## MATHEMATICS (MATH)

MATH 800P Number and Operation for K-3 Mathematics Specialists
Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences Description: Number and operations. Place value and its role in arithmetic operations. Development of fractions and number systems. Develop the habits of mind of a mathematical thinker and to develop a depth of understanding of number and operations sufficient to enable the teacher to be a disciplinary resource for other K-3 teachers.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Graded

## MATH 800T Mathematics as a Second Language

Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences Notes: MATH 800T is intended for mid-level mathematics teachers.
Description: Numbers and operations. Careful reasoning, problem solving, and communicating mathematics both orally and in writing. Connections with other areas of mathematics. Development of mathematical thinking habits.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Graded
MATH 801P Geometry, Measurement, and Algebraic Thinking for K-3 Mathematics Specialists
Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences. Description: Polygons, polyhedra, rigid motions, symmetry, congruence, similarity, measurement in one, two and three dimensions, functions, mathematical expressions, solving equations, sequences. Develop the habits of mind of a mathematical thinker and to develop a depth of understanding of geometry, measurement and algebraic thinking to enable the teacher to be a disciplinary resource for other K-3 teachers. Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Graded
MATH 802P Number, Geometry and Algebraic Thinking II for K-3 Math Specialists
Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences
Notes: MATH 802P will not count toward the MA or MS degree in mathematics or statistics.
Description: Number sense and operations in the context of rational numbers, geometry and algebra in grades 4-6 curriculum, and how the mathematical content in grades K-3 (e.g., Taylor-Cox, 2003) lays a foundation for abstract thinking beginning in grades 4 and beyond. Designed to develop a depth of understanding sufficient to enable the teacher to be a disciplinary resource to other K-3 teachers.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

MATH 802T Functions, Algebra, and Geometry for Middle Level Teachers Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences Description: Variables and functions. Use of functions in problem solving. Theory of measurement, especially length, area, and volume. Geometric modeling in algebra. Graphs, inverse functions, linear and quadratic functions, the fundamental theorem of arithmetic, modular arithmetic, congruence and similarity. Ways these concepts develop across the middle level curriculum.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Graded
MATH 803P Algebraic Thinking in the Elementary Classroom
Prerequisites: A valid elementary or early childhood teaching certificate.
Notes: Not open to MA or MS students in mathematics or statistics. Description: Course explores the mathematics supporting algebraic thinking in elementary mathematics. Develops a deeper understanding of algebraic properties and greater flexibility in mathematical reasoning. Case studies, video segments, and student work samples will be examined. Complex mathematical problems will be worked with connections made between participants' thinking and that of their students.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Graded

## MATH 803T Computational Thinking for Teachers

Prerequisites: Elementary or secondary teachers certification, or by permission.
Notes: As an 800-level course with a "T" designation, this course is intended for middle-level teachers pursuing the MAT degree from the Mathematics Department, the MA degree in Mathematics Education (CEHS) or simply taking graduate courses to further their education. Description: This project-based course develops an understanding of computational thinking through engagement in problem-solving in a variety of real-world settings (some of them rather surprising) in our modern society and developing confidence and resources for implementing computational thinking activities in classrooms.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Graded

## MATH 804P Problem Solving and Critical Thinking in the Elementary

 ClassroomPrerequisites: A valid elementary or early childhood teaching certificate.
Notes: Not open to MA or MS students in mathematics or statistics. Description: Course uses problem-solving experiences to develop teachers' critical-thinking skills in order to build a strong foundation for teaching and communicating mathematical concepts. Provides a guided opportunity for the implementation of problem-solving instruction is aligned with the Mathematics Standards in both the primary (K-2) and intermediate (3-5) elementary classroom.

## Credit Hours: 3

Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

## MATH 804T Experimentation, Conjecture and Reasoning

Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences Notes: MATH 804T is intended for middle-level mathematics teachers.

