 179L, 279L, 379L, 479L Topics in Computational Engineering 1-4 Hours
Current topics in computational engineering.

COE 179L.1, 279L.1, 379L.1, 479L.1 Introduction to Machine Learning and Data Sciences 1-4 Hours
Focus on algorithms, mathematics, implementations (on Scikit-learn), and real-life applications of machine learning and data sciences including machine learning algorithms such as supervised learnings (linear models, support vector machines, kernel methods, tree-based algorithms), unsupervised learnings (Density estimation, clustering, dimensionality reduction, PCA), and deep neural networks. Explore the foundations of machine learning including optimization, probability, advanced linear algebra, statistics, and methods to evaluate machine learning methods.

COE 179L.2, 279L.2, 379L.2, 479L.2 Simulation-based Aerodynamic Design and Analysis 1-4 Hours

COE 179L.3, 279L.3, 379L.3, 479L.3 Computational Methods 1-4 Hours
Examine basics of vectors and matrices, linear equations, regression and classification, similarity measures, the Discrete Fourier Transform (DFT), linear filters, and power spectrum estimates. Focus on applying matrix methods to practical applications, such as tomography, image processing, data fitting, time series prediction, optimal control, finance, and machine learning. Utilize MATLAB or Python to do computations with vectors and matrices and run numerical experiments with real-world data sets.

COE 179L.4, 279L.4, 379L.4, 479L.4 Fundamentals and Geophysical Applications of Imaging Radar Systems 1-4 Hours
Explore how radar images are formed and manipulated, as well as applications of the systems to problems such as measurement of the Earth crustal deformation. Focus on radar as a signal processing problem, radar image formation and radar interferometry. Discuss system design, scattering from natural surfaces, range and azimuth processing algorithms, and processor design.

COE 179L.5, 279L.5, 379L.5, 479L.5 Biomechanics of Tissues, Scaffolds, and Cells 1-4 Hours

COE 179L.6, 279L.6, 379L.6, 479L.6 Software Design for Responsible Intelligent Systems 1-4 Hours
Discuss the design, implementation, operation, and assurance of intelligent software systems based on data intensive computing and machine learning techniques. Utilize real-world datasets from engineering disciplines.

COE 179L.7, 279L.7, 379L.7, 479L.7 Parallel Computing for Science and Engineering 1-4 Hours
Explore fundamentals of parallel programming for scientific and engineering applications. Examine the study of general parallel computing principles, including asymptotics; current computer architectures and how parallelism manifests itself in them.