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 804P Problem Solving and Critical 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 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 350 or 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 909; MATH 913; MATH 921; MATH 922; MATH 928; MATH 929

MATH 820 Elementary Analysis for the Sciences
Prerequisites: Math 208 and evidence of adequate preparation
Notes: Students in the sciences and Statistics cannot count MATH 820 toward a minor in Mathematics. A term paper and/or project is required for graduate credit. Not open to graduate students in Mathematics.
Description: A mathematical introduction to elementary analysis (the calculus). Specifically, it is a demanding course that introduces concepts in abstraction: the axiomatic method, proofs, and mathematical thinking and writing in the context of elementary real analysis, or the theory underlying calculus. Specific topics include: logic, sets, functions; the real number system (field and order axioms, completeness axiom); mathematical induction; limits of sequences and functions, convergence, and continuity; the derivative and Riemann integral.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: CHME 815; CHME 825; MECH 881

MATH 821 Differential Equations
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: First- and second-order methods for ordinary differential equations including: separable, linear, Laplace transforms, linear systems, and some applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: MATH 842; MATL 472, MATL 872; MATL 970; MECH 416, MECH 816; MECH 449, MECH 849; MECH 454, MECH 854; MECH 480, MECH 880; MECH 810; MECH 933; MECH 936; MECH 937; MECH 938; METR 880; PHYS 451, PHYS 851

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 922; MATH 924; MATH 925; MATH 932; MATH 933; MATH 935; MATH 941

MATH 828 Principles of Operations Research
Crosslisted with: MATH 428
Prerequisites: MATH 314 or MATH 314H; and RAIK 270H, 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, mean-value 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, MATH 942
Course and Laboratory Fee: $20

MATH 841 Approximation of Functions
Crosslisted with: CSCE 441, CSCE 841, MATH 441
Prerequisites: MATH 221/MATH 221H and MATH 314/MATH 314H.
Description: Polynomial interpolation, uniform approximation, orthogonal polynomials, least-first-power approximation, polynomial and spline interpolation, approximation and interpolation by rational functions.
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 942

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
Prerequisite for: MATH 843; MATH 938

MATH 843 Methods of Applied Mathematics II
Prerequisites: MATH 842 or permission
Description: Application of partial differential equation models to problems in the physical and applied sciences. Includes derivation of partial differential equations, the theory of continuous media, linear and nonlinear wave propagation, diffusion, transform methods, and potential theory.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: MATH 937; MATH 938

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 Linear Algebra
Crosslisted with: CSCE 447, CSCE 847, MATH 447
Prerequisites: MATH 314
Description: Mathematics and algorithms for numerically stable matrix and linear algebra computations, including solution of linear systems, computation of eigenvalues and eigenvectors, singular value decomposition, and QR decomposition.
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 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 921; MATH 922

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 874M Topics in Chemical Pedagogy - Mathematics Integration
Crosslisted with: CHEM 874M, TEAC 874M
Description: Topical chemistry content for high school teachers organized according to the National Science Education Standards. A maximum combined total of 12 hours from TEAC *869 and/or *874 may be counted toward a masters degree. Credit in this course will not count towards a graduate degree in chemistry. May be counted towards the MAT and MScT degrees in mathematics and statistics, not the MA, MS, or PhD. Courses are Web-based.
Credit Hours: 2-3
Min credits per semester: 2
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 314H; and STAT 380 or RAIK 270H.
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
Prerequisite for: MATH 953

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
Prerequisite for: MATH 915; MATH 953

MATH 905 Commutative Algebra
Prerequisites: MATH 818 or permission
Description: Selected topics from classical ideal theory, Dedekind rings, completions, local rings, valvation theory.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

MATH 909 Theory of Semigroups
Prerequisites: MATH 818 or permission
Description: Selected topics from semigroups of transformations, ideal structure and homomorphisms, free semigroups, inverse semigroups, matrix representation, decompositions and extensions.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