Description: Problem solving, reasoning and proof, and communicating mathematics. Development of problem solving skills through the extensive resources of the American Mathematics Competitions.
Concepts of logical reasoning in the context of geometry, number patterns, probability and statistics

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Graded

## MATH 805T Discrete Mathematics for Middle Level Teachers

Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences. Notes: MATH 805T is intended for mid-level mathematics teachers. Description: Concepts of discrete mathematics, as opposed to continuous mathematics, which extend in directions beyond, but related to, topics covered in middle-level curricula. Problems which build upon middle-level mathematics experiences. Logic, mathematical reasoning, induction, recursion, combinatorics, matrices, and graph theory.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 806T Number Theory and Cryptology for Middle Level Teachers
Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences Notes: MATH 806T is intended for mid-level mathematics teachers. Description: Basic number theory results and the RSA cryptography algorithm. Primes, properties of congruences, divisibility tests, linear Diophantine equations, linear congruences, the Chinese Remainder Theorem, Wilson's Theorem, Fermat's Little Theorem, Euler's Theorem, and Euler's phi-function. Mathematical reasoning and integers' connections to the middle school curriculum.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Graded
MATH 807 Mathematics for High School Teaching I
Crosslisted with: MATH 407
Prerequisites: MATH 208/208H and MATH 309 or MATH 310.
Notes: Open only MATH majors with a declared Education option.
Description: Analysis of the connections between college mathematics and high school algebra and precalculus.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: SPRING

MATH 807T Using Mathematics to Understand Our World
Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences. Notes: MATH 807T is intended for middle-level mathematics teachers. Description: The mathematics underlying several socially-relevant questions from a variety of academic disciplines. Construct mathematical models of the problems and study them using concepts developed from algebra, linear and exponential functions, statistics and probability. Original documentation, such as government data, reports and research papers, in order to provide a sense of the role mathematics plays in society, both past and present.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 808 Mathematics for High School Teaching II
Crosslisted with: MATH 408
Prerequisites: MATH 412 and MATH 309 or MATH 310.
Notes: Open only MATH majors with a declared Education option. Description: Analysis of the connections between college mathematics and high school algebra and geometry.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: FALL
MATH 808T Concepts of Calculus for Middle Level Teachers
Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences.
Notes: MATH 808T is intended for middle-level mathematics teachers.
Description: The processes of differentiation and integration, their applications and the relationship between the two processes. Rates of change, slopes of tangent lines, limits, derivatives, extrema, derivatives of products and quotients, anti-derivatives, areas, integrals, and the Fundamental Theorem of Calculus. Connections to concepts in the middle level curriculum.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 810T Algebra for Algebra Teachers
Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences.
Description: The integers. The Euclidean algorithm, the Fundamental Theorem of Arithmetics, and the integers mod n . Polynomials with coefficients in a field. The division algorithm, the Euclidean algorithm, the unique factorization theorem, and its applications. Polynomials whose coefficients are rational, real or complex. Polynomial interpolation. The habits of mind of a mathematical thinker. The conceptual underpinnings of school algebra.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

## MATH 811T Functions for High School Teachers

Prerequisites: A valid secondary mathematics teaching certificate or by permission
Description: Course examines mathematics underlying pre-calculus material through problem solving. Connections to other topics in mathematics, including algebra, geometry and advanced mathematics are highlighted.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 812T Geometry for Geometry Teachers
Prerequisites: A valid secondary mathematics teaching certificate Description: Course examines mathematics underlying high school geometry through problem solving. Topics include Spherical, Euclidean and Hyperbolic geometry, introduction to Neutral geometry, Platonic and Archimedean solids and projective geometry.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 814 Linear Algebra
Prerequisites: A grade of P, C, or better in MATH 107 or MATH 107H
Notes: Not open to MA or MS students in mathematics or statistics.
Description: Fundamental concepts of linear algebra, including properties of matrix arithmetic, systems of linearequations, vector spaces, inner products, determinants, eigenvalues and eigenvectors, and diagonalization.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for. MATH 415, MATH 815; MATH 842

