MATH 5090G Selected Topics in Mathematics
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Specialized study in a selected area of Mathematics. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): Permission of instructor required.
Cross Listing(s): MATH 5090.

MATH 5130G Statistics and Probability for K-8 Teachers
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
An in-depth study of topics in statistics, such as sampling and data analysis, and probability, such as counting methods, odds, and expected value. For Early Childhood and Middle Grade majors only.
Prerequisite(s): A minimum grade of "C" in MATH 3032.
Cross Listing(s): MATH 5130.

MATH 5135G Algebraic Connections for K-8 Teachers
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
The evolution of algebraic concepts through the curriculum will be followed by how algebra is related to other areas of mathematics and real-world applications. For Early Childhood and Middle Grade majors only.
Prerequisite(s): A minimum grade of "C" in MATH 3032.
Cross Listing(s): MATH 5135.

MATH 5136G History of Mathematics
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
A survey of the historical development of mathematics. The emphasis will be on mathematical concepts, problem solving, and pedagogy from a historical perspective. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 2242.
Cross Listing(s): MATH 5136.

MATH 5137G Geometry for K-8 Teachers
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
A continuation of the study of geometry from MATH 3032. Focus will be on two and three dimensional geometry, Motion geometry and tessellations will also be covered. For Early Childhood and Middle Grade majors only.
Prerequisite(s): A minimum grade of "C" in MATH 3032.
Cross Listing(s): MATH 5137.

MATH 5230G Advanced Geometry
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Selected topics from Euclidean and Non-Euclidean Geometry. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 3130 or one year of teaching high school mathematics.
Cross Listing(s): MATH 5230.

MATH 5232G Mathematical Applications Using Technology
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Selected mathematical topics used in research, problem solving, and demonstrations will be investigated with the use of current technologies. Intended for mathematics education majors. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 2243 and 3 hours of mathematics at the junior level or above.
Cross Listing(s): MATH 5232.

MATH 5234G Number Theory
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Introduction to the principal ideas of elementary number theory: Divisibility, congruencies, linear Diophantine Equations, Fermat's Theorem, Pythagorean triples and the distribution of primes. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 2332.
Cross Listing(s): MATH 5234 and MATH 5234H.

MATH 5236G Patterns of Problem Solving
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
A study of patterns involved in solving problems. Particular attention is paid to Polya's heuristics and his characterization of the problem solving process. The student will also solve many problems. The application of these techniques by mathematics teachers will be stressed. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 1441 or permission of instructor.
Cross Listing(s): MATH 5236.

MATH 5330G Operations Research
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Introduction to basic deterministic and probabilistic operations research models of decision problems. Mathematical methods of optimization for these models will be analyzed both analytically and numerically. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 2331 and MATH 3337.
Cross Listing(s): MATH 5330.

MATH 5331G Analysis I
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Provides a transition from calculus to real analysis. Emphasis will be placed on understanding and constructing mathematical proofs. Rigorous development of fundamental concepts in analysis, including topics such as relations, functions, limits of functions, cardinality, topology of the reals, completeness axiom, compact sets, sequences, subsequence, continuity and differentiability. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 2243 and MATH 2332.
Cross Listing(s): MATH 5331.

MATH 5332G Analysis II
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
A continuation of Analysis I, including topics such as Riemann integration, infinite series, sequences and series of functions, metric spaces, and normed spaces. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 5331 or MATH 5331G.
Cross Listing(s): MATH 5332.

MATH 5333G Modern Algebra I
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course is an introduction to the fundamental algebraic structures: groups, rings and fields. Topics covered include: binary operations, groups (permutation groups, subgroups, cyclic groups, group homomorphisms, factor groups), rings (integral domains, ring homomorphisms) and fields. The historical and mathematical connections to the secondary mathematics curriculum will be incorporated as appropriate. Graduate students will be given an extra assignment not required of undergraduate students.
Prerequisite(s): A minimum grade of "C" in MATH 2332.
Cross Listing(s): MATH 5333.
MATH 5334G Modern Algebra II
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
A continuation of the study of the fundamental algebraic structures. Topics to be covered include: isomorphism of groups, rings, fields, a deeper study of quotient structures and the isomorphism theorems, field of quotients, factorization of polynomials over a field, arithmetic properties of rings of polynomials over fields, extension fields, algebraic extensions, geometric constructions and the classic problems. Graduate students will be given an extra assignment not required of undergraduate students.
Prerequisite(s): A minimum grade of "C" in MATH 5333 or MATH 5333G.
Cross Listing(s): MATH 5334.

