Mathematics - Algebra

110, Linear Algebra, Spring 2020, Kenneth A. Ribet

Upper-division course on abstract linear algebra. Catalog Description: Matrices, vector spaces, linear transformations, inner products, determinants. Eigenvectors. QR factorization. Quadratic forms and Rayleigh's principle. Jordan canonical form, applications. Linear functionals.
Textbook: Axler, Linear Algebra Done Right, Ch. 1-8, 10

250a, Groups, Rings, and Fields, Fall 2019, Richard E. Borcherds

Graduate course in algebra. Catalog Description: Group theory, including the Jordan-Holder theorem and the Sylow theorems. Basic theory of rings and their ideals. Unique factorization domains and principal ideal domains. Modules. Chain conditions. Fields, including fundamental theorem of Galois theory, theory of finite fields, and transcendence degree.
Textbook: Lang, Algebra Ch. 1-6

250b, Commutative Algebra, Spring 2020, Paul A. Vojta

Graduate course in algebra. Catalog Description: Development of the main tools of commutative and homological algebra applicable to algebraic geometry, number theory and combinatorics.
Textbook: Eisenbud, Commutative Algebra Ch. 1-10

Mathematics - Analysis

202a, Topology and Measure Theory, Fall 2019, Marc A. Rieffel

Graduate course in analysis. Catalog Description: Metric spaces and general topological spaces, compactness, theorems of Tychonoff, Urysohn, Tietze, locally compact spaces; an introduction to general measure spaces and integration of functions on them, with Lebesgue measure on the real line as a key example; Banach spaces of functions, and the very beginnings of functional analysis.

202b, Functional Analysis, Spring 2020, Marc A. Rieffel

Graduate course in analysis. Catalog Description: The Hahn-Banach Theorem, duals of Banach spaces and weak topologies, Krein-Milman Theorem, Hilbert spaces, the Radon-Nikodym Theorem, Stone-Weierstrass Theorem, signed measures, Radon measures, operators on Banach and Hilbert spaces, additional topics as time allows.

222a, Partial Differential Equations I, Fall 2020, Daniel Tataru

Graduate analysis course in partial differential equations. Catalog Description: The theory of boundary value and initial value problems for partial differential equations, with emphasis on nonlinear equations. Laplace's equation, heat equation, wave equation, nonlinear first-order equations, conservation laws, Hamilton-Jacobi equations, Fourier transform, Sobolev spaces.
Textbook: Evans, Partial Differential Equations

222b, Partial Differential Equations II, Spring 2021, Maciej Zworski

Graduate analysis course in partial differential equations. Catalog Description: Sobolev spaces, Gagliardo–Nirenberg–Sobolev and Morrey inequalties, Schauder estimates, Calculus of variations, applications of Sobolev space techniques, De Giorgi-Nash-Moser Theorem, Oscillatory integrals, Pseudodifferential operators, Cauchy problem for hyperbolic equations via energy estimates, Parametrix construction for hyperbolic equations and applications.
Textbook: Evans, Partial Differential Equations

258, Euclidean Harmonic Analysis, Fall 2019, Francis Michael Christ

Graduate course in analysis. Catalog Description: Basic properties of Fourier series, convergence and summability, conjugate functions, Hardy spaces, boundary behavior of analytic and harmonic functions.

Mathematics - Geometry

214, Differentiable Manifolds, Spring 2021, Richard Balmer

Graduate course in differential geometry. Catalog Description: Smooth manifolds and maps, tangent and normal bundles. Sard's theorem and transversality, Whitney embedding theorem. Morse functions, differential forms, Stokes' theorem, Frobenius theorem. Basic degree theory. Flows, Lie derivative, Lie groups and algebras.
Textbook: Lee, Smooth Manifolds

261a, Lie Groups, Spring 2021, Semeon Artamonov

Graduate course in lie theory. Catalog Description: Lie groups and Lie algebras, fundamental theorems of Lie, general structure theory; compact, nilpotent, solvable, semi-simple Lie groups; classification theory and representation theory of semi-simple Lie algebras and Lie groups, further topics such as symmetric spaces, Lie transformation groups, etc., if time permits. In view of its simplicity and its wide range of applications, it is preferable to cover compact Lie groups and their representations in 261A.
Textbook: Fulton/Harris, Representation Theory

Statistics

134, Introduction to Probability, Fall 2019, Adam Lucas

Catalog Description: An introduction to probability, emphasizing concepts and applications. Conditional expectation, independence, laws of large numbers. Discrete and continuous random variables. Central limit theorem. Selected topics such as the Poisson process, Markov chains, characteristic functions.
Textbook: Pitman, Probability

205a, Probability Theory I, Fall 2020, Shirshendu Ganguly

Graduate course in probability theory. Catalog Description: Measure theory concepts needed for probability. Expection, distributions. Laws of large numbers and central limit theorems for independent random variables. Characteristic function methods. Conditional expectations, martingales and martingale convergence theorems. Markov chains. Stationary processes. Brownian motion.
Textbook: Durrett, Probability: Theory and Examples

205b, Probability Theory II, Spring 2021, Jim Pitman

Graduate course in stochastic processes. A continuation of the material in Probability Theory I(205a). Covers the theory of Markov Chains, Stationary Processes, Random Walks, Ergodic Theory, Brownian Motion, etc.
Textbook: Durrett, Probability: Theory and Examples

Computer Science

61b, Data Structures, Spring 2020, Paul N. Hilfinger

Catalog Description: Fundamental dynamic data structures, including linear lists, queues, trees, and other linked structures; arrays strings, and hash tables. Storage management. Elementary principles of software engineering. Abstract data types. Algorithms for sorting and searching. Introduction to the Java programming language.

170, Algorithms and Intractable Problems, Fall 2020, Avishay Tal, Umesh Vazirani

Catalog Description: Concept and basic techniques in the design and analysis of algorithms; models of computation; lower bounds; algorithms for optimum search trees, balanced trees and UNION-FIND algorithms; numerical and algebraic algorithms; combinatorial algorithms. Turing machines, how to count steps, deterministic and nondeterministic Turing machines, NP-completeness. Unsolvable and intractable problems.

188, Artificial Intelligence, Summer 2020

Catalog Description: Ideas and techniques underlying the design of intelligent computer systems. Topics include search, game playing, knowledge representation, inference, planning, reasoning under uncertainty, machine learning, robotics, perception, and language understanding.

270, Combinatorial Algorithms and Data Structures

Catalog Description: Design and analysis of efficient algorithms for combinatorial problems. Network flow theory, matching theory, matroid theory; augmenting-path algorithms; branch-and-bound algorithms; data structure techniques for efficient implementation of combinatorial algorithms; analysis of data structures; applications of data structure techniques to sorting, searching, and geometric problems.