Mathematics (MATH)

Courses

MATH 1A. Pre-Calculus I. 4 Workload Units.
Basic equations and inequalities, linear and quadratic functions, and systems of simultaneous equations.

Grading Option: Workload Credit Letter Grade with P/NP.

MATH 1B. Pre-Calculus II. 4 Units.
Preparation for calculus and other mathematics courses. Exponentials, logarithms, trigonometry, polynomials, and rational functions. Satisfies no requirements other than contribution to the 180 units required for graduation.

Prerequisite: Recommended: A passing score on the Pre-Calculus Self-Assessment exam, or a score of 450 or higher on the Mathematics section of the SAT Reasoning Test. Not for students with a score of 3 or higher on the AP Calc AB exam. Not for students with a score of 3 or higher on the AP Calc BC exam.

Restriction: MATH 1B may not be taken for credit if taken after MATH 2A.

MATH 2A. Single-Variable Calculus I. 4 Units.
Introduction to derivatives, calculation of derivatives of algebraic and trigonometric functions; applications including curve sketching, related rates, and optimization. Exponential and logarithm functions.

Prerequisite: MATH 1B or SAT Mathematics or ACT Mathematics. MATH 1B with a grade of C- or better. SAT Mathematics with a minimum score of 650. ACT Mathematics with a minimum score of 29. Placement via the Calculus Placement exam (fee required) is also accepted.

Overlaps with MATH 5A, MATH 7A.

Restriction: School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. School of Info & Computer Sci students have first consideration for enrollment.

(Vb)

MATH 2B. Single-Variable Calculus II. 4 Units.
Definite integrals; the fundamental theorem of calculus. Applications of integration including finding areas and volumes. Techniques of integration. Infinite sequences and series.

Prerequisite: MATH 2A or MATH 5A or MATH 7A or AP Calculus AB or AP Calculus BC. AP Calculus AB with a minimum score of 3. AP Calculus BC with a minimum score of 3

Overlaps with MATH 7B.

Restriction: School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. School of Info & Computer Sci students have first consideration for enrollment.

(Vb)

MATH 2D. Multivariable Calculus I. 4 Units.
Differential and integral calculus of real-valued functions of several real variables, including applications. Polar coordinates.

Prerequisite: MATH 2B or MATH 5B or MATH 7B or AP Calculus BC. AP Calculus BC with a minimum score of 4

Overlaps with MATH H2D.

Restriction: School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment. School of Info & Computer Sci students have first consideration for enrollment. Undeclared Majors have first consideration for enrollment.

(Vb)

MATH 2E. Multivariable Calculus II. 4 Units.
The differential and integral calculus of vector-valued functions. Implicit and inverse function theorems. Line and surface integrals, divergence and curl, theorems of Greens, Gauss, and Stokes.

Prerequisite: MATH 2D or MATH H2D

Restriction: School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment.

MATH H2D. Honors Multivariable Calculus I. 4 Units.
Differential and integral calculus of real-valued functions of several real variables, including applications. Polar coordinates. Covers the same material as MATH 2D-E, but with a greater emphasis on the theoretical structure of the subject matter.

Prerequisite: MATH 2B or MATH 5B or MATH 7B or (AP Calculus BC and (MATH H3A or MATH 3A)). MATH 2B with a grade of A or better. MATH 5B with a grade of A or better. MATH 7B with a grade of A or better. AP Calculus BC with a minimum score of 5. MATH H3A with a grade of B- or better. MATH 3A with a grade of A or better

Overlaps with MATH 2D.

(Vb)

MATH H2E. Honors Multivariable Calculus II. 4 Units.
Differential and integral calculus of real-valued functions of several real variables, including applications. Polar coordinates. Covers the same material as MATH 2D-E, but with a greater emphasis on the theoretical structure of the subject matter.

Prerequisite: MATH H2D. MATH H2D with a grade of B- or better

Overlaps with MATH 2E.

MATH 3A. Introduction to Linear Algebra. 4 Units.
Systems of linear equations, matrix operations, determinants, eigenvalues and eigenvectors, vector spaces, subspaces, and dimension.

Prerequisite: MATH 2B or MATH 5B or MATH 7B or AP Calculus BC. AP Calculus BC with a minimum score of 4

Overlaps with I&C SCI 6N, MATH H3A.

Restriction: Undeclared Majors have first consideration for enrollment. School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment.

(Vb)

MATH 3D. Elementary Differential Equations. 4 Units.
Linear differential equations, variation of parameters, constant coefficient cookbook, systems of equations, Laplace transforms, series solutions.

Prerequisite: (MATH 3A or MATH H3A) and (MATH 2D or MATH H2D)

Restriction: School of Physical Sciences students have first consideration for enrollment. School of Engineering students have first consideration for enrollment.

MATH H3A. Honors Introduction to Linear Algebra. 4 Units.
Systems of linear equations, matrix operations, determinants, eigenvalues, eigenvectors, vector spaces, subspaces, and dimension.

Prerequisite: MATH 2B or MATH 5B or MATH 7B or AP Calculus BC. MATH 2B with a grade of A or better. MATH 5B with a grade of A or better. MATH 7B with a grade of A or better. AP Calculus BC with a minimum score of 5

Overlaps with MATH 3A, I&C SCI 6N.

Restriction: School of Physical Sciences students only. School of Engineering students only. Mathematics Majors only. Undeclared Majors only.

MATH 5A. Calculus for Life Sciences I. 4 Units.
Differential calculus with applications to life sciences. Exponential, logarithmic, and trigonometric functions. Limits, differentiation techniques, optimization and difference equations.

Prerequisite: MATH 1B or SAT Mathematics or ACT Mathematics. MATH 1B with a grade of C- or better. SAT Mathematics with a minimum score of 650. ACT Mathematics with a minimum score of 29. Placement via the Calculus Placement exam (fee required) is also accepted.

Overlaps with MATH 2A, MATH 7A.

Restriction: School of Biological Sciences students have first consideration for enrollment.

(Vb)

MATH 5B. Calculus for Life Sciences II. 4 Units.
Integral calculus and multivariable calculus with applications to life sciences. Integration techniques, applications of the integral, phase plane methods and basic modeling, basic multivariable methods.

Prerequisite: MATH 5A or MATH 2A or MATH 7A or AP Calculus AB or AP Calculus BC. AP Calculus AB with a minimum score of 3. AP Calculus BC with a minimum score of 3

Restriction: School of Biological Sciences students have first consideration for enrollment. Cannot be taken for credit after MATH 2B.