MATH 5335G Intermediate Linear Algebra
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
General vector spaces and bases, linear operators, least squares problems, eigenvalue problems, and applications of these concepts. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 2331 and MATH 2332.
Cross Listing(s): MATH 5335.

MATH 5336G Applied Numerical Methods
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Introduction to scientific computation. Solutions of linear and nonlinear equations, polynomial interpolation, numerical differentiation and integration, data fitting, and other numerical methods. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 2331 and prior knowledge of a programming language.
Cross Listing(s): MATH 5336.

MATH 5337G Difference Equations
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course is an introduction to the theory and applications of difference equations. Topics include the difference calculus, first order linear difference equations, results and solutions of linear equations, applications, equations with variable coefficients and nonlinear equations that can be linearized. Graduate students will be given an extra assignment not required of undergraduate students.
Prerequisite(s): A minimum grade of "C" in MATH 2242 or MATH 2242H and MATH 2331.
Cross Listing(s): MATH 5337.

MATH 5338G Methods of Applied Mathematics
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Methods of applied mathematics concentrating on techniques for the analysis of differential and integral equations. Topics include: integral equations, differential operators, Fredholm alternative, distribution theory and Green's function methods. Graduate students will be given an extra assignment not required of undergraduate students.
Prerequisite(s): A minimum grade of "C" in MATH 2331 and MATH 3230.
Cross Listing(s): MATH 5338.

MATH 5339G Partial Differential Equations
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
The study of differential equations involving functions of more than one variable. Topics include: Laplace, heat and wave equations, boundary value problems, methods of separation of variables and eigenfunction expansions, Fourier series, Green's functions, maximum principle and computational methods. Graduate students will be given an extra assignment not required of undergraduate students.
Prerequisite(s): A minimum grade of "C" in MATH 2243 or MATH 2243H and MATH 3230.
Cross Listing(s): MATH 5339.

MATH 5430G Introduction to Mathematical Biology
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
An introduction to applications of mathematics to various biological, ecological, physiological, and medical problems, which will be analyzed both analytically and numerically. Graduate students will be given additional assignments that will not be completed by undergraduate students.
Prerequisite(s): A minimum grade of "C" in MATH 3230.
Cross Listing(s): MATH 5430.

MATH 5431G Combinatorics and Graph Theory
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
The course covers basic theory and applications of combinatorics and graph theory. Combinatorics is a study of different enumeration techniques of finite but large sets. Topics that will be studied include principle of inclusion and exclusion, generating functions and methods to solve difference equations. Graph theory is a study of graphs, trees and networks. Topics that will be discussed include Euler formula, Hamilton paths, planar graphs and coloring problem; the use of trees in sorting and prefix codes; and useful algorithms on networks such as shortest path algorithm, minimal spanning tree algorithm and min-flow max-cut algorithm. Graduate students will be given extra assignments determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 2332 and MATH 3337.
Cross Listing(s): MATH 5431.

MATH 5433G Differential Geometry of Curves and Surfaces
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Differential geometry uses tools from calculus and linear algebra to study the geometric properties of smooth curves and surfaces in Euclidean spaces. Topics include: arc length surface area, geodesics, curvature, first and second fundamental forms, Gauss-Bonnett formula. Graduate students will be assigned additional assignments and/or project.
Prerequisite(s): A minimum grade of "C" in MATH 2243 or MATH 2243H and MATH 2331.
Cross Listing(s): MATH 5433.

MATH 5434G Functions of a Complex Variable
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Topics in complex variables including functions, limits, derivatives, integrals, the Cauchy-Riemann conditions, series representation of functions, Cauchy Integral formula, and elementary conformal mappings. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 2332.
Cross Listing(s): MATH 5434.

MATH 5435G Introduction to Topology
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
An introduction to metric spaces, topological spaces, connectedness and compactness of topological spaces, and continuous functions on topological spaces. Graduate students enrolled in this course will complete one or more assignments that the undergraduate students will not be required to complete.
Prerequisite(s): A minimum grade of "C" in MATH 2332.
Cross Listing(s): MATH 5435.

