MAT

Mathematics

MAT 511: Fundamental Concepts of Mathematics

Fundamental Concepts of Mathematics. Brief history of mathematics; sets, functions and logic; constructions of number systems, including their historical development; mathematical induction. The main focus of the course will be on the construction and writing of mathematical proofs. Fall, Spring, or

Summer, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 512: Algebra for Teachers

Linear algebra, the algebra of polynomials, algebraic properties of the complex numbers, number fields, solutions of equations. Mathematical topics integrate the study of the historical development of algebra, including contributions from diverse cultures. Prerequisite: MAT 511 Semesters Offered:

Fall, Spring, 3 credits, Letter graded (A, A-, B +, etc.)

MAT 513: Analysis for Teachers I

Topics in differential calculus, its foundations, and its applications. This course is designed for teachers and prospective teachers of advanced placement calculus. Mathematical topics integrate the study of the historical development of calculus, including contributions from diverse cultures. Prerequisite: MAT 511 Fall, Spring, or

Summer, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 514: Analysis for Teachers II

Topics in calculus, its foundations, and its applications. Emphasis is on integration and on numerical techniques. This course is designed for teachers and prospective teachers of advanced placement calculus. Mathematical topics integrate the study of the historical development of calculus, including contributions from diverse cultures. Analysis for Teachers I is not a prerequisite for this course. Prerequisite: MAT 511 Fall, Spring, or

Summer, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 515: Geometry for Teachers

A re-examination of elementary geometry using concepts from analysis and algebra. Mathematical topics integrate the study of the historical development of Euclidean and non-Euclidian geometries, including contributions from diverse cultures. Prerequisite: MAT 511 Fall, Spring, or

Summer, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 516: Probability and Statistics for Teachers

A priori and empirical probabilities; conditional probability; mean and standard deviation; random variables; financial distributions; continuous distributions; sampling; estimation; decision making. Mathematical topics integrate the study of the historical development of statistics and probability, including contributions from diverse cultures. Prerequisite: MAT 511 Fall, Spring, or

Summer, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 517: Calculators and Computers for Teachers

Calculators and Computers for teachers. Graphing calculators, programming, computing and curve sketching; Geometers Sketchpad or other computer based classroom tools; educational use of the world wide web.

Fall, Spring, or
Summer, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 518: Seminar on the Uses of Mathematics

This seminar explores the ways in which secondary school and elementary college mathematics are used in such diverse areas as psychology, sociology, political science, economics, business, engineering, physics, chemistry, biology, and medicine. Primarily for secondary school teachers of mathematics.

Fall, Spring, or
Summer, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 519: Seminar in Mathematics in Teaching and Learning

Seminar format. This course involves deliberative group inquiry - through reading, writing and intensive discussion - into mathematics teaching, learning and mathematics education research; analysis and design of cognitively demanding mathematical tasks; and analysis of students' mathematical thinking, written responses, and common misconceptions in the mathematics classroom. Each student completes an action research project focused on a topic selected with guidance from the instructor.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 520: Geometry for Teachers II

Vector algebra on the plane and in the 3-space; area and volume of geometric figures; analytic geometry. Prerequisite: MAT 511

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 521: Introduction to Number Theory

Congruences, quadratic residues, quadratic forms, continued fractions, Diophantine equations, number-theoretical functions, and properties of prime numbers.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 522: Introduction to Measure Theory

Introduction to Lebesgue measure and integration. Aspects of Fourier series, function spaces, Hilbert spaces, Banach spaces.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 523: Analysis in Several Dimensions

Continuity, differentiation and integration in Euclidean n-space. Differentiable maps. Implicit and inverse function theorems. Differential forms and the general Stokes' theorem.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 524: Abstract Algebra I

Groups and rings together with their homorphisms and quotient structures. Unique factorization, polynomials, and fields.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 525: Abstract Algebra II

A continuation of MAT 524, covering modules over rings (including the structure theorem for Modules over Principal Ideal Domains), theory of fields, field extensions, and an introduction to Galois theory.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 526: Linear Algebra

Finite dimensional vector spaces over a field, linear maps, isomorphisms, dual spaces, quotient vector spaces, bilinear and quadratic functions, inner products, canonical forms of linear operators, multilinear algebra, tensors.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 529: Basic Topology and Geometry (for Masters Program)

A broadly based introduction to topology and geometry, the mathematical theories of shape, form, and rigid structure. Topics include intuitive knot theory, lattices and tiling, non-Euclidean geometry, smooth curves and surfaces in Euclidean 3-space, open sets

and continuity, combinatorial and algebraic invariants of spaces, higher dimensional spaces.