## MATH 814T Linear Algebra for Teachers

Prerequisites: A valid secondary mathematics teaching certificate or by permission.
Description: Emphasis on connections between linear equations, linear transformations and the geometry of lines and planes. Applications to production planning, encryption methods, and analyzing data.
Topics include methods of solving linear systems with an emphasis on solution behavior, along with behaviors exhibited by explicit linear transformations.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Graded

## MATH 815 Theory of Linear Transformations

Crosslisted with: MATH 415
Prerequisites: MATH 314/814; and MATH 309, MATH 310, or MATH 325. Description: Topics fundamental to the study of linear transformations on finite and infinite dimensional vector spaces over the real and complex number fields including: subspaces, direct sums, quotient spaces, dual spaces, matrix of a transformation, adjoint map, invariant subspaces, triangularization and diagonalization. Additional topics may include: Riesz Representation theorem, projections, normal operators, spectral theorem, polar decomposition, singular value decomposition, determinant as an n-linear functional, Cayley-Hamilton theorem, nilpotent operators, and Jordan canonical form.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 816T Math in the City for Teachers
Prerequisites: An undergraduate course in at least one of statistics, differential equations or matrix algebra; a valid secondary mathematics teaching certificate
Description: A modeling course run in collaboration with area businesses or organizations in which real world problems are studied. Course emphasizes how mathematics is used outside academia.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 817 Introduction to Modern Algebra I
Prerequisites: MATH 417
Description: Topics from elementary group theory and ring theory, including fundamental isomorphism theorems, ideals, quotient rings, domains. Euclidean or principal ideal rings, unique factorization, modules and vector spaces including direct sum decompositions, bases, and dual spaces.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for. MATH 818
MATH 818 Introduction to Modern Algebra II
Prerequisites: MATH 817
Description: Topics from field theory including Galois theory and finite fields and from linear transformations including characteristic roots, matrices, canonical forms, trace and transpose, and determinants.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for. MATH 901; MATH 902; MATH 905; MATH 915;
MATH 928; MATH 929

## MATH 823 Complex Analysis

Crosslisted with: MATH 423
Prerequisites: A grade of P, C, or better in MATH 208 or MATH 208H
Description: Complex numbers, functions of complex variables, analytic
functions, complex integration, Cauchy's integral formulas, Taylor and
Laurent series, calculus of residues and contour integration, conformal
mappings, harmonic functions. Applications of these concepts in engineering, physical sciences, and mathematics.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 824 Introduction to Partial Differential Equations
Crosslisted with: MATH 424
Prerequisites: A grade of P, C, or better in MATH 208/208H and MATH 221/221H.
Notes: Not open to MA or MS students in mathematics or statistics.
Description: Derivation of the heat, wave, and potential equations; separation of variables method of solution; solutions of boundary value problems by use of Fourier series, Fourier transforms, eigenfunction expansions with emphasis on the Bessel and Legendre functions; interpretations of solutions in various physical settings.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for. MECH 812

## MATH 825 Mathematical Analysis I

Prerequisites: MATH 325
Description: Real number system, topology of Euclidean space and metric spaces, continuous functions, derivatives and the mean value theorem, the Riemann and Riemann-Stieltjes integral, convergence, the uniformity concept, implicit functions, line and surface integrals.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: MATH 826

## MATH 826 Mathematical Analysis II

Prerequisites: MATH 825
Description: Real number system, topology of Euclidean space and metric spaces, continuous functions, derivatives and the mean value theorem, the Riemann and Riemann-Stieltjes integral, convergence, the uniformity concept, implicit functions, line and surface integrals.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for MATH 921; MATH 924; MATH 925; MATH 926;
MATH 941

MATH 828 Principles of Operations Research
Crosslisted with: MATH 428
Prerequisites: MATH 314 or MATH 314 H ; and RAIK 270 H , STAT 380, or

## MECH 321.

Description: Introduction to techniques and applications of operations research. Includes linear programming, queueing theory, decision analysis, network analysis, and simulation.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 830 Differential Equations I
Prerequisites: MATH 325
Description: Phase diagrams, bifurcation theory, linear systems, the matrix exponential function, Floquet theory, stability theory, existence (Poincare-Bendixson Theorem) and non-existence of periodic solutions for non-linear ordinary differential equations, self-adjoint equations, and Sturm-Liouville theory.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for. MATH 831

## MATH 831 Differential Equations II

Prerequisites: MATH 830
Description: Vector calculus, transport equations, Laplace's equation, the heat equation, the wave equation, maximum principles, meanvalue formulae, finite speed of propagation, energy methods, solution representations.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 833 Nonlinear Optimization
Crosslisted with: MATH 433
Prerequisites: MATH 208/208H; MATH 314/314H; and MATH 309,
MATH 310, or MATH 325.
Description: Mathematical theory of unconstrained and constrained optimization for nonlinear multivariate functions, particularly iterative methods, such as quasi-Newton methods, least squares optimization, and convex programming. Computer implementation of these methods.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: SPRING
MATH 839 Mathematical Biology
Crosslisted with: MATH 439
Prerequisites: MATH 221/221H \& MATH 314/314H.
Description: Discrete and continuous models in ecology: population models, predation, food webs, the spread of infectious diseases, and life histories. Elementary biochemical reaction kinetics; random processes in nature. Use of software for computation and graphics.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

## MATH 840 Numerical Analysis I

Crosslisted with: CSCE 440, CSCE 840, MATH 440
Prerequisites: CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N,
CSCE 155T, or SOFT 160; MATH 107.
Notes: Credit toward the degree may be earned in only one of the following: CSCE/MATH 440/840 and MECH 480/880.
Description: Principles of numerical computing and error analysis covering numerical error, root finding, systems of equations, interpolation, numerical differentiation and integration, and differential equations.
Modeling real-world engineering problems on digital computers. Effects of floating point arithmetic.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: CSCE 942
Course and Laboratory Fee: \$20

## MATH 842 Methods of Applied Mathematics I

Prerequisites: MATH 821 and 814, or their equivalents
Description: Interdependence between mathematics and the physical and applied sciences. Includes the calculus of variations, scaling and dimensional analysis, regular and singular perturbation methods.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 845 Number Theory
Crosslisted with: MATH 445
Prerequisites: MATH 310.
Description: Fundamentals of number theory, including congruences, primality tests, factoring methods. Diophantine equations, quadratic reciprocity, continued fractions, and elliptic curves.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 847 Numerical Methods for Applied Math
Crosslisted with: MATH 447
Prerequisites: MATH 208/208H, MATH 221/221H \& MATH 314/314H
Description: Numerical methods for approximate solutions of applied mathematics problems. Topics typically considered include numerical solution of linear systems of equations, approximation of eigenvalues and eigenvectors, numerical solution of nonlinear systems of equations, and numerical solution of initial value problems for ordinary differential equations. Given time, mathematical applications in optimization, machine learning, or data science may be considered.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: CSCE 942

## MATH 850 Discrete Mathematics I

Prerequisites: MATH 310 or 325
Description: Enumeration of standard combinatorial objects (subsets, partitions, permutations). Structure and existence theorems for graphs and sub-graphs. Selected classes of error-correcting codes. Extremal combinatorics of graphs, codes, finite sets and posets.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: MATH 852
MATH 852 Discrete Math II
Prerequisites: MATH 850
Description: Enumeration of standard combinatorial objects (subsets, partitions, permutations). Structure and existence theorems for graphs and sub-graphs. Selected classes of error-correcting codes. Extremal combinatorics of graphs, codes, finite sets and posets.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 856 Differential Topology
Prerequisites: MATH 471/871
Description: Introduction to a selection of topics in differentiable manifolds, smooth maps, vector fields and vector bundles, embeddings and immersions, differential forms, integration on manifolds, and applications.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 871 Topology I
Prerequisites: MATH 325 or MATH 417
Description: Topological spaces, continuous functions, product and quotient spaces, compactness and connectedness, homotopy, fundamental groups.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for. MATH 856; MATH 872
MATH 872 Topology II
Prerequisites: MATH 871 and MATH 417
Description: Fundamental groups and the van Kampen theorem, covering spaces and the Galois correspondence, applications to groups, homology and the Mayer-Vietoris theorem.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