MATH 5436G Introduction to Fractals
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Fractals as nonlinear systems involving feedback and iteration. Classical fractals, limits and self-similarity. Fractal dimensions. Encoding of fractals. Decoding of fractals. Iterated function systems. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of "C" in MATH 5331 or MATH 5331G.
Cross Listing(s): MATH 5436.
MATH 5437G Mathematics and Computation of Curves and Surfaces
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course is a study of the mathematical and computational techniques used for the computer generation of curves and surfaces. The primary representations for the curves and surfaces are univariate and multivariate polynomials and splines in the Bernstein/Bezier and B-spline bases. These curves and surfaces are used for data fitting (interpolation and smoothing) and approximation. Topics include: recursion, smoothness, surfaces over grids, surfaces over triangulations, simplex and box splines, variational curves and surfaces, transformations and projections. Graduate students will be given an extra assignment not required of undergraduate students.
Prerequisite(s): A minimum grade of "C" in MATH 2243 or MATH 2243H and MATH 2331.
Cross Listing(s): MATH 5437.

MATH 5530G Mathematics for Scientists and Engineers
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
A survey of mathematical topics useful in the study of areas of applied sciences such as physics, engineering and computer science. Topics include: linear algebra and matrices, ordinary differential equations, partial differential equations, Fourier series, vector calculus, complex variables, numerical methods, probability and graph theory. For non-math majors only. Graduate students will be given an extra assignment not required of undergraduate students.
Prerequisite(s): A minimum grade of "C" in MATH 2242 or MATH 2242H.
Cross Listing(s): MATH 5530.

MATH 5539G Mathematical Models
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course introduces students to a variety of mathematical tools used for solving real world problems, with the focus on identifying the problem, constructing an appropriate model, and finding the best available method to solve it. Graduate students will be given an extra assignment not required of undergraduate students.
Prerequisite(s): A minimum grade of "C" in MATH 2242 or MATH 2242H.
Cross Listing(s): MATH 5539.

MATH 6130 Fundamental Concepts of Arithmetic and Geometry
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This is an online course intended for current K-5 teachers seeking a mathematics endorsement on their teaching certificate. The course will cover two and three dimensional shapes and their properties, perimeter, area, volume, and measurement, and applications of these topics to the K-5 classroom. This course cannot be taken for credit for students enrolled in a degree program outside the College of Education.
Prerequisite(s): Requires current Georgia Teacher Certification.

MATH 6133 Applications in Geometry for K-5 Teachers
3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.
This is an online course intended for current K-5 teachers seeking a mathematics endorsement on their teaching certificate. The course will cover two and three dimensional shapes and their properties, perimeter, area, volume, and measurement, and applications of these topics to the K-5 classroom. This course cannot be taken for credit for students enrolled in a degree program outside the College of Education.
Prerequisite(s): Requires current Georgia Teacher Certification.

MATH 6161 Mathematical Reasoning
3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.

MATH 6230 Fundamental Ideas of Calculus
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
A review of the principal ideas of calculus, with emphasis on concepts. Intended for Mathematics Education majors.
Prerequisite(s): A minimum grade of "C" in MATH 1441; permission of instructor.

MATH 6301 College Geometry
3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.

MATH 6435 Linear Algebra
3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.

MATH 6547 Intro to Statistical Methods
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.

MATH 6601 Intro to Mathematical Proofs
3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.

MATH 6701 History of Mathematics
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.

MATH 6702 Foundations of Mathematics
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.

MATH 6703 Advanced Numerical Analysis I
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.

MATH 6704 Advanced Numerical Analysis II
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.

MATH 6705 Special Topics in Applied Mathematics
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.

MATH 6706 Advanced Differential Equations
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.

MATH 6708 Linear Algebra
3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.

MATH 6710 Mathematical Optimization Theory
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
The course covers fundamentals of mathematical optimization theory. Topics include: elements of convex analysis, first and second order necessary and sufficient optimality conditions for unconstrained and constrained optimization problems, Lagrange multiplier theory, Lagrange duality theory, and an overview of important optimization techniques for convex, conic, semidefinite and complementarity problems.
Prerequisite(s): A minimum grade of "C" in MATH 5331.

MATH 6712 Methods of Optimization
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
The first part of the course provides a brief introduction to the foundations of optimization, including optimality conditions. The second part concentrates on selected methods for unconstrained and constrained optimization problems. These include but are not limited to: line search methods, gradient methods, Newton-type methods, trust region methods, non-gradient methods, penalty and barrier methods, interior-point methods, methods of feasible directions and dual methods. Selected methods will be implemented on the computer. Prior completion of MATH 5330 is recommended.
Prerequisite(s): A minimum grade of "C" in MATH 5331.

MATH 7132 Methods of Optimization
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.

MATH 7130 Mathematical Optimization Theory
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
The course covers fundamentals of mathematical optimization theory. Topics include: elements of convex analysis, first and second order necessary and sufficient optimality conditions for unconstrained and constrained optimization problems, Lagrange multiplier theory, Lagrange duality theory, and an overview of important optimization techniques for convex, conic, semidefinite and complementarity problems.
Prerequisite(s): A minimum grade of "C" in MATH 5331.

MATH 7132 Methods of Optimization
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
The first part of the course provides a brief introduction to the foundations of optimization, including optimality conditions. The second part concentrates on selected methods for unconstrained and constrained optimization problems. These include but are not limited to: line search methods, gradient methods, Newton-type methods, trust region methods, non-gradient methods, penalty and barrier methods, interior-point methods, methods of feasible directions and dual methods. Selected methods will be implemented on the computer. Prior completion of MATH 5330 is recommended.
Prerequisite(s): A minimum grade of "C" in MATH 5331.

MATH 7231 Advanced Numerical Analysis I
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
An in-depth study of computer arithmetic, the solution of non-linear equations, the solution of systems of linear equations, eigenvalue problems and interpolation. Algorithms and methods are developed and then implemented on a computer.
Prerequisite(s): A minimum grade of "C" in MATH 5336 or 5336G.

MATH 7232 Advanced Numerical Analysis II
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
An in-depth study of orthogonal polynomials, numerical integration, and numerical solutions of ordinary and partial differential equations. Development and computer implementation of algorithms and methods.
Prerequisite(s): A minimum grade of "C" in MATH 7231.
MATH 7234 Advanced Linear Algebra  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
The study of linear maps on finite dimensional vector spaces. Topics include: diagonalization (direct sums, invariant subspaces and Cayley-Hamilton theorem for linear operators), inner product spaces (self-adjoint, orthogonal operators, orthogonal projections and the spectral theorem, bilinear and quadratic forms), canonical forms (Jordan and rational forms, minimal polynomials), special matrices (non-negative matrices), and the exponential of a linear operator.  
Prerequisite(s): A minimum grade of "C" in MATH 5335.

MATH 7235 Analytic Number Theory  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
A study of topics from the classical analytic theory of numbers. Topics will be chosen from arithmetic functions, the distribution of primes, congruences, the Riemann-zeta functions, the prime number theorem, Eisenstein series, quadratic residues, Dirichlet series, Euler products, the Dedekind eta function, the Jacobi theta functions, integer partitions, and modular forms.  
Prerequisite(s): A minimum grade of "C" in MATH 5234 and MATH 5434.

MATH 7236 Advanced Ordinary Differential Equations  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
The theory of ordinary differential equations and dynamical systems. Topics include: Sturm-Liouville boundary value problems, eigenfunction expansions, Lyapunov stability, limit cycles, Poincare-Bendixon theorem, Floquet's theory and Invariance theorems.  
Prerequisite(s): A minimum grade of "C" in MATH 3230.

MATH 7237 Mathematical Control Theory  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
State-space techniques from modern control system theory. Topics include realization theory for MIMO systems, state-space techniques for feedback control, closed loop observer design, and state-space techniques in optimal control.  
Prerequisite(s): A minimum grade of "C" in MATH 3230 and MATH 3536G.

MATH 7330 Functional Analysis  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
The study of normed linear spaces and linear operators. Topics include: Hilbert spaces (projection theorem, Riesz representation, Parseval relation); Banach spaces (convexity, duality, bounded and compact operators, theorems of Hahn-Banach, Banach-Steinhaus, open mapping, closed graph, Fredholm alternative); Stone-Weierstrass and Banach fixed point theorems.  
Prerequisite(s): A minimum grade of "C" in MATH 5332 and MATH 5335.

MATH 7331 Real Analysis  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
Theory of Lebesgue measure and integration, monotone convergence, the dominated convergence theorem, Fubini's Theorem, Radon-Nikodym theorem, Riesz representation theorem, Lp and lp spaces, functions of finite variation, Stieltjes integral, absolute continuity.  
Prerequisite(s): A minimum grade of "C" in MATH 5331.

MATH 7332 Advanced Partial Differential Equations  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
Prerequisite(s): A minimum grade of "C" in MATH 5339 or MATH 5339G.

MATH 7333 Complex Analysis  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
An in-depth study of functions of one complex variable. Topics include: properties of holomorphic, harmonic, meromorphic and entire functions (open mapping, maximum modulus, mean value, Poisson's, Rouche's, Liouville's, Picard's and Mittag-Leffler's theorems), residue theory (residue theorem, argument principle and applications), conformal mappings (Mobius and Christoffel-Schwarz canonical transformations, Riemann mapping theorem), analytic continuation (monodromy theorem, Schwarz reflection principle, Riemann surfaces and multi-valued functions).  
Prerequisite(s): A minimum grade of "C" in MATH 5331 and MATH 5434.

MATH 7343 Approximation Theory  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
The study of the approximation of functions in normed linear spaces. The course emphasizes the theory of interpolation and approximation by polynomials, rational functions and spline functions. Main topics include: best approximation, order of approximation, interpolation, existence and uniqueness of best approximants, theorems by Weierstrass, Haar, Chebyshev, Bernstein, Markov, Korovkin, Schoenberg, and applications.  
Prerequisite(s): A minimum grade of "C" in MATH 5331 and MATH 5335.

MATH 7420 Applied Combinatorics  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
Counting principles including combinations, permutations, generating functions, recurrence relations, the principle of inclusion, exclusion and Polya's theory of counting. This course is for high school mathematics teachers in the MAT or MED programs, who have had a full sequence of calculus courses and a first course in linear algebra.

MATH 7430 Abstract Algebra I  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
The course provides a comprehensive study of group theory. The course begins with basic concepts of group theory (binary structures, subgroups, homomorphisms) and continues with the study of normal subgroups, quotient groups and the isomorphism theorems. Further topics to be studied include group actions, Sylow's theorem and the structure of finitely generated abelian groups.  
Prerequisite(s): A minimum grade of "C" in MATH 5333 or MATH 5333G.

MATH 7431 Abstract Algebra II  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
The course provides a comprehensive study of rings and fields. The course begins with the basic concepts (rings, subrings, ideals, quotient rings, homomorphisms), continues with the arithmetic of rings, applications to rings of polynomials and field theory, and concludes with a chapter on Galois theory that links field theory and group theory.  
Prerequisite(s): A minimum grade of "C" in MATH 7430.

MATH 7432 Differential Geometry of Manifolds  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
The study and applications of calculus on manifolds. Topics include: atlases, tangent spaces, differentiable maps; immersions and submanifolds, submersions and quotient manifolds; matrix groups and their Lie algebras; vector fields and flows; differential forms, exterior derivative, and Lie derivative.  
Prerequisite(s): A minimum grade of "C" in MATH 3230 and MATH 3535.

MATH 7434 Elements of Algebraic Topology  
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.  
The study of the topology of geometric objects from the algebraic viewpoint, in particular using homotopy and homology groups. Main topics: Topological manifolds, homotopy, fundamental group, free groups, covering spaces, and homology.  
Prerequisite(s): A minimum grade of "C" in MATH 5435.
MATH 7610 Graduate Seminar
1 Credit Hour. 1 Lecture Hour. 0 Lab Hours.
Under supervision of one or more faculty members, each student will choose topics related to his or her concentration, or topics of interest to the class, read and research on them, then make presentations in front of the class or a larger audience. Students will also attend presentations of internal and external speakers on mathematical sciences.
Prerequisite(s): A minimum grade of "C" in MATH 5332 or MATH 5335 or STAT 5531 or MATH 7231.

MATH 7820 Historical & Cult Dev of Math
3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.

MATH 7821 Hist & Cult Dev of Math II
3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.

MATH 7890 Directed Study in Mathematics
1-3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.
Directed study under faculty supervision.
Prerequisite(s): Permission of instructor and Department Chair required.

MATH 7895 Research
1-3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.
Graduate students will conduct a program of independent research under the direction of a thesis advisor or an advisory committee on a topic in Mathematical Sciences. Results of the research will be presented as a thesis in partial fulfillment of the requirement of the Master of Science degree.

MATH 7999 Thesis
1-3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.
Results of independent research conducted under the direction of a thesis advisor will be presented as a thesis in partial fulfillment of the Master of Science degree. The thesis will be defended before an advisory committee.