There will be a required short paper on the fundamental group of a topological space or some similar topic.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 530: Topology, Geometry I

Basic point set topology; connectedness, compactness, continuity, etc. Metric spaces, function spaces, and topological manifolds. Introduction to algebraic topology; fundamental group and covering space; homology; applications.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 531: Topology, Geometry II

Foundations of differentiable manifolds: differentiable maps, vector fields and flows, and differential forms and integration on manifolds. Stokes' theorem. Froebenius theorem. Lie derivatives. Immersions and submersions. DeRham chomology, cochain complexes, degree of a map, Mayer-Vietoris Theorem.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 532: Real Analysis I

Ordinary differential equations; Banach and Hilbert spaces; inverse and implicit function theorems; Lebesque measure; general measures and integrals; measurable functions; convergence theorems for integrals.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 533: Real Analysis II

Representations and decomposition theorems in measure theory; Fubini's theorem; L-p spaces; Fourier series; Laplace; heat and wave equations; open mapping and uniform boundedness theorems for Banach spaces; differentiation of the integral; change of variable of integration. Spring

3 credits, Letter graded (A, A-, B+, etc.)

MAT 534: Algebra I

Groups: normal subgroups, quotient groups, Lagrange's theorem, class formula, finite p-groups and solvable groups, Sylow's theorems, finitely generated abelian groups. Rings and modules: subrings, fields, prime and maximal ideals, quotient rings, ID's, PID's, UFD's, polynomial rings, field of fractions, the Wedderburn theorem, Hilbert basis theorem, finitely generated modules over a PID. Vector spaces: basis, linear maps and matrices, dual spaces, determinants, eigenvalues and vectors, inner products, spectral theorem for normal operators.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 535: Algebra II

Vector spaces: Cayley-Hamilton Theorem, Jordon normal form, bilinear forms, signature, tensor products, symmetric and exterior algebras. Homological algebra: categories and functors, universal and free objects, exact sequences, extensions. Representation theory for finite groups: irreducible representations and Shur's Lemma, characters, orthogonality. Galois theory: splitting fields, finite fields, extension fields of various types, Galois polynomial and group, fundamental theorem of Galois theory, symmetric functions.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 536: Complex Analysis I

Elementary functions, holomorphic functions. Cauchy theory, power series, classification of isolated singularities, calculus of residues, open mapping theorem, Riemann mapping theorem.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 537: Several Complex Variables

Definition and basic properties of holomorphic functions and mappings. Analytic sets: Basic definitions, Local theory of Weierstrass, Meromorphic functions. Hartogs Phenomenon. Domains of convergence of power series. Domains of holomorphy. Pseudoconvexity and the Levi Problem. Complex manifolds, holomorphic vector bundles and Hermitian metrics. Cousin problems. L2 estimates for the inhomogeneous Cauchy-Riemann Equations and applications.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 538: Riemann Surfaces

Basic definitions and examples. Holomorphic differential forms. Riemann-Hurwitz Theorem. The Riemann-Roch Theroem. The Dirichlet Problem. The Hodge Theorem for Riemann surfaces. Embeddings into Projective Space. Uniformization theorem(s). Abel's Theorem and Jacobi's inversion theorem. Further topics may include: Sheaves and cohomology. Fields of meromorphic functions, valuations and connections with algebraic number theory. Monodromy and classification of branched covers.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 540: Advanced Topology, Geometry I

