APPLIED MATHEMATICS (AMTH)

AMTH 222a or b / MATH 222a or b, Linear Algebra with Applications Staff
Matrix representation of linear equations. Gauss elimination. Vector spaces. Linear independence, basis, and dimension. Orthogonality, projection, least squares approximation; orthogonalization and orthogonal bases. Extension to function spaces. Determinants. Eigenvalues and eigenvectors. Diagonalization. Difference equations and matrix differential equations. Symmetric and Hermitian matrices. Orthogonal and unitary transformations; similarity transformations. Students who plan to continue with upper level math courses should instead consider MATH 225 or 226. After MATH 115 or equivalent. May not be taken after MATH 225 or 226. QR

AMTH 244a or b / MATH 244a or b, Discrete Mathematics Staff
Basic concepts and results in discrete mathematics: graphs, trees, connectivity, Ramsey theorem, enumeration, binomial coefficients, Stirling numbers. Properties of finite set systems. Prerequisite: MATH 115 or equivalent. Some prior exposure to proofs is recommended (ex. MATH 225). QR

AMTH 247b / MATH 247b, Intro to Partial Differential Equations Staff
Introduction to partial differential equations, wave equation, Laplace's equation, heat equation, method of characteristics, calculus of variations, series and transform methods, and numerical methods. Prerequisites: MATH 222 or 225 or 226, MATH 246 or ENAS 194 or equivalents. QR

* **AMTH 342a / EENG 432a, Linear Systems** A Stephen Morse
Introduction to finite-dimensional, continuous, and discrete-time linear dynamical systems. Exploration of the basic properties and mathematical structure of the linear systems used for modeling dynamical processes in robotics, signal and image processing, economics, statistics, environmental and biomedical engineering, and control theory. Prerequisite: MATH 222 or permission of instructor. QR

AMTH 361b / S&DS 361b, Data Analysis Brian Macdonald
Selected topics in statistics explored through analysis of data sets using the R statistical computing language. Topics include linear and nonlinear models, maximum likelihood, resampling methods, curve estimation, model selection, classification, and clustering. Extensive use of the R programming language. Experience with R programming (from e.g. S&DS 106, S&DS 220, S&DS 230, S&DS 242), probability and statistics (e.g. 106, 220, 238, 241, or concurrently with 242), linear algebra (e.g. MATH 222, MATH 225, MATH 118), and calculus is required. This course is a prerequisite for S&DS 425 and may not be taken after S&DS 425. QR

* **AMTH 362b / CPSC 362b / EENG 435b, Decisions and Computations across Networks** A Stephen Morse
For a long time there has been interest in distributed computation and decision making problems of all types. Among these are consensus and flocking problems, the multi-agent rendezvous problem, distributed averaging, gossiping, localization of sensors in a multi-sensor network, distributed algorithms for solving linear equations, distributed management of multi-agent formations, opinion dynamics, and distributed state estimation. The aim of this course is to explain what these problems are and to discuss their solutions. Related concepts from spectral graph theory, rigid graph theory, non-

homogeneous Markov chain theory, stability theory, and linear system theory are covered. Although most of the mathematics need is covered in the lectures, students taking this course should have a working understanding of basic linear algebra. The course is open to all students. Prerequisite: Linear algebra or instructor permission. SC

AMTH 364b / EENG 454b / S&DS 364b, Information Theory Staff
Foundations of information theory in communications, statistical inference, statistical mechanics, probability, and algorithmic complexity. Quantities of information and their properties: entropy, conditional entropy, divergence, redundancy, mutual information, channel capacity. Basic theorems of data compression, data summarization, and channel coding. Applications in statistics and finance. After STAT 241. QR

AMTH 431a / ECON 431a / S&DS 431a, Optimization and Computation Zhuoran Yang
This course is designed for students in Statistics & Data Science who need to know about optimization and the essentials of numerical algorithm design and analysis. It is an introduction to more advanced courses in optimization. The overarching goal of the course is teach students how to design algorithms for Machine Learning and Data Analysis (in their own research). This course is not open to students who have taken S&DS 430. Prerequisites: Knowledge of linear algebra, multivariate calculus, and probability. Linear Algebra, by MATH 222, 223 or 230 or 231; Graph Theory, by MATH 244 or CPSC 365 or 366; and comfort with proof-based exposition and problem sets, such as is gained from MATH 230 and 231, or CPSC 366.

AMTH 447a / MATH 447a, Partial Differential Equations John Schotland
Introduction to partial differential equations, wave equation, Laplace's equation, heat equation, method of characteristics, calculus of variations, series and transform methods, and numerical methods. Prerequisites: MATH 305

* **AMTH 482a, Research Project** John Wettlaufer
Individual research. Requires a faculty supervisor and the permission of the director of undergraduate studies. The student must submit a written report about the results of the project. May be taken more than once for credit.

* **AMTH 491a, Senior Project** John Wettlaufer
Individual research that fulfills the senior requirement. Requires a faculty supervisor and the permission of the director of undergraduate studies. The student must submit a written report about the results of the project.