* Mathematics 1A: Calculus
* Mathematics 1B: Calculus
* Mathematics 53: Multivariable Calculus
* Mathematics 54: Linear Algebra & Differential Equations
* Mathematics 55: Discrete Mathematics
* -----------------------------------------------------------------------
* Mathematics 104: Introduction to Analysis
* Mathematics 110: Linear Algebra
* Mathematics 113: Introduction to Abstract Algebra
* Mathematics 128A: Numerical Analysis
* Mathematics 185: Introduction to Complex Analysis

https://math.berkeley.edu/courses/offerings/search?keys=&coursenum=125A&semester=All&instructor=

Mathematics

* 103
* 123: Ordinary Differential Equations (Math 104):

Existence and uniqueness of solutions, linear systems, regular singular points. Other topics selected from analytic systems, autonomous systems, Sturm-Liouville Theory.

(1) Introduction: examples and tricks (2) Existence and uniqueness of solutions (3) Linear ODE and systems (4) Stability (5) Boundary value problems: Sturm-Liouville theory (6) Additional topics

Required Text: An Introduction to Ordinary Differential Equations" by Agarwal and O'Regan (Springer)

* 125A Mathematical Logic (Math 113):

Sentential and quantificational logic. Formal grammar, semantical interpretation, formal deduction, and their interrelation. Applications to formalized mathematical theories. Selected topics from model theory or proof theory.

**Syllabus:**(1) will be quick, (2) and (3) are the heart of the course, (4) depends on how much time we have.

1. Sentential (aka propositional) logic, chapter 1 of Enderton.
2. Signatures and structures: bits and pieces mostly from chapter 2 of Enderton, many examples from mathematics.
3. First-order (aka predicate) logic: syntax and semantics, compactness: sections 2.0 - 2.5 of Enderton.
4. Some model theory, from the first four chapters of Marker's book.

**Required Text:** A Mathematical Introduction to Logic by Herbert Enderton

**Recommended Reading:** Model Theory : An Introduction by David Marker (electronic copy available through UCBerkeley library website)

Sentential and quantificational logic. Formal grammar, semantical interpretation, formal deduction, and their interrelation. Applications to formalized mathematical theories. Selected topics from model theory or proof theory.

* 125B
* 126: Introduction to Partial Differential Equations (Math 53, 54, 104):

This course is an introduction to partial differential equations. It covers elliptic, parabolic and hyperbolic equations, initial and boundary value problems, Fourier transform, distributions, nonlinear first order equations

Required Text:

1. Introduction to Partial Differential Equations, 2e (the course covers roughly Part 1 of the book.
2. A Guide to Distribution Theory and Fourier Transforms

* 127: Mathematical and Computational Methods in Molecular...

**Prerequisites:** 53, 54, and 55; Statistics 20 recommended.

**Syllabus:** Introduction to mathematical and computational problems arising in the context of molecular biology. Theory and applications of combinatorics, probability, statistics, geometry, and topology to problems ranging from sequence determination to structure analysis.

* 128B: Numerical Analysis

**Prerequisites:** Math 110, Math 128A or equivalent, basic MATLAB skills.

**Syllabus:** This is a follow-up of Math 128A. In this course, we will continue to learn some of the most basic concepts and methods in scientific computing. Our text book is **Numerical Analysis, 8-th or 9-th edition** (by R. L. Burden and J. D. Faires). We will mostly cover chapters 7 through 12. There will be emphasis on **matlab** programming with up to 3 programming assignments. We will also spend some time to discuss methods for solving nonlinear equations of a single variable.

**Syllabus:** Second part of the course sequence on introductory numerical analysis: Iterative methods for linear systems; Approximation theory; Eigenvalue approximations; Solution of systems of equations; Numerical methods for ODEs and PDEs.

**Required Text:**  R. L. Burden and J. D. Faires, Numerical Analysis, 9th edition, 2010.

**Required Text:** Numerical Analysis, 2nd ed., Timothy Sauer, Pearson Pub., 2011

* 140: Metric Differential Geometry

**Prerequisites:** Math 104 or Math 121B  
**Required Text:** Elementary Differential Geometry (Second Edition) by Andrew Pressley, Elements of Differential Geometry, by Millman and Parker

**Syllabus:** Frenet formulas, isoperimetric inequality, local theory of surfaces in Euclidean space, first and second fundamental forms, Gaussian and mean curvature, isometries, geodesics, parallelism, the Gauss-Bonnet-Von Dyck Theorem.