Homotopy, fundamental group and higher homotopy groups, fiber bundles and covering, homotopy exact sequences of pairs, fiber bundles, classification of coverings, CW-complexes, homotopy excision, suspension, topological manifolds, topological classification of 1- and 2-manifolds.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 541: Algebraic Topology

Singular and simplicial homology, their properties and equivalence, calculations for CW-complexes. Eilenberg-Steenrod axioms, cohomology, cup and cross products, Poincare, Lefschetz and Alexander dualities. Prerequisites: MAT 530, MAT 531, Fall

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 543: Representation Theory

[will alternate with MAT 544] An introduction to representation theory, with a focus on explicit examples. Representations of finite groups (in characteristic zero), especially symmetric and alternating groups. Representation theory of compact Lie groups and semisimple Lie algebras (which may also be covered in MAT 552). Representations of classical groups, esp. GL(n) and orthogonal groups. Schur-Weil duality for representations of S_n and GL(n), Young diagrams. Other possible topics include spin representations and Clifford algebras, representations of exceptional groups, applications to physics (e.g. hydrogen atom, spin, quarks), or an introduction to invariant theory. Sample textbooks: - W. Fulton and J. Harris, Representation Theory: A First Course - A. Kirillov, Introduction to Lie Groups and Lie Algebras - T. Bröcker, Representations of compact Lie groups - P. Etingof et al, Introduction to representation theory (https://bookstore.ams.org/stml-59/) - G. Heckman, Lie Algebras in Mathematics and Physics (https://www.math.ru.nl/~heckman/Lie.pdf) Prerequisites: MAT 535.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 544: Commutative and Homological Algebra

An introduction to the techniques of commutative and homological algebra useful in algebra, algebraic geometry, number theory, and related fields. Review of rings and modules, tensor products and localization. Spectrum of prime ideals, Noetherian and Artinian rings and modules, completion, dimension theory, local rings, discrete valuation rings and Dedekind domains, integral dependence. Chain complexes, projective and injective resolutions, examples of derived functors (Ext and Tor), basic category theory (adjoint functors, natural transformations, limits and colimits), abelian categories. Prerequisite: MAT 535

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 545: Complex Geometry

Foundational material and techniques in complex algebraic and differential geometry: Review of basic results in several complex variables/analytic geometry, sheaves and cohomology of sheaves, complex vector bundles, Chern classes, positivity, Kaehler manifolds, projective manifolds, Hodge decomposition for Kaehler manifolds, Kodaira vanishing theorem, Hard Lefschetz Theorem, divisors and line bundles, Bertini's theorem, Lefschetz theorem on (1,1) classes, blowing up, Kodaira's embedding theorem.

Fall, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

MAT 550: Introduction to Probability

[will alternate with MAT 551] Introduction to probability theory: independence, laws of large numbers, central limit theorems, martingales, Markov chains, and a selection of other topics such as ergodic theory, Brownian motion, random walks on graphs and groups, percolation, mixing times, randomized algorithms.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 551: Introduction to PDE

Introduction to basic types of partial differential equations and techniques for studying them. First order equations; The Cauchy problem and the Cauchy-Kovalevskaya Theorem; Laplace, heat, and wave operators; Sobolev and Holder spaces; second order linear elliptic equations: weak solutions, existence and regularity theory; L^p and Schauder estimates; de Giorgi-Nash-Moser theory; introduction to nonlinear equations" Prerequisite: MAT 531, MAT 536

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 552: Introduction to Lie Groups and Lie Algebras

An introduction to Lie groups and Lie algebras, as used in mathematics and physics. Basic facts about Lie groups and Lie algebras; classical groups. Structure theory of Lie algebras. Representation theory of sl (2,C). Classification of complex semisimple Lie algebras via their root systems. Examples of exceptional Lie algebras. Other possible topics include the representation theory compact Lie groups and semisimple Lie algebras (with a focus on analytic techniques).

3 credits, Letter graded (A, A-, B+, etc.)