(Vb)

MATH 8. Explorations in Functions and Modeling. 4 Units.
Explorations of applications and connections in topics in algebra, geometry, calculus, and statistics for future secondary math educators. Emphasis on nonstandard modeling problems.

Corequisite: MATH 2A or MATH 5A or MATH 7A
Prerequisite: MATH 2A or MATH 5A or MATH 7A or AP Calculus AB or AP Calculus BC. AP Calculus AB with a minimum score of 3. AP Calculus BC with a minimum score of 3

MATH 9. Introduction to Programming for Numerical Analysis. 4 Units.
Introduction to computers and programming using Matlab and Python. Representation of numbers and precision, input/output, functions, custom data types, testing/debugging, reading exceptions, plotting data, numerical differentiation, basics of algorithms. Analysis of random processes using computer simulations.

Prerequisite: MATH 2A or MATH 5A or MATH 7A or AP Calculus AB or AP Calculus BC. AP Calculus AB with a minimum score of 3. AP Calculus BC with a minimum score of 3

Restriction: Mathematics Majors have first consideration for enrollment.

(II and Vb).

MATH 10. Introduction to Programming for Data Science. 4 Units.
Introduction to Python for data science. Selecting appropriate data types; functions and methods; plotting; the libraries NumPy, pandas, scikit-learn. Foundations of machine learning.

Corequisite: (MATH 2D or MATH H2D) and (MATH 3A or MATH H3A)
Prerequisite: (MATH 2D or MATH H2D) and (MATH 3A or MATH H3A) and MATH 9

Restriction: Mathematics Majors have first consideration for enrollment.

(II and VB).

MATH 13. Introduction to Abstract Mathematics. 4 Units.
Introduction to formal definition and rigorous proof writing in mathematics. Topics include basic logic, set theory, equivalence relations, and various proof techniques such as direct, induction, contradiction, contrapositive, and exhaustion.

Prerequisite: MATH 2A or MATH 5A or MATH 7A or I&C SCI 6D or AP Calculus AB or AP Calculus BC. AP Calculus AB with a minimum score of 3. AP Calculus BC with a minimum score of 3

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 99. New Math Major Seminar for First-Year and Transfer Students. 1 Unit.
A series of presentations and activities to help first-year and transfer students transition to the UCI mathematics majors. Presentations are given by faculty, current students, and school staff to ensure that students make the most of the math major.

Grading Option: Pass/no pass only.

Restriction: New math majors only, including transfer students majoring in math.

MATH 105A. Numerical Analysis I. 4 Units.
Introduction to the theory and practice of numerical computation with an emphasis on solving equations. Solving transcendental equations; linear systems, Gaussian elimination, QR factorization, iterative methods, eigenvalue computation, power method.

Corequisite: MATH 105LA
Prerequisite: (MATH 3A or MATH H3A) and MATH 9

Overlaps with ENGRMAE 185.

MATH 105B. Numerical Analysis II. 4 Units.
Introduction to the theory and practice of numerical computation with an emphasis on topics from calculus and approximation theory. Lagrange interpolation; Gaussian quadrature; Fourier series and transforms; Methods from data science including least squares and L1 regression.

Corequisite: MATH 105LB
Prerequisite: MATH 105A

MATH 105LA. Numerical Analysis Laboratory. 1 Unit.
Provides practical experience to complement the theory developed in Mathematics 105A.

Corequisite: MATH 105A

MATH 105LB. Numerical Analysis Laboratory. 1 Unit.
Provides practical experience to complement the theory developed in Mathematics 105B.

Corequisite: MATH 105B

MATH 107. Numerical Differential Equations. 4 Units.
Theory and applications of numerical methods to initial and boundary-value problems for ordinary and partial differential equations.

Corequisite: MATH 107L
Prerequisite: MATH 3D and MATH 105B

MATH 107L. Numerical Differential Equations Laboratory. 1 Unit.
Provides practical experience to complement the theory developed in Mathematics 107.

Corequisite: MATH 107

MATH 110A. Optimization I. 4 Units.
Introduction to optimization, linear search method, trust region method, Newton method, linear programming, linear, and non-linear least square methods.

Corequisite: MATH 121B
Prerequisite: (MATH 2D or MATH H2D) and MATH 10 and MATH 121B

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 110B. Optimization II. 4 Units.
The simplex method, interior point method, penalty barrier method, primal dual method, augmented Lagrangian method, and stochastic gradient method.

Prerequisite: MATH 110A. MATH 110A with a grade of C- or better

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 112A. Introduction to Partial Differential Equations and Applications I. 4 Units.
Introduction to ordinary and partial differential equations and their applications in engineering and science. Basic methods for classical PDEs (potential, heat, and wave equations). Classification of PDEs, separation of variables and series expansions, special functions, eigenvalue problems.

Prerequisite: (MATH 2E or MATH H2E) and MATH 3D

MATH 112B. Introduction to Partial Differential Equations and Applications II. 4 Units.
Introduction to partial differential equations and their applications in engineering and science. Basic methods for classical PDEs (potential, heat, and wave equations). Green functions and integral representations, method of characteristics.

Prerequisite: MATH 112A

MATH 112C. Introduction to Partial Differential Equations and Applications III. 4 Units.
Nonhomogeneous problems and Green's functions, Sturm-Liouville theory, general Fourier expansions, applications of partial differential equations in different areas of science.

Prerequisite: MATH 112B

MATH 113A. Mathematical Modeling in Biology I. 4 Units.
Discrete mathematical and statistical models; difference equations, population dynamics, Markov chains, and statistical models in biology.

Prerequisite: MATH 2B or MATH 5B or MATH 7B or AP Calculus BC. AP Calculus BC with a minimum score of 4

MATH 113B. Mathematical Modeling in Biology II. 4 Units.
Linear algebra; differential equations models; dynamical systems; stability; hysteresis; phase plane analysis; applications to cell biology, viral dynamics, and infectious diseases.

Prerequisite: MATH 113A

MATH 115. Mathematical Modeling. 4 Units.
Mathematical modeling and analysis of phenomena that arise in engineering physical sciences, biology, economics, or social sciences.

Prerequisite: MATH 112A

MATH 117. Dynamical Systems. 4 Units.
Introduction to the modern theory of dynamical systems including contraction mapping principle, fractals and chaos, conservative systems, Kepler problem, billiard models, expanding maps, Smale's horseshoe, topological entropy.

Prerequisite: MATH 3D and MATH 140A

MATH 118. The Theory of Differential Equations. 4 Units.
Existence and uniqueness of solutions, continuous dependence of solutions on initial conditions and parameters, Lyapunov and asymptotic stability, Floquet theory, nonlinear systems, and bifurcations.

Prerequisite: MATH 3D and MATH 140A

MATH 120A. Introduction to Abstract Algebra: Groups. 4 Units.
Axioms for group theory; permutation groups, matrix groups. Isomorphisms, homomorphisms, quotient groups. Advanced topics as time permits. Special emphasis on doing proofs.

Prerequisite: (MATH 3A or MATH H3A) and MATH 13. MATH 13 with a grade of C- or better

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 120B. Introduction to Abstract Algebra: Rings and Fields. 4 Units.
Basic properties of rings; ideals, quotient rings; polynomial and matrix rings. Elements of field theory.

Prerequisite: MATH 120A. MATH 120A with a grade of C- or better

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 120C. Introduction to Abstract Algebra: Galois Theory. 4 Units.
Galois Theory: proof of the impossibility of certain ruler-and-compass constructions (squaring the circle, trisecting angles); nonexistence of analogues to the "quadratic formula" for polynomial equations of degree 5 or higher.

Prerequisite: MATH 120B

MATH H120A. Honors Introduction to Graduate Algebra I. 5 Units.
Introduction to abstract linear algebra, including bases, linear transformation, eigenvectors, canonical forms, inner products, and symmetric operators. Introduction to groups, rings, and fields, including examples of groups, group actions, Sylow theorems, modules over principal ideal domains, polynomials, and Galois groups.

Prerequisite: (MATH 3A or MATH H3A) and MATH 13 and (MATH 120A or MATH 121A). MATH 13 with a grade of A or better. MATH 120A with a grade of A or better. MATH 121A with a grade of A or better

Restriction: Mathematics Honors students only.

Concurrent with MATH 206A.

MATH H120B. Honors Introduction to Graduate Algebra II. 5 Units.
Introduction to abstract linear algebra, including bases, linear transformation, eigenvectors, canonical forms, inner products, and symmetric operators. Introduction to groups, rings, and fields, including examples of groups, group actions, Sylow theorems, modules over principal ideal domains, polynomials, and Galois groups.

Prerequisite: MATH H120A

Restriction: Mathematics Honors students only.

Concurrent with MATH 206B.

MATH H120C. Honors Introduction to Graduate Algebra III. 5 Units.
Introduction to abstract linear algebra, including bases, linear transformation, eigenvectors, canonical forms, inner products, and symmetric operators. Introduction to groups, rings, and fields, including examples of groups, group actions, Sylow theorems, modules over principal ideal domains, polynomials, and Galois groups.

Prerequisite: MATH H120B

Restriction: Mathematics Honors students only.

Concurrent with MATH 206C.

MATH 121A. Linear Algebra I. 4 Units.
Introduction to modern abstract linear algebra. Special emphasis on students doing proofs. Vector spaces, linear independence, bases, dimension. Linear transformations and their matrix representations. Theory of determinants.

Prerequisite: (MATH 3A or MATH H3A) and MATH 13. MATH 13 with a grade of C- or better

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 121B. Linear Algebra II. 4 Units.
Introduction to modern abstract linear algebra. Special emphasis on students doing proofs. Canonical forms; inner products; similarity of matrices.

Prerequisite: MATH 121A. MATH 121A with a grade of C- or better

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 130A. Probability I. 4 Units.
Combinatorial probability, conditional probabilities, independence, discrete and continuous random variables, expectation and variance, common probability distributions.

Prerequisite: MATH 3A or MATH H3A

MATH 130B. Probability II. 4 Units.
Joint distributions, sums of independent random variables, conditional distributions and conditional expectation, covariances, moment generating functions, limit theorems.

Prerequisite: MATH 130A or STATS 120A

MATH 130C. Stochastic Processes. 4 Units.
Markov chains, Brownian motion, Gaussian processes, applications to option pricing and Markov chain Monte Carlo methods.

Prerequisite: MATH 130B

MATH 134A. Fixed Income. 4 Units.
Overview of interest theory, time value of money, annuities/cash flows with payments that are not contingent, loans, sinking funds, bonds, general cash flow and portfolios, immunization, duration and convexity, swaps.

Prerequisite: MATH 130A or STATS 120A

Overlaps with MATH 133C.

MATH 134B. Mathematics of Financial Derivatives. 4 Units.
General derivatives; call/put options; hedging and investment strategies: spreads and collars; risk management; forwards and futures; bonds.

Prerequisite: MATH 130A. MATH 130A with a grade of C- or better

Overlaps with MATH 133A.

MATH 134C. Mathematical Models for Finance. 4 Units.
General properties of options: option contracts (call and put options, European, American and exotic options); binomial option pricing model, Black-Scholes option pricing model; risk-neutral pricing formula using Monte-Carlo simulation; option greeks and risk management; interest rate derivatives, Markowitz portfolio theory.

Prerequisite: MATH 134B or MATH 133A

Overlaps with MATH 133B.

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 140A. Elementary Analysis I. 4 Units.
Introduction to real analysis, including convergence of sequence, infinite series, differentiation and integration, and sequences of functions. Students are expected to do proofs.

Prerequisite: (MATH 2D or MATH H2D) and (MATH 3A or MATH H3A) and MATH 13. MATH 13 with a grade of C- or better

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 140B. Elementary Analysis II. 4 Units.
Introduction to real analysis including convergence of sequences, infinite series, differentiation and integration, and sequences of functions. Students are expected to do proofs.

Prerequisite: MATH 140A. MATH 140A with a grade of C- or better

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 140C. Analysis in Several Variables . 4 Units.
Rigorous treatment of multivariable differential calculus. Jacobians, Inverse and Implicit Function theorems.

Prerequisite: MATH 140B

MATH H140A. Honors Introduction to Graduate Analysis I. 5 Units.
Construction of the real number system, topology of the real line, concepts of continuity, differential and integral calculus, sequences and series of functions, equicontinuity, metric spaces, multivariable differential and integral calculus, implicit functions, curves and surfaces.

Prerequisite: (MATH 2E or MATH H2E) and (MATH 3A or MATH H3A) and MATH 13 and MATH 121A and MATH 140A. MATH 2E with a grade of A or better. MATH H2E with a grade of A or better. MATH 13 with a grade of A or better. MATH 121A with a grade of A or better. MATH 140A with a grade of A or better

Concurrent with MATH 205A.

MATH H140B. Honors Introduction to Graduate Analysis II. 5 Units.
Construction of the real number system, topology of the real line, concepts of continuity, differential and integral calculus, sequences and series of functions, equicontinuity, metric spaces, multivariable differential and integral calculus, implicit functions, curves and surfaces.