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 913 Introduction to the Theory of Rings
Prerequisites: MATH 818
Description: Elementary ring theory and examples of rings, the Jacobson radical and the structure of semi-simple rings, rings with minimum condition, Wedderburn's theorem, structure of modules.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

MATH 915 Homological Algebra
Prerequisites: MATH 902 or permission
Description: Basic topics in homological algebra, including homology of complexes, extensions, tensor and torsion products and homological dimension, with application to rings and algebras.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

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 Real Analysis I
Prerequisites: MATH 818, 826, and 871 or permission
Description: Semicontinuity, equicontinuity, absolute continuity, metric spaces, compact spaces, Ascoli's theorem, Stone Weierstrass theorem, Borel and Lebesque measures, measurable functions, Lebesque integration, convergence theorems, Lp spaces, general measure and integration theory, Radon-Nikodyn theorem, Fubini theorem, Lebesque-Stieltjes integration.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: MATH 928; MATH 929

MATH 922 Real Analysis II
Prerequisites: MATH 818, 826, and 871 or permission
Description: Semicontinuity, equicontinuity, absolute continuity, metric spaces, compact spaces, Ascoli's theorem, Stone Weierstrass theorem, Borel and Lebesque measures, measurable functions, Lebesque integration, convergence theorems, Lp spaces, general measure and integration theory, Radon-Nikodyn theorem, Fubini theorem, Lebesque-Stieltjes integration.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

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 927 Asymptotic Methods in Applied Mathematics
Description: Methods for approximating the solutions of differential equations, including local analysis near singular points, singular perturbation methods, boundary layer theory, WKB Theory, and multiple-scale methods. Asymptotic expansion of Laplace and Fourier integrals. Illustration of the use of asymptotics from journals in mathematics, science, and engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

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 932 Advanced Ordinary Differential Equations I
Prerequisites: MATH 826 or permission
Description: Cauchy-Peano existence theorems, continuity and differentiability of solutions with respect to initial conditions, differential inequalities, uniqueness theorem, oscillation theory, Poincare-Bendixson theory, stability theory, almost periodic solutions.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

MATH 933 Advanced Ordinary Differential Equations II
Prerequisites: MATH 826 or permission
Description: Cauchy-Peano existence theorems, continuity and differentiability of solutions with respect to initial conditions, differential inequalities, uniqueness theorem, oscillation theory, Poincare-Bendixson theory, stability theory, almost periodic solutions.
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 935 Advanced Methods in Applied Mathematics I
Prerequisites: MATH 821 and 826
Description: Banach and Hilbert spaces, operator theory with application to differential and integral equations; spectral theory for compact, self-adjoint operators.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: MATH 936

MATH 936 Advanced Methods in Applied Mathematics II
Prerequisites: MATH 935 or permission
Description: Distributions, Green's functions and boundary value problems; integral transforms and spectral representations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

MATH 937 Nonlinear Partial Differential Equations
Prerequisites: MATH 843 or 941 or permission
Description: Nonlinear wave propagation and shock structure with applications, dispersive waves, hyperbolic systems, group velocity and the method of stationary phase. WKB approximation and perturbation methods.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

MATH 938 Mathematical Modeling
Prerequisites: MATH 842, 843 and permission
Description: Advanced course in mathematical modeling for students who desire experience in formulating and analyzing open-ended, real-world problems in the natural and applied sciences. Participation in a few group projects that require conceptualization and analytical, numerical, and graphical analysis with formal oral and written presentation of the results.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
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 hyperbolic, elliptic, and parabolic equations. Classification, existence and uniqueness result, solution representations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: MATH 937

MATH 942 Numerical Analysis III
Crosslisted with: CSCE 942
Prerequisites: CSCE/MATH 840 or 841 or 847
Description: Advanced topics in numerical analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

MATH 953 Algebraic Geometry
Prerequisites: MATH 901-902
Description: Affine geometry, coordinate rings, the Zariski topology, function fields and birational geometry, the Nullstellensatz, Krull dimension and transcendence degree, smoothness, projective geometry, divisors, curves.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

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