MAT 554: Harmonic Analysis

An introduction to the methods and ideas of modern harmonic analysis, including: Fourier series and integrals (convergence, summability, L^p); Maximal functions, weak type inequalities, interpolation; the Hilbert transform; singular integrals with Calderon-Zygmund kernels; H^1 and Bounded Mean Oscillation; Muckenhoupt (A_p) weights; Multipliers; the T(1) theorem. Offered every second year.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 555: Ergodic Theory and Smooth Dynamics

This course will give an overview of the main known topological, geometrical, and measure theoretical phenomena of smooth dynamics: 1) Zero entropy of dynamics: Circle diffeomorphisms, KAM, period doubling, renormalization. 2)Hyperbolic dynamics: stable manifold theorem, structural stability, central limit theorem, symbolic dynamics. 3)General smooth ergodic theory: Oseledec, Pesin, Birkhof theorems. 4)Non-hyperbolic examples: non-uniform hyperbolic examples, homoclinic theory, Newhouse phenomenon, aspects of unimodal dynamics, aspects of Henon dynamics. Prerequisites: MAT 531, MAT 533, MAT 536 3 credits. Offered in Spring.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 556: One-dimensional Real and Complex Dynamics

Advanced material and techniques in one-dimensional dynamics. In real one-dimensional dynamics: circle diffeomorphisms, combinatorics and kneading theory, wandering intervals, ergodic properties and invariant measures, renormalization. For complex one-dimensional maps: Julia, Fatou sets, the Mandelbrot set, fixed point theory, external rays, quadratic-like maps and little Mandelbrot copies.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 560: Mathematical Physics I

Classical mechanics: Lagrangian and Hamiltonian formalism, Hamiltonian group actions. Special relativity and Lorentz and Poincare groups. Classical field theories: Lagrangian and Hamiltonian formulation, Noether theorem, examples. Relativistic theories. Gauge theories: electrodynamics and Yang-Mills theories. General relativity: Einstein-Hilbert action, Einstein equations and Schwarzchild solution. Optional topics may include: Chern-Simons and topological field theories; Classical theory of spinor fields and supergeometry.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 561: Mathematical Physics II

Quantum mechanics: Heisenberg and Schrodinger formalism, examples. Feynman path integral. Quantum field theory: Canonical quantization, Fock space and creation/ annihilation operators. Relativistic particles and unitary representations of the Poincare group. Path integral formalism for fields. Quantization of gauge fields, gauge fixing. Optional topics may include: Dirac equation and spinors, integration over anticommuting variables. Supersymmetric quantum field theories. Topological quantum field theories and other examples, localization.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 562: Symplectic Geometry

Hamilton's equations and their physical origin, symplectic manifolds and various submanifolds; Moser arguments including Darboux theorem and Moser neighborhood theorems, contact manifolds, contact hypersurfaces, symplectizations, Legendrian front diagrams, topological Legendrian knot invariants, almost complex structures compatible with symplectic form, Hamiltonian group actions and symplectic reduction, symplectic toric manifolds, h principle with emphasis on holonomic approximation theorem along with applications to symplectic and contact geometry , Gromov non squeezing theorem and a summary of pseudoholomorphic curve theory. Prerequisite: MAT 531

3 credits, Letter graded (A, A-, B+, etc.)

MAT 566: Differential Topology

Vector bundles, transversality, and characteristic classes. Further topics such as imbeddings and immersions, intersection theory, surgery, and foliations.

Prerequisite: MAT 531
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 568: Differential Geometry

Connections, curvature, geodesics, parallelism, and completeness. Riemannian manifolds, geometry of sub-manifolds; method of integral formulas; applications to global extrinsic theorems. Riemannian curvature. Gauss-Bonnet theorem, Hopf-Rinow theorem.

Prerequisite: MAT 531
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 569: Differential Geometry

A broad introduction to the fundamentals of modern Riemannian geometry, including major ideas and useful techniques: holonomy groups, symmetric spaces; Riemannian submersions; constructing manifolds of non-negative sectional curvature; Ricci and scalar curvature; Weyl curvature and conformal geometry; harmonic forms and

the Hodge theorem; the Bochner technique; the Bishop-Gromov inequality; the Cheeger-Gromoll splitting theorem; Gromov-Hausdorff convergence. Prerequisite: MAT 568

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAT 589: Introduction to Algebraic Geometry

This course offers a systematic introduction to algebraic geometry, from a modern, scheme-theoretic perspective.