Prerequisite: MATH H140A. MATH H140A with a grade of C- or better

Concurrent with MATH 205B.

MATH H140C. Honors Introduction to Graduate Analysis III. 5 Units.
Construction of the real number system; topology of the real line; concepts of continuity, differential, and integral calculus; sequences and series of functions, equicontinuity, metric spaces, multivariable differential, and integral calculus; implicit functions, curves and surfaces.

Prerequisite: MATH H140B. MATH H140B with a grade of C- or better

Concurrent with MATH 205C.

MATH 141. Introduction to Topology. 4 Units.
The elements of naive set theory and the basic properties of metric spaces. Introduction to topological properties.

Prerequisite: MATH 140A

MATH 147. Complex Analysis. 4 Units.
Rigorous treatment of basic complex analysis: analytic functions, Cauchy integral theory and its consequences, power series, residue calculus, harmonic functions, conformal mapping. Students are expected to do proofs.

Prerequisite or corequisite: MATH 140B

MATH 150. Introduction to Mathematical Logic. 4 Units.
First order logic through the Completeness Theorem for predicate logic.

Prerequisite: MATH 13 or (I&C SCI 6B and I&C SCI 6D). MATH 13 with a grade of C- or better. I&C SCI 6B with a grade of C- or better. I&C SCI 6D with a grade of C- or better

Overlaps with LPS 105B, PHILOS 105B.

MATH 161. Modern Geometry. 4 Units.
Euclidean Geometry; Hilbert's Axioms; Absolute Geometry; Hyperbolic Geometry; the Poincare Models; and Geometric Transformations.

Prerequisite: MATH 13 or (I&C SCI 6B and I&C SCI 6D). MATH 13 with a grade of C- or better. I&C SCI 6B with a grade of C- or better. I&C SCI 6D with a grade of C- or better

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 162A. Introduction to Differential Geometry I. 4 Units.
Applications of advanced calculus and linear algebra to the geometry of curves and surfaces in space.

Prerequisite: (MATH 2E or MATH H2E) and MATH 3D

MATH 162B. Introduction to Differential Geometry II. 4 Units.
Applications of advanced calculus and linear algebra to the geometry of curves and surfaces in space.

Prerequisite: MATH 162A. MATH 162A with a grade of C- or better

MATH 173A. Introduction to Cryptology I. 4 Units.
Introduction to some of the mathematics used in the making and breaking of codes, with applications to classical ciphers and public key systems. Includes topics from number theory, probability, and abstract algebra.

Prerequisite: (MATH 2B or MATH 5B or MATH 7B or AP Calculus BC) and (MATH 3A or MATH H3A) and (MATH 13 or (I&C SCI 6B and I&C SCI 6D)). AP Calculus BC with a minimum score of 4

MATH 173B. Introduction to Cryptology II. 4 Units.
Introduction to some of the mathematics used in the making and breaking of codes, with applications to classical ciphers and public key systems. The mathematics covered includes topics from number theory, probability, and abstract algebra.

Prerequisite: MATH 173A

MATH 175. Combinatorics . 4 Units.
Introduction to combinatorics including basic counting principles, permutations, combinations, binomial coefficients, inclusion-exclusion, derangements, ordinary and exponential generating functions, recurrence relations, Catalan numbers, Stirling numbers, and partition numbers.

Prerequisite: (MATH 2B or MATH 5B or MATH 7B or AP Calculus BC) and MATH 13. AP Calculus BC with a minimum score of 4. MATH 13 with a grade of C- or better

MATH 176. Mathematics of Finance. 4 Units.
After reviewing tools from probability, statistics, and elementary differential and partial differential equations, concepts such as hedging, arbitrage, Puts, Calls, the design of portfolios, the derivation and solution of the Blac-Scholes, and other equations are discussed.

Prerequisite: MATH 3A or MATH H3A

Same as ECON 135.

Restriction: Business Economics Majors have first consideration for enrollment. Economics Majors have first consideration for enrollment. Quantitative Economics Majors have first consideration for enrollment. Mathematics Majors have first consideration for enrollment.

MATH 178. Mathematical Machine Learning. 6 Units.
Theoretical introduction to Mathematical Machine Learning. Mathematical foundations and coding implementations using Python libraries such as scikit-learn and Keras. Supervised and unsupervised learning; regression and classification; loss functions; overfitting and the bias-complexity tradeoff. Prominent algorithms in machine learning.

Prerequisite: MATH 10 and MATH 121A and MATH 140A

Overlaps with COMPSCI 178.

MATH 180A. Number Theory I. 4 Units.
Introduction to number theory and applications. Divisibility, prime numbers, factorization. Arithmetic functions. Congruences. Quadratic residue. Diophantine equations. Introduction to cryptography.

Prerequisite: (MATH 3A or MATH H3A) and MATH 13. MATH 13 with a grade of C- or better

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 180B. Number Theory II. 4 Units.
Introduction to number theory and applications. Analytic number theory, character sums, finite fields, discrete logarithm, computational complexity. Introduction to coding theory. Other topics as time permits.

Prerequisite: MATH 180A

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 184. History of Mathematics. 4 Units.
Topics vary from year to year. Some possible topics: mathematics in ancient times; the development of modern analysis; the evolution of geometric ideas. Students will be assigned individual topics for term papers.

Corequisite: MATH 184L
Prerequisite: MATH 120A and MATH 140A

Restriction: Mathematics Majors have first consideration for enrollment.

MATH 184L. History of Mathematics Lesson Lab. 1 Unit.
Aspiring math teachers research, design, present, and peer review middle school or high school math lessons that draw from history of mathematics topics.

Corequisite: MATH 184
Prerequisite: PHY SCI 5

MATH 192. Studies in the Learning and Teaching of Secondary Mathematics. 2 Units.
Focus is on historic and current mathematical concepts related to student learning and effective math pedagogy, with fieldwork in grades 6-14.

Grading Option: Pass/no pass only.

Repeatability: May be repeated for credit unlimited times.

MATH 194. Problem Solving Seminar. 2 Units.
Develops ability in analytical thinking and problem solving, using problems of the type found in the Mathematics Olympiad and the Putnam Mathematical Competition. Students taking the course in fall will prepare for and take the Putnam examination in December.

Grading Option: Pass/no pass only.

Repeatability: May be taken for credit 2 times.

MATH 195W. Mathematical Writing. 4 Units.
Techniques of mathematical writing and communication. Covers effectively writing mathematical papers, creating effective presentations, and communicating mathematics in a variety of media. Focuses on utilizing LaTeX for typesetting mathematics.

