MATH 0225 - Basic Mathematics  
Credit(s): 3 Credits  
Prep course designed to expose students to signed Numbers: common fraction, decimals and percentages; ratio and proportion; area and volume; powers and roots; algebraic expressions and operations; linear equations; basic trig metric functions; factoring polynomials.  
Attributes: Prof. Studies Students Only

MATH 0235 - Intro Elementary Algebra  
Credit(s): 3 Credits  
Prerequisite: Math Assessment.  
Attributes: Prof. Studies Students Only

MATH 0240 - Intro Elementary Algebra I  
Credit(s): 3 Credits  
Review of the real number system; linear equations, and inequalities in one and two variables; functions; systems of linear equations. Fall. MATH 0240 and MATH 0250 together cover the same material as MATH 0260, but in two semesters.  
Prerequisite(s): MATH 0240 with a grade of C- or higher

MATH 0250 - Intro to Elementary Algebra II  
Credit(s): 3 Credits  
Exponents, polynomials and polynomial functions; factoring; rational expressions and functions; roots, radicals and root functions; quadratic equations, inequalities and functions. Spring. MATH 0240 and MATH 0250 together cover the same material as MATH 0260, but in two semesters.  
Prerequisite(s): MATH 0240 with a grade of C- or higher

MATH 0260 - Intermediate Algebra  
Credit(s): 0-3 Credits  
Review of the real number system; linear equations, and inequalities in one and two variables; functions; systems of linear equations; exponents, polynomials and polynomial functions; factoring; rational expressions and functions; roots, radicals and root functions; quadratic equations, inequalities and functions. Fall and spring.  
Prerequisite(s): MATH 0230

MATH 0265 - Intermediate Algebra  
Credit(s): 3 Credits  
Review of the real number system; linear equations, and inequalities in one and two variables; functions; systems of linear equations; exponents, polynomials and polynomial functions; factoring; rational expressions and functions; roots, radicals and root functions; quadratic equations, inequalities and functions. Fall and spring. Credit not given for both MATH 0260 and any of the following: MATH 0240, MATH 0250.  
Prerequisite(s): MATH 0230

MATH 1200 - College Algebra  
Credit(s): 3 Credits  
Brief review of algebraic essentials, graphs, functions and their graphs, linear and quadratic functions, polynomial and rational functions, exponential and logarithmic functions, systems of linear equations. Intended for students needing more preparation before taking MATH 1320 or MATH 1400. (Offered every Fall, Spring and Summer)  
Prerequisite(s): MATH 0260  
Attributes: Prof. Studies Students Only

MATH 1220 - Finite Mathematics  
Credit(s): 3 Credits  
Linear equations and straight lines, matrices, sets and counting, probability and statistics, the mathematics of finance, and logic.  
Prerequisite(s): (MATH 0250 with a grade of C- or higher, Math Waiver per Advisor with a minimum score of 0250, or MATH 0260 with a grade of C- or higher)  
Attributes: Mathematics BA Req (A&S)

MATH 1240 - Mathematics and the Art of M.C. Escher  
Credit(s): 3 Credits  
An inquiry course open to all undergraduates. The art of M.C. Escher is used to explore topics in geometry such as symmetry, tessellations, wallpaper patterns, the geometry of the sphere and hyperbolic geometry. Taught in a computer classroom.  
Prerequisite(s): (MATH 1200 with a grade of C- or higher or Math Waiver per Advisor with a minimum score of 1200)  
Attributes: Mathematics BA Req (A&S)

MATH 1250 - Math Thinking in Real World  
Credit(s): 3 Credits  
An inquiry course open to all undergraduates. In this course, aimed at students in the humanities and social sciences, we study some of the greatest ideas of mathematics that are often hidden from view in lower division courses. Topics selected from number theory, the infinite, geometry, topology, chaos and fractals, and probability. Taught in a computer classroom.  
Attributes: Mathematics BA Req (A&S)

MATH 1260 - Statistics Including Sports and Politics  
Credit(s): 3 Credits  
An inquiry course open to all undergraduates. Producing data through the use of samples and experiments; organizing data through graphs and numbers that describe the distribution of the data of one variable or the relationship between two variables; probability; statistical inference including confidence intervals and tests of significance.  
Attributes: Mathematics BA Req (A&S)

MATH 1300 - Elementary Statistics with Computers  
Credit(s): 3 Credits  
Data production and analysis; probability basics, distributions; sampling, estimation with confidence intervals, hypothesis testing; t-test; correlation and regression; crosstabulations and chi-square. Students learn to use a statistical package such as SPSS. Credit not given for MATH 1300 and any of the following: STAT 1300 or OPM 2070.  
Prerequisite(s): (1 Course from MATH 1200-4999 or Math Waiver per Advisor with a minimum score of 1200)  
Attributes: Chemical Biology Elective, Mathematics BA Req (A&S)
MATH 1305 - Elementary Statistics with Computers  
Credit(s): 3 Credits  
Data production and analysis; probability basics, distributions; sampling, estimation with confidence intervals, hypothesis testing, t-test; correlation and regression; crosstabulations and chi-square. Students learn to use a statistical package such as SPSS.  
Prerequisite(s): (1 Course from MATH 1200-4999 or Math Waiver per Advisor with a minimum score of 1200)  
Attributes: Prof. Studies Students Only  