3 credits, Letter graded (A, A-, B+, etc.)

MAT 598: Teaching Practicum

Seminar and workshop for new teaching assistants.

Fall, 3 credits, S/U grading

MAT 599: M.A. Research

May be repeated for credit.

MAT 602: Topics in Algebra

Typical topics are drawn from group theory, ring theory, representation theory of groups and algebras, fields and commutative algebra, homological algebra.

Prerequisite: Permission of instructor
Fall, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 603: Topics in Algebra

Typical topics are drawn from group theory, ring theory, representation theory of groups and algebras, fields and commutative algebra, homological algebra.

Prerequisite: Permission of instructor
Fall, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 608: Topics in Number Theory

Typical topics are drawn from analytic number theory, algebraic number theory, diophantine equations, and transcendental number theory, with indications of methods from algebra, geometry, analysis, and logic.

Prerequisite: Permission of instructor
Fall, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 609: Topics in Number Theory

Typical topics are drawn from analytic number theory, algebraic number theory, diophantine equations, and transcendental number theory, with indications of methods from algebra, geometry, analysis, and logic.

Prerequisite: Permission of instructor
Fall, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 614: Topics in Algebraic Geometry

Typical topics are drawn from varieties and schemes, algebraic curves, and their arithmetics. Fall

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 615: Topics in Algebraic Geometry

Typical topics are drawn from varieties and schemes, algebraic curves, and their arithmetics. Fall

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 620: Topics in Topology

Topics of current interest such as foliations, surgery, singularities, group actions on manifolds, and homotopy theory.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 621: Topics in Topology

Topics of current interest such as foliations, surgery, singularities, group actions on manifolds, and homotopy theory.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 626: Topics in Complex Analysis

Topics selected from Riemann surfaces, quasiconformal mappings, several complex variables, Fuchsian groups, Kleinian groups, moduli of Riemann surfaces and Kleinian groups, analytic spaces, singularities. Prerequisite: Permission of instructor MAT 626 - Fall, MAT 627 -

Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 627: Topics in Complex Analysis

Topics selected from Riemann surfaces, quasiconformal mappings, several complex variables, Fuchsian groups, Kleinian groups, moduli of Riemann surfaces and Kleinian groups, analytic spaces, singularities. Prerequisite: Permission of instructor MAT 626 - Fall, MAT 627 -

Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 632: Topics in Differential Equations

Typical topics are hyperbolic or elliptic systems, parabolic equations, spectral theory, finite difference equations, Cauchy-Riemann equations and complex vector fields, equations with constant coefficients, solvability of linear equations, Fourier integral operators, nonlinear equations.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 633: Topics in Differential Equations

Typical topics are hyperbolic or elliptic systems, parabolic equations, spectral theory, finite difference equations, Cauchy-Riemann equations and complex vector fields, equations with constant coefficients, solvability of linear equations, Fourier integral operators, nonlinear equations.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 638: Topics in Real Analysis

Topics selected from functional analysis, harmonic analysis, Banach algebras, operator theory. Prerequisite: Permission of instructor MAT 638 - Fall, MAT 639 -

Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 639: Topics in Real Analysis

Topics selected from functional analysis, harmonic analysis, Banach algebras, operator theory. Prerequisite: Permission of instructor MAT 638 - Fall, MAT 639 -

Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 641: Topics in Lie Groups Theory

Typical topics are universal enveloping algebras; free, solvable and nilpotent Lie algebras; Lie theory and formal groups; root systems, Dynkin diagrams, classification and representations of complex semisimple Lie algebras; method of orbits; representations of non-compact Lie groups; loop groups.

Prerequisite: MAT 552
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 644: Topics in Differential Geometry

Typical topics will be drawn from areas such as comparison theorems, pinching theorems,

Morse theory, characteristic classes, minimal varieties, Hodge theory, spectrum of the Laplacian, and geometry of general relativity. Prerequisite: Permission of instructor MAT 644 - Fall, MAT 645 -

Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 645: Topics in Differential Geometry

Typical topics will be drawn from areas such as comparison theorems, pinching theorems, Morse theory, characteristic classes, minimal varieties, Hodge theory, spectrum of the Laplacian, and geometry of general relativity. Prerequisite: Permission of instructor MAT 644 - Fall, MAT 645 -

Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 648: Topics in Mathematical Physics

Typical topics are mathematical methods of classical and quantum mechanics; methods of functional integration and its applications; infinite-dimensional Lie algebras, quantum groups and representations; conformal field theories; super-symmetry; topological quantum field theories; gauge theories and geometry in four-dimensions; supergravity and mirror symmetry; strings.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 649: Topics in Mathematical Physics

Typical topics are mathematical methods of classical and quantum mechanics; methods of functional integration and its applications; infinite-dimensional Lie algebras, quantum groups and representations; conformal field theories; super-symmetry; topological quantum field theories; gauge theories and geometry in four-dimensions; supergravity and mirror symmetry; strings.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 655: Topics in Dynamical Systems

Typical topics are drawn from holomorphic and low-dimensional dynamics, hyperbolic dynamics, theory of Hamiltonian systems, ergodic theory, and bifurcation theory.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 656: Topics in Dynamical Systems

Typical topics are drawn from holomorphic and low-dimensional dynamics, hyperbolic dynamics, theory of Hamiltonian systems, ergodic theory, and bifurcation theory.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 662: Advanced Topics in Algebra

Prerequisite: Permission of instructor

MAT 662 - Fall, MAT 663 -
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 663: Advanced Topics in Algebra

Prerequisite: Permission of instructor

MAT 662 - Fall, MAT 663 -
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 666: Advanced Topics in Topology

Prerequisite: Permission of instructor

MAT 666 - Fall, MAT 667 -
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 667: Advanced Topics in Topology

Prerequisite: Permission of instructor

MAT 666 - Fall, MAT 667 -
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 670: Advanced Topics in Complex Analysis

Prerequisite: Permission of instructor

MAT 670 - Fall, MAT 671 -
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 671: Advanced Topics in Complex Analysis

Prerequisite: Permission of instructor

MAT 670 - Fall, MAT 671 -
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 674: Advanced Topics in Differential Equations

Prerequisite: Permission of instructor

MAT 674 - Fall, MAT 675 -
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 675: Advanced Topics in Differential Equations

Prerequisite: Permission of instructor

MAT 674 - Fall, MAT 675 -
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 678: Advanced Topics in Real Analysis

Prerequisite: Permission of instructor

MAT 678 - Fall, MAT 679 -
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 679: Advanced Topics in Real Analysis

Prerequisite: Permission of instructor

MAT 678 - Fall, MAT 679 -
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 682: Advanced Topics in Differential Geometry

Prerequisite: Permission of instructor MAT 682 - Fall, MAT 683 -

Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 683: Advanced Topics in Differential Geometry

Prerequisite: Permission of instructor MAT 682 - Fall, MAT 683 -

Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 685: Advanced Topics in Dynamics

An advanced topic selected from holomorphic and low-dimensional dynamics, hyperbolic dynamics, KAM theory, smooth ergodic theory, geodesic flows, bifurcation theory.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 686: Advanced Topics in Dynamics

An advanced topic selected from holomorphic and low-dimensional dynamics, hyperbolic dynamics, KAM theory, smooth ergodic theory, geodesic flows, bifurcation theory.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 690: Advanced topics in algebraic geometry

Fall, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 691: Advanced topics in algebraic geometry

Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAT 696: Mathematics Seminar

May be repeated for credit.

MAT 697: Mathematics Colloquium

May be repeated for credit.

MAT 698: Independent Study

May be repeated for credit.

MAT 699: Dissertation Research on Campus

Dissertation research under direction of advisor. Prerequisite: Advancement to candidacy (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.

Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

MAT 700: Dissertation Research off Campus - Domestic

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

MAT 701: Dissertation Research off Campus - International

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

MAT 800: FULL TIME SUMMER RES

May be repeated for credit.