## MATH 887 Probability Theory

Crosslisted with: MATH 487
Prerequisites: MATH 314 or MATH 314H; and MATH 309, MATH 310, or MATH 325.
Description: Probability, conditional probability, Bayes' theorem, independence, discrete and continuous random variables, density and distribution functions, multivariate distributions, probability and moment generating functions, the central limit theorem, convergence of sequences of random variables, random walks, Poisson processes and applications.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 889 Stochastic Processes
Crosslisted with: MATH 489
Prerequisites: MATH 314 or MATH 314 H ; and STAT 380 or RAIK 270 H .
Description: Markov chains, continuous-time Markov processes, the
Poisson process, Brownian motion, introduction to stochastic calculus.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 893 Seminar in Mathematics
Crosslisted with: MATH 493
Prerequisites: Permission.
Description: Topics in one or more branches of mathematics.
Credit Hours: 1-4
Min credits per semester. 1
Max credits per semester. 4
Max credits per degree: 8
Grading Option: Grade Pass/No Pass Option
MATH 894 Independent Study in Mathematics
Prerequisites: Permission.
Description: Directed reading or research with a faculty member.
Credit Hours: 1-4
Min credits per semester. 1
Max credits per semester. 4
Max credits per degree: 4
Grading Option: Grade Pass/No Pass Option
MATH 899 Masters Thesis
Prerequisites: Admission to masters degree program and permission of major adviser
Credit Hours: 1-10
Min credits per semester. 1
Max credits per semester. 10
Max credits per degree: 99
Grading Option: Grade Pass/No Pass Option

## MATH 901 Algebra I

Prerequisites: MATH 818 or permission
Description: In-depth treatment of groups, rings, modules, algebraic field
extensions, Galois theory, multilinear products, categories.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

## MATH 902 Algebra II

Prerequisites: MATH 818 or permission
Description: In-depth treatment of groups, rings, modules, algebraic field extensions, Galois theory, multilinear products, categories.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

## MATH 905 Commutative Algebra I

Prerequisites: MATH 818
Description: A first course in commutative algebra covering core topics in the field including noetherian rings, graded rings, localization, Nakayama's lemma, integral extensions, primary decomposition, Hilbert functions, and dimension theory.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: FALL
Prerequisite for. MATH 906; MATH 953
MATH 906 Commutative Algebra II
Prerequisites: MATH 905
Description: Continuation of Math 905, covering topics such as regular sequences, system of parameters, the Koszul complex, depth, Cohen-
Macaulay rings, regular rings, and Gorenstein rings.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: SPRING

## MATH 911 Theory of Groups

Description: Basic topics of infinite and finite group theory from among geometric, combinatorial, and algorithmic group theory, homology of groups, solvable and nilpotent groups and representation theory.
Credit Hours: 3-6
Min credits per semester. 3
Max credits per semester. 6
Max credits per degree: 18
Grading Option: Grade Pass/No Pass Option
MATH 915 Homological Algebra
Prerequisites: MATH 818
Description: Category theory, complexes and homology, Hom and tensor products, projective, injective and flat modules, resolutions, derived
functors, and applications.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: FALL
MATH 918 Topics in Algebra
Credit Hours: 3-6
Min credits per semester. 3
Max credits per semester. 6
Max credits per degree: 18
Grading Option: Grade Pass/No Pass Option