* 141: Elementary Differential Topology

**Prerequisites:** 104 or equivalent and linear algebra

**Description:** Manifolds in n-dimensional Euclidean space and smooth maps, Sard's Theorem, classification of compact one-manifolds, transversality and intersection modulo 2.

**Required Text:** Differential Topology, by V. Guillemin and A. Pollack;  Munkres, Analysis On Manifolds

* 189: Mathematical Methods in Classical and Quantum Mecha

**Prerequisites:** essential prerequisite linear algebra (Math 54 or Math 110 )

**Prerequisites:** 104, 110, 2 semesters lower division Physics.

**Syllabus:**  the course will be a mathematical introduction at the undergraduate level to the Hilbert space approach to quantum mechanics.

**Syllabus:** Topics in mechanics presented from a mathematical viewpoint: e.g., Lagrangian mechanics, Hamiltonian mechanics and symplectic geometry, differential equations for fluids, spectral theory in quantum mechanics, probability theory and statistical mechanics. See department bulletins for specific topics each semester course is offered.

**Recommended Reading:** K. Hannabuss "An introduction to Quantum Theory" Oxford Graduate Texts in Mathematics.  Also recommended : L. D. Faddeev, O.A. Yakubovskii " Lectures on Quantum Mechanics for Mathematics Students".

**Required Text:** Mathematical Methods of Classical Mechanics (Arnol'd)

* 170: Mathematical Methods for Optimization

**Prerequisites:** 53 and 54.

**Syllabus:** Linear programming and a selection of topics from among the following: matrix games, integer programming, semidefinite programming, nonlinear programming, convex analysis and geometry, polyhedral geometry, the calculus of variations, and control theory.

**Required Text:** Introduction to Optimization.  Pablo Pedregal.  Springer, 2004, 978-1-4419-233  
 Introduction to Linear Optimization by Dimitris Bertsimas and John N. Tsitsiklis

* 172: Combinatorics

**Prerequisites:** 55

**Description:** Basic combinatorial principles, graphs, partially ordered sets, generating functions, asymptotic methods, combinatorics of permutations and partitions, designs and codes. Additional topics at the discretion of the instructor.

**Required Text:** R. Brualdi, Introductory Combinatorics, 5th edition, Pearson Prentice Hall, 2010

**Syllabus:** This course is an introductory course to combinatorics. We will cover roughly Chapters 1 to 8 and 11 of Brualdi, that is permutations, pigeonhole principle, binomial coefficients, inclusion-exclusion principle, recurrence relations, generating functions, and basic graph theory. Then we will discuss some topics around polytopes and Ehrhart theory (time permitting).

# Statistics

* C100
* 133
* 134
* 135: Introduction to the Theory of Sets

**Prerequisites:** 113 and 104

**Description:** Set-theoretical paradoxes and means of avoiding them. Sets, relations, functions, order and well-order. Proof by transfinite induction and definitions by transfinite recursion. Cardinal and ordinal numbers and their arithmetic. Construction of the real numbers. Axiom of choice and its consequences. Zermelo-Frenkel Axiomatic System.  Operations on sets. Relations, Ordering, Functions, Equivalences. Cardinal Numbers and their arithmetic. Order types and their arithmetic.  The theory of Natural Numbers.  The Axiom of Choice. Well-Ordering. Ordinals and their arithmetic. Transfinite Induction. Zorn's Lemma. Alephs.

**Text:** Elements of Set Theory. Herbert B. Enderton

* 150
* 151: Mathematics of the Secondary School Curriculum I
* **Prerequisites:** 1A-1B, 53, or equivalent
* **Description:** Math 151 is the first in the series 151-153, which when combined with the CalTeach program leads to the California Teaching Credential without needing a Master's Degree. The 151-153 sequence prepares the student to teach math in High School and grades 7-8. Throughout the sequence, we present complete proofs for the results that high school students must learn, and the proofs are chosen so they can be understood by a high school student. In the first part of Math 151 we develop the theory for fractions and Rational Numbers, and do a bit of number theory. In the second half of 151 we use a small set of axioms to create a foundation for Geometry, and end with a discussion of linear equations.

Theory of rational numbers based on the number line, the Euclidean algorithm and fractions in lowest terms. The concepts of congruence and similarity, equation of a line, functions, and quadratic functions.

* 153: Mathematics of the Secondary School Curriculum III
* **Prerequisites:** 151, 152
* **Description:** The real line and least upper bound, limit and decimal expansion of a number, differentiation and integration, Fundamental Theorem of Calculus, characterizations of sine, cosine, exp, and log.
* 154
* 155
* 156