ENGINEERING SCIENCE & APPLIED MATH (ES_APPM)

ES_APPM 245-0 Elementary Applied Linear Algebra (1 Unit) Basic linear algebra methods including basic matrix/vector operations, solution of linear systems of equations, eigenvalues, and singular values. Focus will be on applications of the methods on a range of engineering topics including: least squares and data fitting, game theory, graph theory, principal component analysis, linear programming, and other related engineering topics.

ES_APPM 252-1 Honors Calculus for Engineers (1 Unit) Calculus sequence for the mathematically interested students who want to dig deeper, cover more mathematical material, and see more applications than the standard calculus sequence offers. It also provides an introduction to computation (no previous experience required). Satisfies the same requirements as Math 228-1,2.

ES_APPM 252-2 Honors Calculus for Engineers (1 Unit) Calculus sequence for the mathematically interested students who want to dig deeper, cover more mathematical material, and see more applications than the standard calculus sequence offers. It also provides an introduction to computation (no previous experience required). Satisfies the same requirements as Math 228-1,2.

ES_APPM 311-0 Methods of Applied Mathematics (1 Unit)
ES_APPM 311-0 provides a survey of methods of applied mathematics with a focus on differential equations and is intended for undergraduate and graduate engineering students. It is not suitable for undergraduate or graduate students in applied mathematics; they take ES_APPM 314-0, instead. Ordinary differential equations: review of elementary ODEs, initial and boundary value problems, Fredholm Alternative Theorem, Power series solution of ODEs, Special functions, Sturm-Liouville eigenvalue problems, Eigenfunction expansions, Fourier series. Partial Differential Equations: Classification, Heat, Wave and Laplace equations and their applications, Solution by separation of variables, Series solutions, Full and partial eigenfunction expansions.
Prerequisites: GEN_ENG 205-4 (EA4), or equivalent, or permission of instructor.

ES_APPM 312-0 Complex Variables (1 Unit)
Imaginary numbers and complex variables, analytic functions, calculus of complex functions, contour integration with application to transform inversion, conformal mapping.
Prerequisite: GEN_ENG 205-4, GEN_ENG 206-4, or MATH 250-0.

ES_APPM 314-0 Advanced Methods for Differential Equations (1 Unit)
The intended audience for this course are students interested in applied mathematics, specifically, in analytical solution techniques for differential equations. Review of methods for solving ODEs, including power series methods. Self-adjoint and non self-adjoint boundary value problems. Special Functions. Eigenvalue problems. Eigenfunction expansions. Transform methods. Distribution theory. Green's functions for ODEs. Solution of PDEs by separation of variables. No textbook required; lecture notes provided. May not receive credit for both this course and ES_APPM 311. Suggessted.
prerequisites: GEN_ENG 205-4 (EA4), or equivalent, or permission of instructor.

ES_APPM 322-0 Applied Dynamical Systems (1 Unit)
Example-oriented survey of nonlinear dynamical systems, including chaos. Combines numerical exploration of differential equations describing physical problems with analytic methods and geometric concepts. Applications to mechanical, fluid dynamical, electrical, chemical, and biological systems.
Prerequisites: GEN_ENG 205-4, GEN_ENG 206-4, or MATH 250-0. ES_APPM 311-1 is recommended.

ES_APPM 344-0 High Performance Scientific Computing (1 Unit)
Solving partial differential equations using high performance computing platforms. Basic C programming. Distributed computing using MPI. GPU programming using CUDA. Adaptation of algorithms for solving PDE's to different architectures.

ES_APPM 345-0 Applied Linear Algebra (1 Unit)
Understanding and implementation of algorithms to calculate matrix decompositions such as eigenvalue/vector, LU, QR, and SVD decompositions. Applications include data-fitting, image analysis, and ranking algorithms.
Prerequisites: GEN_ENG 205-4, GEN_ENG 206-4, ES_APPM 245-0, or MATH240-0.

ES_APPM 346-0 Modeling and Computation in Science & Engineering (1 Unit)
Advanced techniques for initial value problems, differential algebraic systems, bifurcations, chaos, and partial differential equations. Applications drawn from different physical areas.
Prerequisites: MATH 228-2, MATH 240-0, and MATH 250-0; or GEN_ENG 205-4 and PHYSICS 135-1, PHYSICS 135-2; or equivalent; familiarity with a programming language; or consent of instructor.

ES_APPM 370-1 Introduction to Computational Neuroscience (1 Unit)
From neurons to networks. Ion channels, Hodgkin-Huxley framework, simplified models, cable equation, synapses, spike triggered average, and optimal stimulus. Feedforward and recurrent firing rate networks. Statistical approach, Bayesian modeling. Brief introduction to numerical methods.

ES_APPM 372-0 Introduction to the Analysis of RNA Sequencing Data (1 Unit)
This course will give an introduction to the theory and practice of analyzing high-throughput RNA sequencing through lectures and hands-on exercises. The basic topics covered will include: 1) the format of/working with raw sequencing data; 2) aligning reads to a reference genome; 3) the format of/working with aligned SAM/BAM files; 4) different ways to perform read-based gene counting; 4) How to visually explore reads and read counts; 5) variance shrinkage and principal components; 6) The theory of/doing differential expression analysis. Additional topics will be covered as time permits, based in part upon the interests of the course participants.

ES_APPM 375-1 Quantitative Biology I: Experiments, Data, Models, and Analysis (1 Unit)
High-resolution, high-throughput, and dynamic imaging and sequencing data is the substrate of modern biology. The course consists of case-studies where we learn how to computational work with, analyze, and make sense of experimental dataset using fundamental principles of mathematics, statistics, and physics. No formal course prerequisites. Programming in python.

ES_APPM 375-2 Quantitative Biology II: Experiments, Data, Models, and Analysis (1 Unit)
High-resolution, high-throughput, and dynamic imaging and sequencing data is the substrate of modern biology. In this course we learn how to perform experiments, and computational work with, analyze, and make sense of experimental dataset using fundamental principles of mathematics, statistics, and physics. No formal course prerequisites. Programming in python.

ES_APPM 395-0 Special Topics (1 Unit)

ES_APPM 398-0 Introduction to Applied Math Research (0 Unit)
This is a seminar course where ESAM faculty present their current and planned research topics in applied mathematics.

ES_APPM 399-0 Projects (1 Unit) Special studies to be carried out under faculty direction. Credit to be arranged.