MATH 1320 - Survey of Calculus  
Credit(s): 3 Credits  
Linear equations and graphs; functions and graphs; limits; the derivative; rules of differentiation; curve sketching and optimization; antiderivatives; the definite integral; multivariable calculus and partial derivatives. (Offered every Fall, Spring and Summer)  
Prerequisite(s): (MATH 1200 with a grade of C- or higher or Math Waiver per Advisor with a minimum score of 1200)  
Attributes: Mathematics BA Req (A&S)  

MATH 1325 - Survey of Calculus  
Credit(s): 3 Credits  
Linear equations and graphs; functions and graphs; limits; the derivative; rules of differentiation; curve sketching and optimization; antiderivatives; the definite integral; multivariable calculus and partial derivatives. (Offered every Fall, Spring and Summer)  
Prerequisite(s): (MATH 1200 with a grade of C- or higher or Math Waiver per Advisor with a minimum score of 1200)  
Attributes: Mathematics BA Req (A&S)  

MATH 1400 - Pre-Calculus  
Credit(s): 3 Credits  
Functions, graphs and models; modeling with linear and quadratic functions; polynomial and rational functions; modeling with exponential and logarithmic functions; trigonometric functions; trigonometric identities and conditional equations; additional topics in trigonometry; additional topics in analytic geometry; parametric equations. (Offered every Fall, Spring and Summer)  
Prerequisite(s): (Math Waiver per Advisor with a minimum score of 1200 or MATH 1200 with a grade of C- or higher)  
Attributes: Mathematics BA Req (A&S)  

MATH 1450 - Cryptology  
Credit(s): 3 Credits  
An inquiry course open to all undergraduates. Aimed at students who require a course at the level of calculus or higher and who are interested in the mathematical basis for cryptography systems. Topics include permutation based codes, block cipher schemes and public key encryption.  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 1510 - Calculus I  
Credit(s): 4 Credits  
Functions; continuity; limits; the derivative; differentiation from graphical, numerical and analytical viewpoints; optimization and modeling; rates and related rates; the definite integral; antiderivatives from graphical, numerical and analytical viewpoints. (Offered every Fall, Spring and Summer)  
Prerequisite(s): (MATH 1510 or Math Waiver per Advisor with a minimum score of 1200)  
Attributes: Mathematics BA Req (A&S)  

MATH 1520 - Calculus II  
Credit(s): 4 Credits  
Symbolic and numerical techniques of integration, improper integrals, applications using the definite integral, sequences and series, power series, Taylor series, differential equations. (Offered every Fall, Spring and Summer)  
Prerequisite(s): (Math Waiver per Advisor with a minimum score of 1510, MATH 1510 with a grade of C- or higher, or AP Calculus AB with a minimum score of 4)  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 1650 - Cryptology  
Credit(s): 3 Credits  
An inquiry course open to all undergraduates. Aimed at students who require a course at the level of calculus or higher and who are interested in the mathematical basis for cryptography systems. Topics include permutation based codes, block cipher schemes and public key encryption.  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 1660 - Discrete Mathematics  
Credit(s): 3 Credits  
Concepts of discrete mathematics used in computer science; sets, sequences, strings, symbolic logic, proofs, mathematical induction, sums and products, number systems, algorithms, complexity, graph theory, finite state machines.  
Prerequisite(s): (MATH 1200 or Math Waiver per Advisor with a minimum score of 1200)  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 1930 - Special Topics  
Credit(s): 1-3 Credits (Repeatable for credit)  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 1980 - Independent Study  
Credit(s): 1-3 Credits (Repeatable for credit)  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 2530 - Calculus III  
Credit(s): 4 Credits  
Three-dimensional analytic geometry, vector-valued functions, partial differentiation, multiple integration, and line integrals. (Offered every Fall and Spring)  
Prerequisite(s): (MATH 1520 with a grade of C- or higher or Math Waiver per Advisor with a minimum score of 1520)  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 2660 - Principles of Mathematics  
Credit(s): 3 Credits  
Introduction to the basic techniques of writing proofs and to fundamental ideas used throughout mathematics. Topics covered include formal logic, proof by contradiction, set theory, mathematical induction and recursion, relations and congruence, functions. Offered every Fall and Spring)  
Prerequisite(s): (MATH 1510 or Math Waiver per Advisor with a minimum score of 1510)  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 2690 - Mathematical Problem Solving  
Credit(s): 1 Credit  
Intended primarily to train students for the William Lowell Putnam Mathematical Competition, this course covers a mélange of ingenious techniques for solving mathematics problems cutting across the entire undergraduate spectrum, including pre-calculus, calculus, combinatorics, probability, inequalities. Coverage tailored to students' interests. Offered every Fall)  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 2930 - Special Topics  
Credit(s): 1-4 Credits (Repeatable for credit)  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 2980 - Independent Study  
Credit(s): 1-4 Credits (Repeatable for credit)  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 3050 - Cryptology  
Credit(s): 3 Credits  
An inquiry course open to all undergraduates. Aimed at students who require a course at the level of calculus or higher and who are interested in the mathematical basis for cryptography systems. Topics include permutation based codes, block cipher schemes and public key encryption.  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 3060 - Discrete Mathematics  
Credit(s): 3 Credits  
Concepts of discrete mathematics used in computer science; sets, sequences, strings, symbolic logic, proofs, mathematical induction, sums and products, number systems, algorithms, complexity, graph theory, finite state machines.  
Prerequisite(s): (MATH 1200 or Math Waiver per Advisor with a minimum score of 1200)  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 3930 - Special Topics  
Credit(s): 1-4 Credits (Repeatable for credit)  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)  

MATH 3980 - