Mathematics

Overview
The Department of Mathematics is generally recognized as one of the broadest, liveliest, and most distinguished departments of mathematics in the world. With approximately 55 regular faculty members representing most of the major fields of current research, along with 25 to 30 postdoctoral scholars, 180 graduate students, 475 undergraduate majors, one of the finest mathematics libraries in the nation, and a favorable climate in one of America's most exciting and cosmopolitan centers for mathematics research and teaching, UC Berkeley has become a favorite location for the study of mathematics by students and faculty from all over the world.

UC Berkeley is increasingly interested in developing the talents of outstanding mathematics students and has a number of challenging honors-level courses. The department encourages all major students to participate in the annual William Lowell Putnam Mathematical Competition (http://www.maa.org/awards/putnam.html). Additionally, the department sponsors undergraduate teams in the annual Mathematical Contest in Modeling, in which teams of three write mathematical solutions to real-life problems. An active Mathematics Undergraduate Student Association (MUSA) (http://musa.berkeley.edu), of which all departmental majors are automatically members, contributes to making Berkeley a stimulating and rewarding place to study mathematics. In addition, the Noetherian Ring (http://math.berkeley.edu/~nring), an organization seeking to promote and support women in mathematics at Berkeley, is open to undergraduate students.

Berkeley's mathematics education program is greatly enriched by its large number of graduate students, postdoctoral faculty and fellows, and visiting teachers in residence each year. They come from all over the world to teach courses, participate in seminars, collaborate in research, give talks at the weekly Mathematics Colloquium, and be available as consultants. An affiliated interdisciplinary group, with its own doctoral program, is the Group in Logic and the Methodology of Science. There are two NSF funded Research Training Groups: one in Representation Theory, Geometry and Combinatorics (http://math.berkeley.edu/research/training-groups/rtcg) and one in Geometry, Topology and Operator Algebras (http://math.berkeley.edu/research/training-groups/gtoa). These groups run seminars, workshops, and other activities and support graduate student and postdoctoral fellows in their areas of interest. The department has several graduate student groups (http://math.berkeley.edu/resources/student-groups): the Mathematics Graduate Student Association (MGSA) (http://math.berkeley.edu/~mgsa), comprising all graduate students; the Noetherian Ring (http://math.berkeley.edu/~nring), a group of women in mathematics; and a student lecture series, Many Cheerful Facts (http://math.berkeley.edu/~mcf).

Facilities
The Mathematics Library (http://www.lib.berkeley.edu/math) on the first floor of Evans Hall, part of the system of University of California Libraries (http://libraries.universityofcalifornia.edu), provides researchers and students with access to world-class collections.

The Mathematical Sciences Research Institute (MSRI) (http://www.msri.org) was founded by the National Science Foundation in 1981. In a beautifully designed building on the hills above the Berkeley campus and overlooking San Francisco Bay, about 1,700 mathematicians from around the world come each year to participate in research programs in a wide variety of mathematical topics. The combined and cooperative efforts of the department, the center, and the MSRI provide a program of mathematics courses, workshops, seminars, and colloquia of remarkable variety and exciting intensity.

Undergraduate Programs
Applied Mathematics (http://guide.berkeley.edu/undergraduate/degree-programs/applied-mathematics): BA
Mathematics (http://guide.berkeley.edu/undergraduate/degree-programs/mathematics): BA (also available with a Teaching Concentration), Minor

Graduate Programs
Applied Mathematics (http://guide.berkeley.edu/graduate/degree-programs/applied-mathematics): PhD
Mathematics (http://guide.berkeley.edu/graduate/degree-programs/mathematics): MA, PhD

Mathematics
MATH 1A Calculus 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
This sequence is intended for majors in engineering and the physical sciences. An introduction to differential and integral calculus of functions of one variable, with applications and an introduction to transcendental functions.

Calculus: Read More [+]

Rules & Requirements

Prerequisites: Three and one-half years of high school math, including trigonometry and analytic geometry, plus a satisfactory grade in one of the following: CEEB MAT test, an AP test, the UC/CSU math diagnostic test, or 32. Consult the mathematics department for details. Students with AP credit should consider choosing a course more advanced than 1A.

Credit Restrictions: Students will receive no credit for 1A after taking 16B.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of discussion per week
Summer: 8 weeks - 5 hours of lecture and 5 hours of discussion per week

Additional Details

Subject/Course Level: Mathematics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Calculus: Read Less [-]
MATH 1B Calculus 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
Continuation of 1A. Techniques of integration; applications of integration.
Infinite sequences and series. First-order ordinary differential equations.
Second-order ordinary differential equations; oscillation and damping;
series solutions of ordinary differential equations.
Calculus: Read More [+]
Rules & Requirements
Prerequisites: 1A
Credit Restrictions: Students will receive no credit for Mathematics 1B after taking Mathematics 1BM.<br/>Students will receive no credit for Mathematics 1B after taking Mathematics H1B.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of discussion per week
Summer: 8 weeks - 5 hours of lecture and 5 hours of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Calculus: Read Less [-]

MATH H1B Honors Calculus 4 Units
Terms offered: Fall 2015, Fall 2014, Fall 2013
Honors version of 1B. Continuation of 1A. Techniques of integration;
applications of integration. Infinite sequences and series. First-order
ordinary differential equations. Second-order ordinary differential
equations; oscillation and damping; series solutions of ordinary
differential equations.
Honors Calculus: Read More [+]
Rules & Requirements
Prerequisites: 1A
Credit Restrictions: Students will receive 2 units of credit for H1B after taking 16B.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week
Summer: 8 weeks - 5 hours of lecture and 5 hours of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Honors Calculus: Read Less [-]

MATH 10A Methods of Mathematics: Calculus, Statistics, and Combinatorics 4 Units
Terms offered: Summer 2018 8 Week Session, Fall 2017, Summer 2017 8 Week Session
This sequence is intended for majors in the life sciences. Introduction
to differential and integral calculus of functions of one variable.
Representation of data, elementary probability theory, statistical models,
and testing.
Methods of Mathematics: Calculus, Statistics, and Combinatorics: Read More [+]
Rules & Requirements
Prerequisites: Three and one-half years of high school math, including trigonometry and analytic geometry
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of discussion per week
Summer: 8 weeks - 5 hours of lecture and 5 hours of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Methods of Mathematics: Calculus, Statistics, and Combinatorics: Read Less [-]
**MATH 10B Methods of Mathematics: Calculus, Statistics, and Combinatorics 4 Units**
Terms offered: Summer 2018 8 Week Session, Spring 2018, Summer 2017 8 Week Session
Elementary combinatorics and discrete probability theory. Introduction to graphs, matrix algebra, linear equations, difference equations, and differential equations.
Methods of Mathematics: Calculus, Statistics, and Combinatorics: Read More [+]

**Rules & Requirements**

**Prerequisites:** Continuation of 10A

**Credit Restrictions:** Students will receive 2 units of credit for Mathematics 10B after completing Mathematics 55.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture and 3 hours of discussion per week

**Summer:** 8 weeks - 5 hours of lecture and 5 hours of discussion per week

**Additional Details**

**Subject/Course Level:** Mathematics/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

Methods of Mathematics: Calculus, Statistics, and Combinatorics: Read Less [-]

---

**MATH 16A Analytic Geometry and Calculus 3 Units**
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
This sequence is intended for majors in the life and social sciences. Calculus of one variable; derivatives, definite integrals and applications, maxima and minima, and applications of the exponential and logarithmic functions.

Analytic Geometry and Calculus: Read More [+]

**Rules & Requirements**

**Prerequisites:** Three years of high school math, including trigonometry, plus a satisfactory grade in one of the following: CEEB MAT test, an AP test, the UC/CSU math diagnostic exam, or 32. Consult the mathematics department for details

**Credit Restrictions:** Students will receive no credit for 16A after taking 1A. Two units of 16A may be used to remove a deficient grade in 1A.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 2 hours of lecture and 1 hour of discussion per week

**Summer:** 8 weeks - 4 hours of lecture and 4 hours of discussion per week

**Additional Details**

**Subject/Course Level:** Mathematics/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

Analytic Geometry and Calculus: Read Less [-]

---

**MATH 16B Analytic Geometry and Calculus 3 Units**
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017

Analytic Geometry and Calculus: Read More [+]

**Rules & Requirements**

**Prerequisites:** 16A

**Credit Restrictions:** Students will receive no credit for 16B after 1B, 2 units after 1A. Two units of 16B may be used to remove a deficient grade in 1A.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 2 hours of lecture and 1 hour of discussion per week

**Summer:** 8 weeks - 4 hours of lecture and 4 hours of discussion per week

**Additional Details**

**Subject/Course Level:** Mathematics/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

Analytic Geometry and Calculus: Read Less [-]
MATH 24 Freshman Seminars 1 Unit
Terms offered: Spring 2018, Fall 2017, Spring 2017
The Berkeley Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Berkeley Seminars are offered in all campus departments, and topics vary from department to department and semester to semester.
Freshman Seminars: Read More [+]

Rules & Requirements
Repeat rules: Course may be repeated for credit when topic changes. Course may be repeated for credit when topic changes.

Hours & Format
Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

MATH 32 Precalculus 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
Polynomial and rational functions, exponential and logarithmic functions, trigonometry and trigonometric functions. Complex numbers, fundamental theorem of algebra, mathematical induction, binomial theorem, series, and sequences.
Precalculus: Read More [+]

Rules & Requirements
Prerequisites: Three years of high school mathematics, plus satisfactory score on one of the following: CEEB MAT test, math SAT, or UC/CSU diagnostic examination

Credit Restrictions: Students will receive no credit for 32 after taking 1A-1B or 16A-16B and will receive 3 units after taking 96.

Hours & Format
Summer: 8 weeks - 12.5 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Gibson

Precalculus: Read Less [-]

MATH N32 Precalculus 4 Units
Terms offered: Prior to 2007
Polynomial and rational functions, exponential and logarithmic functions, trigonometry and trigonometric functions. Complex numbers, fundamental theorem of algebra, mathematical induction, binomial theorem, series, and sequences.

Precalculus: Read More [+]

Rules & Requirements
Prerequisites: Three years of high school mathematics, plus satisfactory score on one of the following: CEEB MAT test, math SAT, or UC/CSU diagnostic examination

Credit Restrictions: Students will receive no credit for N32 after taking 1A-1B or 16A-16B and will receive 3 units after taking 96.

Hours & Format
Summer: 8 weeks - 12.5 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Gibson

Precalculus: Read Less [-]

MATH 39A Freshman/Sophomore Seminar 2 - 4 Units
Terms offered: Spring 2018, Spring 2010, Spring 2009
Freshman and sophomore seminars offer lower division students the opportunity to explore an intellectual topic with a faculty member and a group of peers in a small-seminar setting. These seminars are offered in all campus departments; topics vary from department to department and from semester to semester.
Freshman/Sophomore Seminar: Read More [+]

Rules & Requirements
Prerequisites: Priority given to freshmen and sophomores

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 2-4 hours of seminar per week

Summer:
6 weeks - 5 hours of lecture and 5 hours of discussion per week
8 weeks - 5 hours of lecture and 5 hours of discussion per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Freshman/Sophomore Seminar: Read Less [-]
MATH 49 Supplementary Work in Lower Division Mathematics 1 - 3 Units
Terms offered: Spring 2017, Spring 2016, Fall 2015
Students with partial credit in lower division mathematics courses may, with consent of instructor, complete the credit under this heading.
Supplementary Work in Lower Division Mathematics: Read More [+]
Rules & Requirements
Prerequisites: Some units in a lower division Mathematics class
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 0 hours of independent study per week
Summer: 6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.
Supplementary Work in Lower Division Mathematics: Read Less [-]

MATH 53 Multivariable Calculus 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
Multivariable Calculus: Read More [+]
Rules & Requirements
Prerequisites: Mathematics 1B
Credit Restrictions: Students will receive no credit for Mathematics 53 after completing Mathematics W53, 53M; 3 units for Mathematics 50A and 1 unit for Mathematics 50B. A deficient grade in 53 may be removed by completing Mathematics W53.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of discussion per week
Summer: 8 weeks - 5 hours of web-based lecture and 5 hours of web-based discussion per week
Online: This is an online course.
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Hutchings
Multivariable Calculus: Read Less [-]
MATH 54 Linear Algebra and Differential Equations 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
Linear Algebra and Differential Equations: Read More [+]
Rules & Requirements
Prerequisites: 1B or 10B. Mathematics 10B
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of discussion per week
Summer: 8 weeks - 5 hours of lecture and 5 hours of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Linear Algebra and Differential Equations: Read Less [-]

MATH H54 Honors Linear Algebra and Differential Equations 4 Units
Terms offered: Fall 2017, Fall 2016, Spring 2016
Honors Linear Algebra and Differential Equations: Read More [+]
Rules & Requirements
Prerequisites: 1B
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Honors Linear Algebra and Differential Equations: Read Less [-]

MATH 55 Discrete Mathematics 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
Logic, mathematical induction sets, relations, and functions. Introduction to graphs, elementary number theory, combinatorics, algebraic structures, and discrete probability theory.
Discrete Mathematics: Read More [+]
Rules & Requirements
Prerequisites: Mathematical maturity appropriate to a sophomore math class. 1A-1B recommended
Credit Restrictions: Students will receive no credit for 55 after taking Computer Science 70.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week
Summer: 8 weeks - 5 hours of lecture and 5 hours of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Discrete Mathematics: Read Less [-]

MATH 74 Transition to Upper Division Mathematics 3 Units
Terms offered: Spring 2009, Fall 2008, Summer 2008 8 Week Session
The course will focus on reading and understanding mathematical proofs. It will emphasize precise thinking and the presentation of mathematical results, both orally and in written form. The course is intended for students who are considering majoring in mathematics but wish additional training.
Transition to Upper Division Mathematics: Read More [+]
Rules & Requirements
Prerequisites: 53 and 54
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week
Summer: 8 weeks - 6 hours of lecture and 0-2 hours of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Transition to Upper Division Mathematics: Read Less [-]
MATH 91 Special Topics in Mathematics 4 Units
Terms offered: Spring 2016, Fall 2012, Spring 2012
Topics to be covered and the method of instruction to be used will be announced at the beginning of each semester that such courses are offered. See department bulletins.
Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer: 8 weeks - 6 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Special Topics in Mathematics: Read Less [-]

MATH 96 College Algebra 2 Units
Terms offered: Summer 2017 8 Week Session, Summer 2015 10 Week Session, Summer 2014 10 Week Session
Elements of college algebra. Designed for students who do not meet the prerequisites for 32. Offered through the Student Learning Center.
Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 4 hours of workshop per week
Summer: 6 weeks - 10 hours of workshop per week
8 weeks - 10 hours of workshop per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
College Algebra: Read Less [-]

MATH 98 Supervised Group Study 1 - 4 Units
Terms offered: Spring 2018, Fall 2017, Spring 2017
Directed Group Study, topics vary with instructor.
Rules & Requirements
Repeat rules: Course may be repeated for credit up to a total of 4 units. Course may be repeated for a maximum of 4 units.
Hours & Format
Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week
Summer: 8 weeks - 1.5-7.5 hours of directed group study per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Supervised Group Study: Read Less [-]

MATH 98BC Berkeley Connect 1 Unit
Terms offered: Spring 2018, Fall 2017, Spring 2017
Berkeley Connect is a mentoring program, offered through various academic departments, that helps students build intellectual community. Over the course of a semester, enrolled students participate in regular small-group discussions facilitated by a graduate student mentor (following a faculty-directed curriculum), meet with their graduate student mentor for one-on-one academic advising, attend lectures and panel discussions featuring department faculty and alumni, and go on field trips to campus resources. Students are not required to be declared majors in order to participate.
Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 1 hour of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Berkeley Connect: Read Less [-]
MATH 99 Supervised Independent Study 1 - 4 Units
Terms offered: Spring 2017, Spring 2016, Fall 2015
Supervised independent study by academically superior, lower division students. 3.3 GPA required and prior consent of instructor who is to supervise the study. A written proposal must be submitted to the department chair for pre-approval.

Rules & Requirements
Prerequisites: Restricted to freshmen and sophomores only. Consent of instructor
Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-4 hours of independent study per week
Summer: 8 weeks - 1-4 hours of independent study per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

MATH C103 Introduction to Mathematical Economics 4 Units
Terms offered: Spring 2018, Spring 2017, Fall 2016
Selected topics illustrating the application of mathematics to economic theory. This course is intended for upper-division students in Mathematics, Statistics, the Physical Sciences, and Engineering, and for economics majors with adequate mathematical preparation. No economic background is required.

Rules & Requirements
Prerequisites: Math 53 and 54

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Formerly known as: 103
Also listed as: ECON C103

MATH 104 Introduction to Analysis 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
The real number system. Sequences, limits, and continuous functions in R and R. The concept of a metric space. Uniform convergence, interchange of limit operations. Infinite series. Mean value theorem and applications. The Riemann integral.

Rules & Requirements
Prerequisites: 53 and 54

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer: 8 weeks - 8 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

MATH H104 Honors Introduction to Analysis 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Honors section corresponding to 104. Recommended for students who enjoy mathematics and are good at it. Greater emphasis on theory and challenging problems.

Rules & Requirements
Prerequisites: 53 and 54

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Honors Introduction to Analysis: Read Less [-]
MATH 105 Second Course in Analysis 4 Units
Differential calculus in R^n: the derivative as a linear map; the chain rule; inverse and implicit function theorems. Lebesgue integration on the line; comparison of Lebesgue and Riemann integrals. Convergence theorems. Fourier series, L2 theory. Fubini's theorem, change of variable.
Second Course in Analysis: Read More [+]

Rules & Requirements
Prerequisites: 104

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Second Course in Analysis: Read Less [-]

MATH 110 Linear Algebra 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
Linear Algebra: Read More [+]

Rules & Requirements
Prerequisites: 54 or a course with equivalent linear algebra content

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Linear Algebra: Read Less [-]

MATH H110 Honors Linear Algebra 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Honors section corresponding to course 110 for exceptional students with strong mathematical inclination and motivation. Emphasis is on rigor, depth, and hard problems.
Honors Linear Algebra: Read More [+]

Rules & Requirements
Prerequisites: 54 or a course with equivalent linear algebra content

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer: 8 weeks - 6 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Honors Linear Algebra: Read Less [-]

MATH 113 Introduction to Abstract Algebra 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
Introduction to Abstract Algebra: Read More [+]

Rules & Requirements
Prerequisites: 54 or a course with equivalent linear algebra content

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer: 8 weeks - 8 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Introduction to Abstract Algebra: Read Less [-]
MATH H113 Honors Introduction to Abstract Algebra 4 Units
Honors section corresponding to 113. Recommended for students who enjoy mathematics and are willing to work hard in order to understand the beauty of mathematics and its hidden patterns and structures. Greater emphasis on theory and challenging problems.
Honors Introduction to Abstract Algebra: Read More [+]
Rules & Requirements
Prerequisites: 54 or a course with equivalent linear algebra content

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Honors Introduction to Abstract Algebra: Read Less [-]

MATH 114 Second Course in Abstract Algebra 4 Units
Terms offered: Spring 2018, Spring 2017, Fall 2015
Further topics on groups, rings, and fields not covered in Math 113. Possible topics include the Sylow Theorems and their applications to group theory; classical groups; abelian groups and modules over a principal ideal domain; algebraic field extensions; splitting fields and Galois theory; construction and classification of finite fields.
Second Course in Abstract Algebra: Read More [+]
Rules & Requirements
Prerequisites: 110 and 113, or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Second Course in Abstract Algebra: Read Less [-]

MATH 115 Introduction to Number Theory 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Summer 2017 8 Week Session
Divisibility, congruences, numerical functions, theory of primes. Topics selected: Diophantine analysis, continued fractions, partitions, quadratic fields, asymptotic distributions, additive problems.
Introduction to Number Theory: Read More [+]
Rules & Requirements
Prerequisites: 53 and 54

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 0-2 hours of discussion per week
Summer: 8 weeks - 6 hours of lecture and 0-4 hours of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Introduction to Number Theory: Read Less [-]

MATH 116 Cryptography 4 Units
Terms offered: Fall 2015, Fall 2014, Fall 2013
Construction and analysis of simple cryptosystems, public key cryptography, RSA, signature schemes, key distribution, hash functions, elliptic curves, and applications.
Cryptography: Read More [+]
Rules & Requirements
Prerequisites: 55

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 0-2 hours of discussion per week
Summer: 8 weeks - 6 hours of lecture and 0-4 hours of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Cryptography: Read Less [-]
MATH 118 Fourier Analysis, Wavelets, and Signal Processing 4 Units
Terms offered: Fall 2017, Spring 2017, Spring 2016
Introduction to signal processing including Fourier analysis and wavelets. Theory, algorithms, and applications to one-dimensional signals and multidimensional images.
Fourier Analysis, Wavelets, and Signal Processing: Read More [+]
Rules & Requirements
Prerequisites: 53 and 54
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Fourier Analysis, Wavelets, and Signal Processing: Read Less [-]

MATH 121A Mathematical Tools for the Physical Sciences 4 Units
Terms offered: Fall 2017, Fall 2016, Spring 2016
Intended for students in the physical sciences who are not planning to take more advanced mathematics courses. Rapid review of series and partial differentiation, complex variables and analytic functions, integral transforms, calculus of variations.
Mathematical Tools for the Physical Sciences: Read More [+]
Rules & Requirements
Prerequisites: 53 and 54
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Mathematical Tools for the Physical Sciences: Read Less [-]

MATH 121B Mathematical Tools for the Physical Sciences 4 Units
Intended for students in the physical sciences who are not planning to take more advanced mathematics courses. Special functions, series solutions of ordinary differential equations, partial differential equations arising in mathematical physics, probability theory.
Mathematical Tools for the Physical Sciences: Read More [+]
Rules & Requirements
Prerequisites: 53 and 54
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Mathematical Tools for the Physical Sciences: Read Less [-]

MATH 123 Ordinary Differential Equations 4 Units
Terms offered: Fall 2017, Fall 2016, Spring 2016
Existence and uniqueness of solutions, linear systems, regular singular points. Other topics selected from analytic systems, autonomous systems, Sturm-Liouville Theory.
Ordinary Differential Equations: Read More [+]
Rules & Requirements
Prerequisites: 104
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Ordinary Differential Equations: Read Less [-]
MATH 124 Mathematical and Scientific Computing 4 Units
Terms offered: Not yet offered
An introduction to computer programming with a focus on the solution of mathematical and scientific problems. Basic programming concepts such as variables, statements, loops, branches, functions, data types, and object orientation.
Mathematical/scientific tools such as arrays, plotting, toolboxes, symbolic algebra. Examples and application from various areas such as evaluation of complex mathematical expressions, computational geometry, solving combinatorial problems, randomization, text and string processing, Fourier analysis of images. Mainly based on the MATLAB programming language, but other languages such as Python, Julia, and Maple will also be covered.
Mathematical and Scientific Computing: Read More [+]
Rules & Requirements
Prerequisites: Math 53, 54, 55
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Mathematical and Scientific Computing: Read Less [-]

MATH 125A Mathematical Logic 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Mathematical Logic: Read More [+]
Rules & Requirements
Prerequisites: Math 113 or consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Mathematical Logic: Read Less [-]

MATH 126 Introduction to Partial Differential Equations 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
Waves and diffusion, initial value problems for hyperbolic and parabolic equations, boundary value problems for elliptic equations, Green's functions, maximum principles, a priori bounds, Fourier transform.
Introduction to Partial Differential Equations: Read More [+]
Rules & Requirements
Prerequisites: 53 and 54
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer: 8 weeks - 6 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Introduction to Partial Differential Equations: Read Less [-]

MATH 127 Mathematical and Computational Methods in Molecular Biology 4 Units
Terms offered: Fall 2017, Fall 2016, Spring 2016
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.
Mathematical and Computational Methods in Molecular Biology: Read More [+]
Rules & Requirements
Prerequisites: 53, 54, and 55; Statistics 20 recommended
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Mathematical and Computational Methods in Molecular Biology: Read Less [-]
MATH 128A Numerical Analysis 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
Programming for numerical calculations, round-off error, approximation and interpolation, numerical quadrature, and solution of ordinary differential equations. Practice on the computer.
Numerical Analysis: Read More [+]
Rules & Requirements
Prerequisites: 53 and 54
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Summer: 8 weeks - 4 hours of lecture and 4 hours of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Numerical Analysis: Read Less [-]

MATH 128B Numerical Analysis 4 Units
Iterative solution of systems of nonlinear equations, evaluation of eigenvalues and eigenvectors of matrices, applications to simple partial differential equations. Practice on the computer.
Numerical Analysis: Read More [+]
Rules & Requirements
Prerequisites: 110 and 128A
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Summer: 8 weeks - 6 hours of lecture and 1.5 hours of discussion per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Numerical Analysis: Read Less [-]

MATH 130 The Classical Geometries 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
A critical examination of Euclid's Elements; ruler and compass constructions; connections with Galois theory; Hilbert's axioms for geometry, theory of areas, introduction of coordinates, non-Euclidean geometry, regular solids, projective geometry.
The Classical Geometries: Read More [+]
Rules & Requirements
Prerequisites: 110 and 113
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
The Classical Geometries: Read Less [-]

MATH 135 Introduction to the Theory of Sets 4 Units
Terms offered: Fall 2017, Spring 2017, Spring 2016
Introduction to the Theory of Sets: Read More [+]
Rules & Requirements
Prerequisites: 113 and 104
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Introduction to the Theory of Sets: Read Less [-]
MATH 136 Incompleteness and Undecidability 4 Units
Terms offered: Spring 2018, Spring 2017, Fall 2015
Incompleteness and Undecidability: Read More [+]

Rules & Requirements
Prerequisites: 53, 54, and 55

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Incompleteness and Undecidability: Read Less [-]

MATH 140 Metric Differential Geometry 4 Units
Terms offered: Fall 2017, Spring 2017, Fall 2015
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.
Metric Differential Geometry: Read More [+]

Rules & Requirements
Prerequisites: 104

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Metric Differential Geometry: Read Less [-]

MATH 141 Elementary Differential Topology 4 Units
Terms offered: Fall 2017, Fall 2016, Spring 2016
Manifolds in n-dimensional Euclidean space and smooth maps, Sard’s Theorem, classification of compact one-manifolds, transversality and intersection modulo 2.
Elementary Differential Topology: Read More [+]

Rules & Requirements
Prerequisites: 104 or equivalent and linear algebra

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Elementary Differential Topology: Read Less [-]

MATH 142 Elementary Algebraic Topology 4 Units
Terms offered: Spring 2018, Spring 2017, Fall 2015
The topology of one and two dimensional spaces: manifolds and triangulation, classification of surfaces, Euler characteristic, fundamental groups, plus further topics at the discretion of the instructor.
Elementary Algebraic Topology: Read More [+]

Rules & Requirements
Prerequisites: 104 and 113

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Elementary Algebraic Topology: Read Less [-]
MATH 143 Elementary Algebraic Geometry 4 Units
Terms offered: Spring 2018, Fall 2016, Fall 2015
Introduction to basic commutative algebra, algebraic geometry, and computational techniques. Main focus on curves, surfaces and Grassmannian varieties.
Rules & Requirements
Prerequisites: 113

MATH 151 Mathematics of the Secondary School Curriculum I 4 Units
Terms offered: Spring 2017, Spring 2016, Spring 2015
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.
Rules & Requirements
Prerequisites: 1A-1B, 53, or equivalent

MATH 152 Mathematics of the Secondary School Curriculum II 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Complex numbers and Fundamental Theorem of Algebra, roots and factorizations of polynomials, Euclidean geometry and axiomatic systems, basic trigonometry.
Rules & Requirements
Prerequisites: 151; 54, 113, or equivalent

MATH 153 Mathematics of the Secondary School Curriculum III 4 Units
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.
Rules & Requirements
Prerequisites: 151, 152
MATH 160 History of Mathematics 4 Units
History of algebra, geometry, analytic geometry, and calculus from ancient times through the seventeenth century and selected topics from more recent mathematical history.
History of Mathematics: Read More [+]

MATH 170 Mathematical Methods for Optimization 4 Units
Terms offered: Spring 2018, Spring 2017, Fall 2015
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.
Mathematical Methods for Optimization: Read More [+]

MATH 172 Combinatorics 4 Units
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.
Combinatorics: Read More [+]

MATH 185 Introduction to Complex Analysis 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
Analytic functions of a complex variable. Cauchy's integral theorem, power series, Laurent series, singularities of analytic functions, the residue theorem with application to definite integrals. Some additional topics such as conformal mapping.
Introduction to Complex Analysis: Read More [+]

1. **MATH 160 History of Mathematics 4 Units**
   - History of algebra, geometry, analytic geometry, and calculus from ancient times through the seventeenth century and selected topics from more recent mathematical history.

2. **MATH 170 Mathematical Methods for Optimization 4 Units**
   - Terms offered: Spring 2018, Spring 2017, Fall 2015
   - 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.

3. **MATH 172 Combinatorics 4 Units**
   - 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.

4. **MATH 185 Introduction to Complex Analysis 4 Units**
   - Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
   - Analytic functions of a complex variable. Cauchy's integral theorem, power series, Laurent series, singularities of analytic functions, the residue theorem with application to definite integrals. Some additional topics such as conformal mapping.
MATH H185 Honors Introduction to Complex Analysis 4 Units
Terms offered: Spring 2018, Spring 2016, Spring 2015
Honors section corresponding to Math 185 for exceptional students with strong mathematical inclination and motivation. Emphasis is on rigor, depth, and hard problems.
Honors Introduction to Complex Analysis: Read More [+]
Rules & Requirements
Prerequisites: 104
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Honors Introduction to Complex Analysis: Read Less [-]

MATH 189 Mathematical Methods in Classical and Quantum Mechanics 4 Units
Terms offered: Fall 2015, Fall 2014, Fall 2013
Topics in mechanics presented from a mathematical viewpoint: e.g., 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.
Mathematical Methods in Classical and Quantum Mechanics: Read More [+]
Rules & Requirements
Prerequisites: 104, 110, 2 semesters lower division Physics
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Mathematical Methods in Classical and Quantum Mechanics: Read Less [-]

MATH 191 Experimental Courses in Mathematics 1 - 4 Units
Terms offered: Summer 2018 8 Week Session, Spring 2018, Fall 2017
The topics to be covered and the method of instruction to be used will be announced at the beginning of each semester that such courses are offered. See departmental bulletins.
Experimental Courses in Mathematics: Read More [+]
Rules & Requirements
Prerequisites: Consent of instructor
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 1-4 hours of seminar per week
Summer:
6 weeks - 2.5-10 hours of seminar per week
8 weeks - 1.5-7.5 hours of seminar per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Experimental Courses in Mathematics: Read Less [-]

MATH 195 Special Topics in Mathematics 4 Units
Terms offered: Spring 2011, Spring 2004, Spring 2003
Lectures on special topics, which will be announced at the beginning of each semester that the course is offered.
Special Topics in Mathematics: Read More [+]
Rules & Requirements
Prerequisites: Consent of instructor
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 0 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Special Topics in Mathematics: Read Less [-]
MATH 196 Honors Thesis 4 Units
Terms offered: Spring 2017, Spring 2016, Spring 2015
Independent study of an advanced topic leading to an honors thesis. Honors Thesis: Read More [+]

Rules & Requirements
Prerequisites: Admission to the Honors Program; an overall GPA of 3.3 and a GPA of 3.5 in the major
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 0 hours of independent study per week
Summer: 6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.
Honors Thesis: Read Less [-]

MATH 197 Field Study 1 - 4 Units
Terms offered: Spring 2016, Spring 2015, Spring 2014
For Math/Applied math majors. Supervised experience relevant to specific aspects of their mathematical emphasis of study in off-campus organizations. Regular individual meetings with faculty sponsor and written reports required. Units will be awarded on the basis of three hours/week/unit.
Field Study: Read More [+]

Rules & Requirements
Prerequisites: Upper division standing. Written proposal signed by faculty sponsor and approved by department chair
Credit Restrictions: Enrollment is restricted; see the Course Number Guide in the Bulletin.
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 3-3 hours of fieldwork per week
Summer: 8 weeks - 3-3 hours of fieldwork per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Field Study: Read Less [-]

MATH 198 Directed Group Study 1 - 4 Units
Terms offered: Spring 2017, Fall 2016, Spring 2016
Topics will vary with instructor.
Directed Group Study: Read More [+]

Rules & Requirements
Prerequisites: Must have completed 60 units and be in good standing
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week
Summer: 8 weeks - 1-4 hours of directed group study per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Directed Group Study: Read Less [-]

MATH 198BC Berkeley Connect 1 Unit
Terms offered: Spring 2018, Fall 2017, Spring 2017
Berkeley Connect is a mentoring program, offered through various academic departments, that helps students build intellectual community. Over the course of a semester, enrolled students participate in regular small-group discussions facilitated by a graduate student mentor (following a faculty-directed curriculum), meet with their graduate student mentor for one-on-one academic advising, attend lectures and panel discussions featuring department faculty and alumni, and go on field trips to campus resources. Students are not required to be declared majors in order to participate.
Berkeley Connect: Read More [+]

Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1 hour of discussion per week

Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Berkeley Connect: Read Less [-]
MATH 199 Supervised Independent Study and Research 1 - 4 Units
Terms offered: Fall 2017, Spring 2017, Fall 2016
Supervised Independent Study and Research: Read More [+]
Rules & Requirements
Prerequisites: The standard college regulations for all 199 courses
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 0 hours of independent study per week
Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week
Additional Details
Subject/Course Level: Mathematics/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Supervised Independent Study and Research: Read Less [-]

MATH 202A Introduction to Topology and Analysis 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Introduction to Topology and Analysis: Read More [+]
Rules & Requirements
Prerequisites: 104
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Introduction to Topology and Analysis: Read Less [-]

MATH 202B Introduction to Topology and Analysis 4 Units
Introduction to Topology and Analysis: Read More [+]
Rules & Requirements
Prerequisites: 202A and 110
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Introduction to Topology and Analysis: Read Less [-]

MATH 203 Asymptotic Analysis in Applied Mathematics 4 Units
Terms offered: Fall 2011, Spring 2011, Spring 2010
Asymptotic methods for differential equations, with emphasis upon many physical examples. Topics will include matched asymptotic expansions, Laplace's method, stationary phase, boundary layers, multiple scales, WKB approximations, asymptotic Lagrangians, bifurcation theory. Asymptotic Analysis in Applied Mathematics: Read More [+]
Rules & Requirements
Prerequisites: 104
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Asymptotic Analysis in Applied Mathematics: Read Less [-]
MATH 204 Ordinary Differential Equations 4 Units
Terms offered: Fall 2016, Spring 2016, Fall 2014
Rules & Requirements
Prerequisites: 104

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.

Ordinary Differential Equations: Read Less [-]

MATH 205 Theory of Functions of a Complex Variable 4 Units
Terms offered: Spring 2018, Spring 2017, Fall 2015
Normal families. Riemann Mapping Theorem. Picard's theorem and related theorems. Multiple-valued analytic functions and Riemann surfaces. Further topics selected by the instructor may include: harmonic functions, elliptic and algebraic functions, boundary behavior of analytic functions and HP spaces, the Riemann zeta functions, prime number theorem.
Theory of Functions of a Complex Variable: Read More [+]
Rules & Requirements
Prerequisites: 185

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.

Theory of Functions of a Complex Variable: Read Less [-]

MATH 206 Banach Algebras and Spectral Theory 4 Units
Terms offered: Fall 2016, Fall 2015, Fall 2014
Rules & Requirements
Prerequisites: 202A-202B

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.

Banach Algebras and Spectral Theory: Read Less [-]

MATH 208 C*-algebras 4 Units
Terms offered: Spring 2018, Spring 2015, Spring 2013
Basic theory of C*-algebras. Positivity, spectrum, GNS construction. Group C*-algebras and connection with group representations. Additional topics, for example, C*-dynamical systems, K-theory.
C*-algebras: Read More [+]
Rules & Requirements
Prerequisites: 206

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.
C*-algebras: Read Less [-]
MATH 209 Von Neumann Algebras 4 Units
Terms offered: Spring 2017, Spring 2014, Spring 2012
Basic theory of von Neumann algebras. Density theorems, topologies and normal maps, traces, comparison of projections, type classification, examples of factors. Additional topics, for example, Tomita Takasaki theory, subfactors, group actions, and noncommutative probability.
Von Neumann Algebras: Read More [+]
Rules & Requirements
Prerequisites: 206
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Von Neumann Algebras: Read Less [-]

MATH 212 Several Complex Variables 4 Units
Terms offered: Spring 2016, Fall 2014, Spring 2012
Power series developments, domains of holomorphy, Hartogs’ phenomenon, pseudo convexity and plurisubharmonicity. The remainder of the course may treat either sheaf cohomology and Stein manifolds, or the theory of analytic subvarieties and spaces.
Several Complex Variables: Read More [+]
Rules & Requirements
Prerequisites: 185 and 202A-202B or their equivalents
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Several Complex Variables: Read Less [-]

MATH 214 Differentiable Manifolds 4 Units
Terms offered: Fall 2017, Spring 2017, Fall 2015
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. Additional topics selected by instructor.
Differentiable Manifolds: Read More [+]
Rules & Requirements
Prerequisites: 202A
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Differentiable Manifolds: Read Less [-]

MATH 215A Algebraic Topology 4 Units
Terms offered: Fall 2017, Spring 2017, Fall 2015
Fundamental group and covering spaces, simplicial and singular homology theory with applications, cohomology theory, duality theorem. Homotopy theory, fibrations, relations between homotopy and homology, obstruction theory, and topics from spectral sequences, cohomology operations, and characteristic classes. Sequence begins fall.
Algebraic Topology: Read More [+]
Rules & Requirements
Prerequisites: 113 and point-set topology (e.g. 202A)
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructors: 113C, 202A, and 214
Algebraic Topology: Read Less [-]
MATH 215B Algebraic Topology 4 Units
Terms offered: Spring 2016, Spring 2015, Spring 2014
Fundamental group and covering spaces, simplicial and singular homology theory with applications, cohomology theory, duality theorem. Homotopy theory, fibrations, relations between homotopy and homology, obstruction theory, and topics from spectral sequences, cohomology operations, and characteristic classes. Sequence begins fall.
Algebraic Topology: Read More [+]

Rules & Requirements
Prerequisites: 215A, 214 recommended (can be taken concurrently)

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructors: 113C, 202A, and 214

MATH C218A Probability Theory 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
The course is designed as a sequence with Statistics C205B/ Mathematics C218A with the following combined syllabus. Measure theory concepts needed for probability. Expectation, 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.
Probability Theory: Read More [+]

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Also listed as: STAT C205B

MATH C218B Probability Theory 4 Units
The course is designed as a sequence with with Statistics C205A/ Mathematics C218A with the following combined syllabus. Measure theory concepts needed for probability. Expectation, 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.
Probability Theory: Read More [+]

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Also listed as: STAT C205B

MATH 219 Dynamical Systems 4 Units
Terms offered: Spring 2018, Fall 2016, Spring 2015
Diffeomorphisms and flows on manifolds. Ergodic theory. Stable manifolds, generic properties, structural stability. Additional topics selected by the instructor.
Dynamical Systems: Read More [+]

Rules & Requirements
Prerequisites: 214

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Also listed as: STAT C205A
MATH 220 Introduction to Probabilistic Methods in Mathematics and the Sciences 4 Units
Terms offered: Spring 2012, Spring 2011, Spring 2010
Brownian motion, Langevin and Fokker-Planck equations, path integrals and Feynman diagrams, time series, an introduction to statistical mechanics, Monte Carlo methods, selected applications.
Introduction to Probabilistic Methods in Mathematics and the Sciences: Read More [+]

Rules & Requirements
Prerequisites: Some familiarity with differential equations and their applications

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.

MATH 221 Advanced Matrix Computations 4 Units
Terms offered: Spring 2018, Fall 2016, Spring 2016
Direct solution of linear systems, including large sparse systems: error bounds, iteration methods, least square approximation, eigenvalues and eigenvectors of matrices, nonlinear equations, and minimization of functions.
Advanced Matrix Computations: Read More [+]

Rules & Requirements
Prerequisites: Consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer: 8 weeks - 6 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Advanced Matrix Computations: Read Less [-]

MATH 222A Partial Differential Equations 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Partial Differential Equations: Read More [+]

Rules & Requirements
Prerequisites: 105 or 202A

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Partial Differential Equations: Read Less [-]

MATH 222B Partial Differential Equations 4 Units
The theory of boundary value and initial value problems for partial differential equations, with emphasis on nonlinear equations. Second-order elliptic equations, parabolic and hyperbolic equations, calculus of variations methods, additional topics selected by instructor.
Partial Differential Equations: Read More [+]

Rules & Requirements
Prerequisites: 105 or 202A

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Partial Differential Equations: Read Less [-]
MATH C223A Advanced Topics in Probability and Stochastic Process 3 Units
Terms offered: Fall 2016, Fall 2015, Fall 2014, Fall 2013
The topics of this course change each semester, and multiple sections may be offered. Advanced topics in probability offered according to students demand and faculty availability.
Rules & Requirements
Prerequisites: Statistics C205A-C205B or consent of instructor
Repeat rules: Course may be repeated for credit with instructor consent. Course may be repeated for credit when topic changes.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Also listed as: STAT C206A

Advanced Topics in Probability and Stochastic Process: Read More [+]

MATH C223B Advanced Topics in Probability and Stochastic Processes 3 Units
The topics of this course change each semester, and multiple sections may be offered. Advanced topics in probability offered according to students demand and faculty availability.
Rules & Requirements
Repeat rules: Course may be repeated for credit with instructor consent. Course may be repeated for credit when topic changes.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Also listed as: STAT C206A

Advanced Topics in Probability and Stochastic Processes: Read Less [-]

MATH 224A Mathematical Methods for the Physical Sciences 4 Units
Terms offered: Fall 2016, Fall 2014, Fall 2013
Rules & Requirements
Prerequisites: Graduate status or consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructors: 112 or 113C; 104A and 185, or 121A-121B-121C, or 120A-120B-120C.

Mathematical Methods for the Physical Sciences: Read Less [-]

MATH 224B Mathematical Methods for the Physical Sciences 4 Units
Terms offered: Spring 2015, Spring 2014, Spring 2013
Rules & Requirements
Prerequisites: Graduate status or consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.

Mathematical Methods for the Physical Sciences: Read Less [-]
MATH 225A Metamathematics 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015

MATH 227A Theory of Recursive Functions 4 Units
Terms offered: Fall 2015, Fall 2013, Spring 2012
Recursive and recursively enumerable sets of natural numbers; characterizations, significance, and classification. Relativization, degrees of unsolvability. The recursion theorem. Constructive ordinals, the hyperarithmetical and analytical hierarchies. Recursive objects of higher type. Sequence begins fall.

MATH 225B Metamathematics 4 Units

MATH 228A Numerical Solution of Differential Equations 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015

Rules & Requirements
Prerequisites: 125B and 135

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructor: 125B and 135.

Rules & Requirements
Prerequisites: Mathematics <BR/>225B

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructor: 225C.

Rules & Requirements
Prerequisites: 128A

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructor: 128A-128B.
MATH 228B Numerical Solution of Differential Equations 4 Units
Numerical Solution of Differential Equations: Read More [+]
Rules & Requirements
Prerequisites: 128A
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructor: 128A-128B.
Numerical Solution of Differential Equations: Read Less [-]

MATH 229 Theory of Models 4 Units
Terms offered: Spring 2015, Spring 2013, Spring 2012
Syntactical characterization of classes closed under algebraic operations. Ultraproducts and ultralimits, saturated models. Methods for establishing decidability and completeness. Model theory of various languages richer than first-order.
Theory of Models: Read More [+]
Rules & Requirements
Prerequisites: 225B
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructor: 125A and 135.
Theory of Models: Read Less [-]

MATH 235A Theory of Sets 4 Units
Terms offered: Spring 2014, Fall 2011, Spring 2008
Theory of Sets: Read More [+]
Rules & Requirements
Prerequisites: 125A and 135
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructor: 125A and 135.
Theory of Sets: Read Less [-]

MATH 236 Metamathematics of Set Theory 4 Units
Terms offered: Fall 2014, Fall 2010, Spring 2009
Various set theories: comparison of strength, transitive, and natural models, finite axiomatizability. Independence and consistency of axiom of choice, continuum hypothesis, etc. The measure problem and axioms of strong infinity.
Metamathematics of Set Theory: Read More [+]
Rules & Requirements
Prerequisites: 225B and 235A
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Metamathematics of Set Theory: Read Less [-]
MATH 239 Discrete Mathematics for the Life Sciences 4 Units
Terms offered: Spring 2011, Fall 2008, Spring 2008
Introduction to algebraic statistics and probability, optimization, phylogenetic combinatorics, graphs and networks, polyhedral and metric geometry.
Discrete Mathematics for the Life Sciences: Read More [+]
Rules & Requirements
Prerequisites: Statistics 134 or equivalent introductory probability theory course, or consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Discrete Mathematics for the Life Sciences: Read Less [-]

MATH C239 Discrete Mathematics for the Life Sciences 4 Units
Terms offered: Spring 2013
Introduction to algebraic statistics and probability, optimization, phylogenetic combinatorics, graphs and networks, polyhedral and metric geometry.
Discrete Mathematics for the Life Sciences: Read More [+]
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Discrete Mathematics for the Life Sciences: Read Less [-]

MATH 240 Riemannian Geometry 4 Units
Terms offered: Fall 2016, Fall 2015, Fall 2014
Riemannian metric and Levi-Civita connection, geodesics and completeness, curvature, first and second variations of arc length. Additional topics such as the theorems of Myers, Synge, and Cartan-Hadamard, the second fundamental form, convexity and rigidity of hypersurfaces in Euclidean space, homogeneous manifolds, the Gauss-Bonnet theorem, and characteristic classes.
Riemannian Geometry: Read More [+]
Rules & Requirements
Prerequisites: 214
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Riemannian Geometry: Read Less [-]

MATH 241 Complex Manifolds 4 Units
Terms offered: Fall 2017, Fall 2014, Spring 2013
Riemann surfaces, divisors and line bundles on Riemann surfaces, sheaves and the Dolbeault theorem on Riemann surfaces, the classical Riemann-Roch theorem, theorem of Abel-Jacobi. Complex manifolds, Kahler metrics. Summary of Hodge theory, groups of line bundles, additional topics such as Kodaira's vanishing theorem, Lefschetz hyperplane theorem.
Complex Manifolds: Read More [+]
Rules & Requirements
Prerequisites: 214 and 215A
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Complex Manifolds: Read Less [-]
MATH 242 Symplectic Geometry 4 Units
Terms offered: Fall 2017, Fall 2015, Spring 2014
Basic topics: symplectic linear algebra, symplectic manifolds, Darboux theorem, cotangent bundles, variational problems and Legendre transform, hamiltonian systems, Lagrangian submanifolds, Poisson brackets, symmetry groups and momentum mappings, coadjoint orbits, Kahler manifolds.
Symplectic Geometry: Read More [+]
Rules & Requirements
Prerequisites: 214

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Symplectic Geometry: Read Less [-]

MATH C243 Seq: Methods and Applications 3 Units
Terms offered: Spring 2015, Spring 2014
A graduate seminar class in which a group of students will closely examine recent computational methods in high-throughput sequencing followed by directly examining interesting biological applications thereof.
Seq: Methods and Applications: Read More [+]
Rules & Requirements
Prerequisites: Graduate standing in Math, MCB, and Computational Biology; or consent of the instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructor: Pachter
Also listed as: MCELLBI C243
Seq: Methods and Applications: Read Less [-]

MATH 245A General Theory of Algebraic Structures 4 Units
Terms offered: Fall 2017, Fall 2015, Spring 2014
Structures defined by operations and/or relations, and their homomorphisms. Classes of structures determined by identities. Constructions such as free objects, objects presented by generators and relations, ultraproducts, direct limits. Applications of general results to groups, rings, lattices, etc. Course may emphasize study of congruence- and subalgebra-lattices, or category-theory and adjoint functors, or other aspects.
General Theory of Algebraic Structures: Read More [+]
Rules & Requirements
Prerequisites: Math 113

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
General Theory of Algebraic Structures: Read Less [-]

MATH 249 Algebraic Combinatorics 4 Units
Terms offered: Fall 2017, Fall 2016, Spring 2015
(I) Enumeration, generating functions and exponential structures, (II) Posets and lattices, (III) Geometric combinatorics, (IV) Symmetric functions, Young tableaux, and connections with representation theory. Further study of applications of the core material and/or additional topics, chosen by instructor.
Algebraic Combinatorics: Read More [+]
Rules & Requirements
Prerequisites: 250A or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructor: Pachter
Also listed as: MCELLBI C243
Algebraic Combinatorics: Read Less [-]
MATH 250A Groups, Rings, and Fields 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Prerequisites: 114 or consent of instructor

MATH 250B Multilinear Algebra and Further Topics 4 Units
Prerequisites: 250A

MATH 251 Ring Theory 4 Units
Terms offered: Fall 2016, Spring 2013, Fall 2009
Topics such as: Noetherian rings, rings with descending chain condition, theory of the radical, homological methods.

MATH 252 Representation Theory 4 Units
Terms offered: Fall 2015, Fall 2014, Fall 2013
Structure of finite dimensional algebras, applications to representations of finite groups, the classical linear groups.

MATH 253 Homological Algebra 4 Units
Terms offered: Fall 2016, Fall 2014, Summer 2014 10 Week Session
Modules over a ring, homomorphisms and tensor products of modules, functors and derived functors, homological dimension of rings and modules.
MATH 254A Number Theory 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Valuations, units, and ideals in number fields, ramification theory, quadratic and cyclotomic fields, topics from class field theory, zeta-functions and L-series, distribution of primes, modular forms, quadratic forms, diophantine equations, P-adic analysis, and transcendental numbers. Sequence begins fall.
Number Theory: Read More [+]

Rules & Requirements

Prerequisites: 250A for 254A; 254A for 254B

Repeat rules: Course may be repeated for credit with instructor consent. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.

Instructor: 250A.

Number Theory: Read Less [-]

MATH 254B Number Theory 4 Units
Terms offered: Spring 2018, Spring 2017, Spring 2015
Valuations, units, and ideals in number fields, ramification theory, quadratic and cyclotomic fields, topics from class field theory, zeta-functions and L-series, distribution of primes, modular forms, quadratic forms, diophantine equations, P-adic analysis, and transcendental numbers. Sequence begins fall.
Number Theory: Read More [+]

Rules & Requirements

Prerequisites: 254A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.

Instructor: 250A.

Number Theory: Read Less [-]

MATH 255 Algebraic Curves 4 Units
Terms offered: Fall 2014, Fall 2011, Spring 2009
Elliptic curves. Algebraic curves, Riemann surfaces, and function fields. Singularities. Riemann-Roch theorem, Hurwitz's theorem, projective embeddings and the canonical curve. Zeta functions of curves over finite fields. Additional topics such as Jacobians or the Riemann hypothesis.

Algebraic Curves: Read More [+]

Rules & Requirements

Prerequisites: 250A-250B or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.

Algebraic Curves: Read Less [-]

MATH 256A Algebraic Geometry 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015

Algebraic Geometry: Read More [+]

Rules & Requirements

Prerequisites: 250A-250B for 256A; 256A for 256B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.

Instructor: 250A.

Algebraic Geometry: Read Less [-]
MATH 256B Algebraic Geometry 4 Units
Algebraic Geometry: Read More [+]

Rules & Requirements
Prerequisites: 256A

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructor: 250A.

MATH 257 Group Theory 4 Units
Terms offered: Spring 2018, Spring 2014, Fall 2011
Topics such as: generators and relations, infinite discrete groups, groups of Lie type, permutation groups, character theory, solvable groups, simple groups, transfer and cohomological methods.
Group Theory: Read More [+]

Rules & Requirements
Prerequisites: 250A

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructor: 250A.

MATH 258 Harmonic Analysis 4 Units
Terms offered: Fall 2016, Spring 2015, Spring 2012
Basic properties of Fourier series, convergence and summability, conjugate functions, Hardy spaces, boundary behavior of analytic and harmonic functions. Additional topics at the discretion of the instructor.
Harmonic Analysis: Read More [+]

Rules & Requirements
Prerequisites: 206 or a basic knowledge of real, complex, and linear analysis

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.

MATH 261A Lie Groups 4 Units
Terms offered: Spring 2017, Fall 2015, Fall 2013
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. Sequence begins Fall.
Lie Groups: Read More [+]

Rules & Requirements
Prerequisites: 214

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.
Instructor: 214.
MATH 261B Lie Groups 4 Units
Terms offered: Fall 2017, Spring 2016, Spring 2014
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. Sequence begins Fall.

MATH 265 Differential Topology 4 Units
Terms offered: Spring 2011, Fall 2008, Fall 2004
Approximations, degrees of maps, vector bundles, tubular neighborhoods. Introduction to Morse theory, handlebodies, cobordism, surgery. Additional topics selected by instructor from: characteristic classes, classification of manifolds, immersions, embeddings, singularities of maps.

MATH 266 Topics in Numerical Analysis 4 Units
Terms offered: Spring 2016, Spring 2014
Advanced topics chosen by the instructor. The content of this course changes, as in the case of seminars.

MATH 270 Hot Topics Course in Mathematics 2 Units
Terms offered: Spring 2018, Fall 2017, Spring 2017
This course will give introductions to current research developments. Every semester we will pick a different topic and go through the relevant literature. Each student will be expected to give one presentation.

MATH 273 Topics in Numerical Analysis 4 Units
Terms offered: Spring 2016, Spring 2014
Advanced topics chosen by the instructor. The content of this course changes, as in the case of seminars.

MATH 274 Topics in Algebra 4 Units  
Terms offered: Spring 2018, Spring 2017, Fall 2016  
Advanced topics chosen by the instructor. The content of this course changes, as in the case of seminars.  
Topics in Algebra: Read More [+]

Rules & Requirements

Prerequisites: Consent of instructor  
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.

Topics in Algebra: Read Less [-]

MATH 275 Topics in Applied Mathematics 4 Units  
Terms offered: Spring 2017, Spring 2014, Fall 2013  
Advanced topics chosen by the instructor. The content of this course changes, as in the case of seminars.  
Topics in Applied Mathematics: Read More [+]

Rules & Requirements

Prerequisites: Consent of instructor  
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.

Topics in Applied Mathematics: Read Less [-]

MATH 276 Topics in Topology 4 Units  
Terms offered: Fall 2017, Spring 2016, Spring 2015  
Advanced topics chosen by the instructor. The content of this course changes, as in the case of seminars.  
Topics in Topology: Read More [+]

Rules & Requirements

Prerequisites: Consent of instructor  
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.

Topics in Topology: Read Less [-]

MATH 277 Topics in Differential Geometry 4 Units  
Advanced topics chosen by the instructor. The content of this course changes, as in the case of seminars.  
Topics in Differential Geometry: Read More [+]

Rules & Requirements

Prerequisites: Consent of instructor  
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Mathematics/Graduate

Grading: Letter grade.

Topics in Differential Geometry: Read Less [-]
**MATH 278 Topics in Analysis 4 Units**
Terms offered: Spring 2018, Fall 2015, Spring 2015
Advanced topics chosen by the instructor. The content of this course changes, as in the case of seminars.
Topics in Analysis: Read More [+]

**Rules & Requirements**
Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.

Topics in Analysis: Read Less [-]

**MATH 279 Topics in Partial Differential Equations 4 Units**
Terms offered: Fall 2017, Spring 2017, Spring 2016
Advanced topics chosen by the instructor. The content of this course changes, as in the case of seminars.
Topics in Partial Differential Equations: Read More [+]

**Rules & Requirements**
Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.

Topics in Partial Differential Equations: Read Less [-]

**MATH 290 Seminars 1 - 6 Units**
Terms offered: Spring 2017, Spring 2015, Fall 2014
Topics in foundations of mathematics, theory of numbers, numerical calculations, analysis, geometry, topology, algebra, and their applications, by means of lectures and informal conferences; work based largely on original memoirs.

Seminars: Read More [+]

**Rules & Requirements**
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 0 hours of seminar per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: Letter grade.

Seminars: Read Less [-]

**MATH 295 Individual Research 1 - 12 Units**
Terms offered: Summer 2016 10 Week Session, Spring 2016, Fall 2015
Intended for candidates for the Ph.D. degree.

Individual Research: Read More [+]

**Rules & Requirements**
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-12 hours of independent study per week

Summer:
3 weeks - 5 hours of independent study per week
6 weeks - 2.5-30 hours of independent study per week
8 weeks - 1.5-60 hours of independent study per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: The grading option will be decided by the instructor when the class is offered.

Individual Research: Read Less [-]
MATH 299 Reading Course for Graduate Students 1 - 6 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Investigation of special problems under the direction of members of the department.
Reading Course for Graduate Students: Read More [+]

Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 0 hours of independent study per week
Summer: 6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details
Subject/Course Level: Mathematics/Graduate
Grading: The grading option will be decided by the instructor when the class is offered.

Reading Course for Graduate Students: Read Less [-]

MATH 301 Undergraduate Mathematics Instruction 1 - 2 Units
Terms offered: Spring 2018, Fall 2017, Spring 2017
May be taken for one unit by special permission of instructor. Tutoring at the Student Learning Center or for the Professional Development Program.
Undergraduate Mathematics Instruction: Read More [+]

Rules & Requirements
Prerequisites: Permission of SLC instructor, as well as sophomore standing and at least a B average in two semesters of calculus. Apply at Student Learning Center
Repeat rules: Course may be repeated for credit up to a total of 4 units. Course may be repeated for a maximum of 4 units.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of seminar and 4 hours of tutorial per week

Additional Details
Subject/Course Level: Mathematics/Professional course for teachers or prospective teachers
Grading: Offered for pass/not pass grade only.
Undergraduate Mathematics Instruction: Read Less [-]
MATH 375 Teaching Workshop 4 Units
Terms offered: Spring 2018, Fall 2017, Spring 2017
Mandatory for all graduate student instructors teaching for the first time in the Mathematics Department. The course consists of practice teaching, alternatives to standard classroom methods, guided group and self-analysis of videotapes, reciprocal classroom visitations, and an individual project.

Teaching Workshop: Read More [+]

Rules & Requirements
Prerequisites: 300, graduate standing and appointment as a Graduate Student Instructor

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details
Subject/Course Level: Mathematics/Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

Formerly known as: Mathematics 300

Teaching Workshop: Read Less [-]

MATH 600 Individual Study for Master's Students 1 - 6 Units
Terms offered: Summer 2006 10 Week Session, Fall 2005, Spring 2005
Individual study for the comprehensive or language requirements in consultation with the field adviser.

Individual Study for Master's Students: Read More [+]

Rules & Requirements
Prerequisites: For candidates for master's degree

Credit Restrictions: Course does not satisfy unit or residence requirements for master's degree.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-6 hours of independent study per week
Summer: 8 weeks - 1.5-10 hours of independent study per week

Additional Details
Subject/Course Level: Mathematics/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.

Individual Study for Master's Students: Read Less [-]

MATH 602 Individual Study for Doctoral Students 1 - 8 Units
Terms offered: Fall 2016, Fall 2015, Spring 2015
Individual study in consultation with the major field adviser intended to provide an opportunity for qualified students to prepare themselves for the various examinations required for candidates for the Ph.D. Course does not satisfy unit or residence requirements for doctoral degree.

Individual Study for Doctoral Students: Read More [+]

Rules & Requirements
Prerequisites: For qualified graduate students

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-8 hours of independent study per week

Additional Details
Subject/Course Level: Mathematics/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.

Individual Study for Doctoral Students: Read Less [-]