## MATH 921 Measure and Integration

Prerequisites: MATH 826 or permission
Description: Rigorous treatment of integration and measure theory. General measures and measurable functions. Lebesgue measure and Lebesgue integral. Approximation of functions. Lebesgue's Monotone and Dominated Convergence Theorems. Signed measures and total variation of measures. Radon-Nikodym Theorem. Lebesgue-Stieltjes measures and integrals. Product measures and Fubini's theorem.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: FALL
Prerequisite for. MATH 928; MATH 929
MATH 923 Topics in Analysis
Credit Hours: 3-6
Min credits per semester. 3
Max credits per semester. 6
Max credits per degree: 18
Grading Option: Grade Pass/No Pass Option
MATH 924 Theory of Analytic Functions I
Prerequisites: MATH 826 or permission
Description: Complex number field, elementary functions, analytic functions, conformal mapping, integration and calculus of residues, entire and meromorphic functions, higher transcendental functions, Riemann surfaces.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 925 Theory of Analytic Functions II
Prerequisites: MATH 826 or permission
Description: Complex number field, elementary functions, analytic
functions, conformal mapping, integration and calculus of residues, entire and meromorphic functions, higher transcendental functions, Riemann surfaces.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 926 Spectral Theory
Prerequisites: MATH 826
Description: Geometry of Hilbert spaces, compact operators and applications, self-adjoint and normal bounded operators, unbounded operators, spectrum of an operator and its properties, continuous and Borel functional calculus, applications as time permits
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: FALL
MATH 928 Functional Analysis I
Prerequisites: MATH 818 and 921, or permission
Description: Banach and Hilbert Spaces, linear operators and functionals, completely continuous operators, spectral theory, integral equations.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

MATH 929 Functional Analysis II
Prerequisites: MATH 818 and 921, or permission
Description: Banach and Hilbert Spaces, linear operators and functionals, completely continuous operators, spectral theory, integral equations.

## Credit Hours: 3

Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 934 Topics in Differential Equations
Credit Hours: 3-6
Min credits per semester. 3
Max credits per semester. 6
Max credits per degree: 18
Grading Option: Grade Pass/No Pass Option
MATH 939 Topics in Applied Mathematics
Credit Hours: 3-6
Min credits per semester. 3
Max credits per semester. 6
Max credits per degree: 18
Grading Option: Grade Pass/No Pass Option

## MATH 941 Partial Differential Equations

Prerequisites: MATH 826
Description: Theory of distributions, Fourier transform, fundamental solutions, Sobolev space theory, weak formulation and solution of elliptic boundary value problems, elliptic regularity, Galerkin methods and other techniques of nonlinear analysis.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: FALL

## MATH 953 Algebraic Geometry

Prerequisites: MATH 905
Description: An introduction to algebraic geometry, including affine and projective varieties, coordinate rings, the Zariski topology, the
Nullstellensatz, and dimensions of varieties.
Credit Hours: 3
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: SPRING
MATH 958 Topics in Discrete Mathematics

## Credit Hours: 3-6

Min credits per semester. 3
Max credits per semester. 6
Max credits per degree: 18
Grading Option: Grade Pass/No Pass Option
MATH 990 Topics in Topology
Credit Hours: 3-6
Min credits per semester. 3
Max credits per semester. 6
Max credits per degree: 18
Grading Option: Grade Pass/No Pass Option

## MATH 993 Seminar in Mathematics

Description: Advanced topics in one or more branches of mathematics.
Credit Hours: 1-3
Min credits per semester. 1
Max credits per semester. 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
MATH 994 Independent Study in Mathematics
Prerequisites: Permission.
Description: Independent reading or research directed by a faculty
member.
Credit Hours: 1-12
Min credits per semester. 1
Max credits per semester. 12
Max credits per degree: 24
Grading Option: Grade Pass/No Pass Option
MATH 995 Research Seminar
Credit Hours: 1-3
Min credits per semester. 1
Max credits per semester. 3
Max credits per degree: 6
Grading Option: Grade Pass/No Pass Option

## MATH 999 Doctoral Dissertation

Prerequisites: Admission to doctoral degree program and permission of supervisory committee chair
Credit Hours: 1-24
Min credits per semester. 1
Max credits per semester. 24
Max credits per degree: 99
Grading Option: Grade Pass/No Pass Option