Prerequisite: MATH 120A or MATH 121A or MATH 140A. MATH 120A with a grade of C- or better. MATH 121A with a grade of C- or better. MATH 140A with a grade of C- or better. Satisfactory completion of the Lower-Division Writing requirement.

Restriction: Mathematics Majors have first consideration for enrollment.

(Ib)

MATH 199A. Special Studies in Mathematics. 1-4 Units.
Supervised reading. For outstanding undergraduate Mathematics majors in supervised but independent reading or research of mathematical topics.

Repeatability: Unlimited as topics vary.

MATH 199B. Special Studies in Mathematics. 1-4 Units.
Supervised reading. For outstanding undergraduate Mathematics majors in supervised but independent reading or research of mathematical topics.

Repeatability: Unlimited as topics vary.

MATH 199C. Special Studies in Mathematics. 1-4 Units.
Supervised reading. For outstanding undergraduate Mathematics majors in supervised but independent reading or research of mathematical topics.

Repeatability: Unlimited as topics vary.

MATH 205A. Introduction to Graduate Analysis. 5 Units.
Construction of the real number system, topology of the real line, concepts of continuity, differential and integral calculus, sequences and series of functions, equicontinuity, metric spaces, multivariable differential and integral calculus, implicit functions, curves and surfaces.

Prerequisite: Recommended: MATH 2E and MATH 3A and MATH 13, or equivalent.

Concurrent with MATH H140A.

MATH 205B. Introduction to Graduate Analysis. 5 Units.
Construction of the real number system, topology of the real line, concepts of continuity, differential and integral calculus, sequences and series of functions, equicontinuity, metric spaces, multivariable differential and integral calculus, implicit functions, curves and surfaces.

Prerequisite: MATH 205A. MATH 205A with a grade of B- or better

Concurrent with MATH H140B.

MATH 205C. Introduction to Graduate Analysis. 5 Units.
Construction of the real number system, topology of the real line, concepts of continuity, differential and integral calculus, sequences and series of functions, equicontinuity, metric spaces, multivariable differential and integral calculus, implicit functions, curves and surfaces.

Prerequisite: MATH 205B. MATH 205B with a grade of B- or better

Concurrent with MATH H140C.

MATH 210A. Real Analysis. 4 Units.
Measure theory, Lebesgue integral, signed measures, Radon-Nikodym theorem, functions of bounded variation and absolutely continuous functions, classical Banach spaces, Lp spaces, integration on locally compact spaces and the Riesz-Markov theorem, measure and outer measure, product measure spaces.

Prerequisite: Recommended: MATH 140C or equivalent.

MATH 210B. Real Analysis. 4 Units.
Measure theory, Lebesgue integral, signed measures, Radon-Nikodym theorem, functions of bounded variation and absolutely continuous functions, classical Banach spaces, Lp spaces, integration on locally compact spaces and the Riesz-Markov theorem, measure and outer measure, product measure spaces.

Prerequisite: MATH 210A. MATH 210A with a grade of B- or better

MATH 210C. Real Analysis. 4 Units.
Measure theory, Lebesgue integral, signed measures, Radon-Nikodym theorem, functions of bounded variation and absolutely continuous functions, classical Banach spaces, Lp spaces, integration on locally compact spaces and the Riesz-Markov theorem, measure and outer measure, product measure spaces.

Prerequisite: MATH 210B. MATH 210B with a grade of B- or better

MATH 211A. Topics in Analysis . 4 Units.
Studies in selected areas of Real Analysis, a continuation of MATH 210A-MATH 210B-MATH 210C. Topics addressed vary each quarter.

Prerequisite: Recommended: MATH 210C

MATH 218A. Introduction to Manifolds and Geometry. 4 Units.
General topology and fundamental groups, covering space; Stokes theorem on manifolds, selected topics on abstract manifold theory.

Prerequisite: Recommended: MATH 140C and MATH 121B, or equivalent.

MATH 218B. Introduction to Manifolds and Geometry. 4 Units.
General topology and fundamental groups, covering space; Stokes theorem on manifolds, selected topics on abstract manifold theory.

Prerequisite: MATH 218A. MATH 218A with a grade of B- or better

MATH 218C. Introduction to Manifolds and Geometry. 4 Units.
General topology and fundamental groups, covering space; Stokes theorem on manifolds, selected topics on abstract manifold theory.

Prerequisite: MATH 218B. MATH 218B with a grade of B- or better

MATH 220A. Analytic Function Theory. 4 Units.
Standard theorems about analytic functions. Harmonic functions. Normal families. Conformal mapping.

Prerequisite: Recommended: MATH 140C or equivalent.

MATH 220B. Analytic Function Theory. 4 Units.
Standard theorems about analytic functions. Harmonic functions. Normal families. Conformal mapping.

Prerequisite: MATH 220A. MATH 220A with a grade of B- or better

MATH 220C. Analytic Function Theory. 4 Units.
Standard theorems about analytic functions. Harmonic functions. Normal families. Conformal mapping.

Prerequisite: MATH 220B. MATH 220B with a grade of B- or better

MATH 222A. Several Complex Variables and Complex Geometry. 4 Units.
Several Complex variables, d-bar problems, mappings, Kaehler geometry, de Rham and Dolbeault Theorems, Chern Classes, Hodge Theorems, Calabi conjecture, Kahler-Einstein geometry, Monge-Ampere.

Prerequisite: MATH 220C. MATH 220C with a grade of B- or better

MATH 225A. Introduction to Numerical Analysis and Scientific Computing. 4 Units.
Introduction to fundamentals of numerical analysis from an advanced viewpoint. Error analysis, approximation of functions, nonlinear equations.

Prerequisite: Recommended: MATH 3D and MATH 105B and MATH 140A and MATH 121A and MATH 112A, or equivalent.

Restriction: Graduate students only.

MATH 225B. Introduction to Numerical Analysis and Scientific Computing. 4 Units.
Introduction to fundamentals of numerical analysis from an advanced viewpoint. Numerical linear algebra, numerical solutions of differential equations; stability.

Prerequisite: MATH 225A. MATH 225A with a grade of B- or better

Restriction: Graduate students only.

MATH 225C. Introduction to Numerical Analysis and Scientific Computing. 4 Units.
Introduction to fundamentals of numerical analysis from an advanced viewpoint. Numerical linear algebra, numerical solutions of differential equations; stability.

Prerequisite: Recommended: MATH 3D and MATH 105B and MATH 140A and MATH 121A and MATH 112A, or equivalent.

Restriction: Graduate students only.

MATH 226A. Computational Differential Equations. 4 Units.
Finite difference and finite element methods. Quick treatment of functional and nonlinear analysis background: weak solution, Lp spaces, Sobolev spaces. Approximation theory. Fourier and Petrov-Galerkin methods; mesh generation. Elliptic, parabolic, hyperbolic cases in 226A-B-C, respectively.

Prerequisite: Recommended: MATH 3D and MATH 112A and (MATH 140B or MATH 105B), or equivalent.

MATH 226B. Computational Differential Equations. 4 Units.
Finite difference and finite element methods. Quick treatment of functional and nonlinear analysis background: weak solution, Lp spaces, Sobolev spaces. Approximation theory. Fourier and Petrov-Galerkin methods; mesh generation. Elliptic, parabolic, hyperbolic cases in 226A-B-C, respectively.

Prerequisite: Recommended: MATH 3D and MATH 112A and (MATH 140B or MATH 105B), or equivalent.

MATH 226C. Computational Differential Equations. 4 Units.
Finite difference and finite element methods. Quick treatment of functional and nonlinear analysis background: weak solution, Lp spaces, Sobolev spaces. Approximation theory. Fourier and Petrov-Galerkin methods; mesh generation. Elliptic, parabolic, hyperbolic cases in 226A-B-C, respectively.

Prerequisite: Recommended: MATH 3D and MATH 112A and (MATH 140B or MATH 105B), or equivalent.

MATH 227A. Mathematical and Computational Biology. 4 Units.
Analytical and numerical methods for dynamical systems, temporal-spatial dynamics, steady state, stability, stochasticity. Application to life sciences: genetics, tissue growth and patterning, cancers, ion channels gating, signaling networks, morphogen gradients. Analytical methods.

Prerequisite: Recommended: MATH 2A and MATH 2B and MATH 3A, or equivalent.

MATH 227B. Mathematical and Computational Biology. 4 Units.
Analytical and numerical methods for dynamical systems, temporal-spatial dynamics, steady state, stability, stochasticity. Application to life sciences: genetics, tissue growth and patterning, cancers, ion channels gating, signaling networks, morphogen gradients. Numerical simulations.

Prerequisite: MATH 227A. MATH 227A with a grade of B- or better

MATH 227C. Mathematical and Computational Biology . 4 Units.
Analytical and numerical methods for dynamical systems, temporal-spatial dynamics, steady state, stability, stochasticity. Application to life sciences: genetics, tissue growth and patterning, cancers, ion channels gating, signaling networks, morphogen gradients. Probabilistic methods.

Prerequisite: MATH 227A. MATH 227A with a grade of B- or better

MATH 228. Topics in Applied Math Careers. 2-4 Units.
Prepares students for math careers in industry.

Prerequisite: A basic course in programming; familiarity with probability and differential equations at the upper undergraduate level.

Repeatability: May be taken for credit 1 times as topics vary.

Restriction: Graduate students only.

MATH 230A. Algebra. 4 Units.
Elements of the theories of groups, rings, fields, modules. Galois theory. Modules over principal ideal domains. Artinian, Noetherian, and semisimple rings and modules.

Prerequisite: Recommended: MATH 120A and MATH 121A and MATH 120B, or equivalent.

MATH 230B. Algebra. 4 Units.
Elements of the theories of groups, rings, fields, modules. Galois theory. Modules over principal ideal domains. Artinian, Noetherian, and semisimple rings and modules.

Prerequisite: MATH 230A. MATH 230A with a grade of B- or better

MATH 230C. Algebra. 4 Units.
Elements of the theories of groups, rings, fields, modules. Galois theory. Modules over principal ideal domains. Artinian, Noetherian, and semisimple rings and modules.

Prerequisite: MATH 230B. MATH 230B with a grade of B- or better

MATH 232A. Algebraic Number Theory. 4 Units.
Algebraic integers, prime ideals, class groups, Dirichlet unit theorem, localization, completion, Cebotarev density theorem, L-functions, Gauss sums, diophantine equations, zeta functions over finite fields. Introduction to class field theory.

Prerequisite: MATH 230C. MATH 230C with a grade of B- or better

MATH 232B. Algebraic Number Theory. 4 Units.
Algebraic integers, prime ideals, class groups, Dirichlet unit theorem, localization, completion, Cebotarev density theorem, L-functions, Gauss sums, diophantine equations, zeta functions over finite fields. Introduction to class field theory.

Prerequisite: MATH 232A. MATH 232A with a grade of B- or better

MATH 232C. Algebraic Number Theory. 4 Units.
Algebraic integers, prime ideals, class groups, Dirichlet unit theorem, localization, completion, Cebotarev density theorem, L-functions, Gauss sums, diophantine equations, zeta functions over finite fields. Introduction to class field theory.

Prerequisite: MATH 232B. MATH 232B with a grade of B- or better

MATH 233A. Algebraic Geometry. 4 Units.
Basic commutative algebra and classical algebraic geometry. Algebraic varieties, morphisms, rational maps, blow ups. Theory of schemes, sheaves, divisors, cohomology. Algebraic curves and surfaces, Riemann-Roch theorem, Jacobians, classification of curves and surfaces.

Prerequisite: MATH 230C. MATH 230C with a grade of B- or better

MATH 233B. Algebraic Geometry. 4 Units.
Basic commutative algebra and classical algebraic geometry. Algebraic varieties, morphisms, rational maps, blow ups. Theory of schemes, sheaves, divisors, cohomology. Algebraic curves and surfaces, Riemann-Roch theorem, Jacobians, classification of curves and surfaces.

Prerequisite: MATH 233A. MATH 233A with a grade of B- or better

MATH 233C. Algebraic Geometry. 4 Units.
Basic commutative algebra and classical algebraic geometry. Algebraic varieties, morphisms, rational maps, blow ups. Theory of schemes, sheaves, divisors, cohomology. Algebraic curves and surfaces, Riemann-Roch theorem, Jacobians, classification of curves and surfaces.

Prerequisite: MATH 233B. MATH 233B with a grade of B- or better

MATH 234B. Topics in Algebra. 4 Units.
Group theory, homological algebra, and other selected topics.

Prerequisite: MATH 230C. MATH 230C with a grade of B- or better

Repeatability: Unlimited as topics vary.

MATH 234C. Topics in Algebra. 4 Units.
Group theory, homological algebra, and other selected topics.

Prerequisite: MATH 230C. MATH 230C with a grade of B- or better

Repeatability: Unlimited as topics vary.

MATH 240A. Differential Geometry. 4 Units.
Riemannian manifolds, connections, curvature, and torsion. Submanifolds, mean curvature, Gauss curvature equation. Geodesics, minimal submanifolds, first and second fundamental forms, variational formulas. Comparison theorems and their geometric applications. Hodge theory applications to geometry and topology.

Prerequisite: MATH 218A. MATH 218A with a grade of B- or better

MATH 240B. Differential Geometry. 4 Units.
Riemannian manifolds, connections, curvature and torsion. Submanifolds, mean curvature, Gauss curvature equation. Geodesics, minimal submanifolds, first and second fundamental forms, variational formulas. Comparison theorems and their geometric applications. Hodge theory applications to geometry and topology.

Prerequisite: MATH 240A. MATH 240A with a grade of B- or better

MATH 240C. Differential Geometry. 4 Units.
Riemannian manifolds, connections, curvature and torsion. Submanifolds, mean curvature, Gauss curvature equation. Geodesics, minimal submanifolds, first and second fundamental forms, variational formulas. Comparison theorems and their geometric applications. Hodge theory applications to geometry and topology.

Prerequisite: MATH 240B. MATH 240B with a grade of B- or better

MATH 245A. Topics in Geometric Analysis. 4 Units.
Studies in selected areas of differential geometry, a continuation of MATH 240A-MATH 240B-MATH 240C. Topics addressed vary each quarter.

Prerequisite: MATH 218A. MATH 218A with a grade of B- or better

Repeatability: Unlimited as topics vary.

MATH 245B. Topics in Geometric Analysis. 4 Units.
Studies in selected areas of differential geometry, a continuation of MATH 240A-MATH 240B-MATH 240C. Topics addressed vary each quarter.

Prerequisite: MATH 245A. MATH 245A with a grade of B- or better

Repeatability: Unlimited as topics vary.

MATH 245C. Topics in Geometric Analysis. 4 Units.
Studies in selected areas of differential geometry, a continuation of MATH 240A-MATH 240B-MATH 240C. Topics addressed vary each quarter.

Prerequisite: MATH 245B. MATH 245B with a grade of B- or better

Repeatability: Unlimited as topics vary.

MATH 249. Topics in Differential Geometry. 4 Units.
Studies in selected areas of differential geometry. Topics addressed vary each quarter.

Repeatability: Unlimited as topics vary.

Restriction: Graduate students only.

MATH 250A. Algebraic Topology. 4 Units.
Provides fundamental materials in algebraic topology: fundamental group and covering space, homology and cohomology theory, and homotopy group.

Prerequisite: Recommended: MATH 120B and MATH 141, or equivalent.

MATH 250B. Algebraic Topology. 4 Units.
Provides fundamental materials in algebraic topology: fundamental group and covering space, homology and cohomology theory, and homotopy group.

Prerequisite: MATH 250A. MATH 250A with a grade of B- or better

MATH 250C. Algebraic Topology. 4 Units.
Provides fundamental materials in algebraic topology: fundamental group and covering space, homology and cohomology theory, and homotopy group.

Prerequisite: MATH 250B. MATH 250B with a grade of B- or better

MATH 260A. Functional Analysis. 4 Units.
Normed linear spaces, Hilbert spaces, Banach spaces, Stone-Weierstrass Theorem, locally convex spaces, bounded operators on Banach and Hilbert spaces, the Gelfand-Neumark Theorem for commutative C*-algebras, the spectral theorem for bounded self-adjoint operators, unbounded operators on Hilbert spaces.

Prerequisite: MATH 210C and MATH 220C. MATH 210C with a grade of B- or better. MATH 220C with a grade of B- or better

MATH 260B. Functional Analysis. 4 Units.
Normed linear spaces, Hilbert spaces, Banach spaces, Stone-Weierstrass Theorem, locally convex spaces, bounded operators on Banach and Hilbert spaces, the Gelfand-Neumark Theorem for commutative C*-algebras, the spectral theorem for bounded self-adjoint operators, unbounded operators on Hilbert spaces.

Prerequisite: MATH 260A. MATH 260A with a grade of B- or better

MATH 260C. Functional Analysis. 4 Units.
Normed linear spaces, Hilbert spaces, Banach spaces, Stone-Weierstrass Theorem, locally convex spaces, bounded operators on Banach and Hilbert spaces, the Gelfand-Neumark Theorem for commutative C*-algebras, the spectral theorem for bounded self-adjoint operators, unbounded operators on Hilbert spaces.

Prerequisite: MATH 260B. MATH 260B with a grade of B- or better

MATH 268C. Topics in Functional Analysis. 4 Units.
Selected topics such as spectral theory, abstract harmonic analysis, Banach algebras, operator algebras, and other related topics.

Prerequisite: MATH 268B

Repeatability: Unlimited as topics vary.

MATH 270A. Probability. 4 Units.
Probability spaces, distribution, and characteristic functions. Strong limit theorems. Limit distributions for sums of independent random variables. Conditional expectation and martingale theory. Stochastic processes.

Prerequisite: MATH 210C. MATH 210C with a grade of B- or better. Recommended: MATH 130C or equivalent.

MATH 270B. Probability. 4 Units.
Probability spaces, distribution and characteristic functions. Strong limit theorems. Limit distributions for sums of independent random variables. Conditional expectation and martingale theory. Stochastic processes.

Prerequisite: MATH 270A. MATH 270A with a grade of B- or better

MATH 270C. Probability. 4 Units.
Probability spaces, distribution and characteristic functions. Strong limit theorems. Limit distributions for sums of independent random variables. Conditional expectation and martingale theory. Stochastic processes.

Prerequisite: MATH 270B. MATH 270B with a grade of B- or better

MATH 271A. Stochastic Processes. 4 Units.
Processes with independent increments, Wiener and Gaussian processes, function space integrals, stationary processes, Markov processes.

Prerequisite: MATH 210C. MATH 210C with a grade of B- or better

Overlaps with STATS 270.

MATH 271B. Stochastic Processes. 4 Units.
Processes with independent increments, Wiener and Gaussian processes, function space integrals, stationary processes, Markov processes.

Prerequisite: MATH 271A. MATH 271A with a grade of B- or better

Overlaps with STATS 270.

MATH 271C. Stochastic Processes. 4 Units.
Processes with independent increments, Wiener and Gaussian processes, function space integrals, stationary processes, Markov processes.

Prerequisite: MATH 271B. MATH 271B with a grade of B- or better

Overlaps with STATS 270.

MATH 274. Topics in Probability. 4 Units.
Selected topics, such as theory of stochastic processes, martingale theory, stochastic integrals, stochastic differential equations.

Prerequisite: Recommended: MATH 270C.

Repeatability: Unlimited as topics vary.

Restriction: Graduate students only.

MATH 280A. Mathematical Logic. 4 Units.
Basic set theory; models, compactness, and completeness; basic model theory; Incompleteness and Gödel's Theorems; basic recursion theory; constructible sets.

Prerequisite: Recommended: MATH 150.

MATH 280B. Mathematical Logic. 4 Units.
Basic set theory; models, compactness, and completeness; basic model theory; Incompleteness and Gödel's Theorems; basic recursion theory; constructible sets.

Prerequisite: MATH 280A. MATH 280A with a grade of B- or better

MATH 280C. Mathematical Logic. 4 Units.
Basic set theory; models, compactness, and completeness; basic model theory; Incompleteness and Gödel's Theorems; basic recursion theory; constructible sets.

Prerequisite: MATH 280B. MATH 280B with a grade of B- or better

MATH 281A. Set Theory. 4 Units.
Ordinals, cardinals, cardinal arithmetic, combinatorial set theory, models of set theory, Gödel's constructible universe, forcing, large cardinals, iterate forcing, inner model theory, fine structure.

MATH 281B. Set Theory. 4 Units.
Ordinals, cardinals, cardinal arithmetic, combinatorial set theory, models of set theory, Gödel's constructible universe, forcing, large cardinals, iterate forcing, inner model theory, fine structure.

Prerequisite: MATH 281A. MATH 281A with a grade of B- or better

MATH 281C. Set Theory. 4 Units.
Ordinals, cardinals, cardinal arithmetic, combinatorial set theory, models of set theory, Gödel's constructible universe, forcing, large cardinals, iterate forcing, inner model theory, fine structure.

Prerequisite: MATH 281B. MATH 281B with a grade of B- or better

MATH 282A. Model Theory. 4 Units.
Languages, structures, compactness, and completeness. Model-theoretic constructions. Omitting types theorems. Morley's theorem. Ranks, forking. Model completeness. O-minimality. Applications to algebra.

MATH 282B. Model Theory. 4 Units.
Languages, structures, compactness and completeness. Model-theoretic constructions. Omitting types theorems. Morley's theorem. Ranks, forking. Model completeness. O-minimality. Applications to algebra.

Prerequisite: MATH 282A. MATH 282A with a grade of B- or better

MATH 282C. Model Theory. 4 Units.
Languages, structures, compactness and completeness. Model-theoretic constructions. Omitting types theorems. Morley's theorem. Ranks, forking. Model completeness. O-minimality. Applications to algebra.

Prerequisite: MATH 282B. MATH 282B with a grade of B- or better

MATH 290A. Methods in Applied Mathematics. 4 Units.
Introduction to ODEs and dynamical systems: existence and uniqueness. Equilibria and periodic solutions. Bifurcation theory. Perturbation methods: approximate solution of differential equations. Multiple scales and WKB. Matched asymptotic. Calculus of variations: direct methods, Euler-Lagrange equation. Second variation and Legendre condition.

MATH 290B. Methods in Applied Mathematics. 4 Units.
Introduction to ODEs and dynamical systems: existence and uniqueness. Equilibria and periodic solutions. Bifurcation theory. Perturbation methods: approximate solution of differential equations. Multiple scales and WKB. Matched asymptotic. Calculus of variations: direct methods, Euler-Lagrange equation. Second variation and Legendre condition.

Prerequisite: MATH 290A

MATH 290C. Methods in Applied Mathematics. 4 Units.
Introduction to ODEs and dynamical systems: existence and uniqueness. Equilibria and periodic solutions. Bifurcation theory. Perturbation methods: approximate solution of differential equations. Multiple scales and WKB. Matched asymptotic. Calculus of variations: direct methods, Euler-Lagrange equation. Second variation and Legendre condition.

Prerequisite: MATH 290B

MATH 295A. Partial Differential Equations. 4 Units.
Theory and techniques for linear and nonlinear partial differential equations. Local and global theory of partial differential equations: analytic, geometric, and functional analytic methods.

Prerequisite: MATH 210C. MATH 210C with a grade of B- or better. Recommended: MATH 112B and MATH 112C or equivalent.

MATH 295B. Partial Differential Equations. 4 Units.
Theory and techniques for linear and nonlinear partial differential equations. Local and global theory of partial differential equations: analytic, geometric, and functional analytic methods.

Prerequisite: MATH 295A. MATH 295A with a grade of B- or better

MATH 295C. Partial Differential Equations. 4 Units.
Theory and techniques for linear and nonlinear partial differential equations. Local and global theory of partial differential equations: analytic, geometric, and functional analytic methods.

Prerequisite: MATH 295B. MATH 295B with a grade of B- or better

MATH 296. Topics in Partial Differential Equations. 4 Units.
Studies in selected areas of partial differential equations, a continuation of MATH 295A-MATH 295B-MATH 295C. Topics addressed vary each quarter.

Prerequisite: MATH 295C. MATH 295C with a grade of B- or better

Repeatability: Unlimited as topics vary.

Restriction: Graduate students only.

MATH 297. Mathematics Colloquium. 1 Unit.
Weekly colloquia on topics of current interest in mathematics.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.

MATH 298A. Seminar . 2 Units.
Seminars organized for detailed discussion of research problems of current interest in the Department. The format, content, frequency, and course value are variable.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: Unlimited as topics vary.

MATH 298B. Seminar . 2 Units.
Seminars organized for detailed discussion of research problems of current interest in the Department. The format, content, frequency, and course value are variable.

Prerequisite: MATH 298A. MATH 298A with a grade of B- or better

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: Unlimited as topics vary.

MATH 298C. Seminar . 2 Units.
Seminars organized for detailed discussion of research problems of current interest in the Department. The format, content, frequency, and course value are variable.

Prerequisite: MATH 298B. MATH 298B with a grade of B- or better

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: Unlimited as topics vary.

MATH 299A. Supervised Reading and Research. 1-12 Units.
Supervised reading and research with Mathematics faculty.

Repeatability: May be repeated for credit unlimited times.

MATH 299B. Supervised Reading and Research. 1-12 Units.
Supervised reading and research with Mathematics faculty.

Prerequisite: MATH 299A. MATH 299A with a grade of B- or better

Repeatability: May be repeated for credit unlimited times.

MATH 299C. Supervised Reading and Research. 1-12 Units.
Supervised reading and research with Mathematics faculty.

Prerequisite: MATH 299B. MATH 299B with a grade of B- or better

Repeatability: May be repeated for credit unlimited times.

MATH 399. University Teaching. 1-4 Units.
Limited to Teaching Assistants.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.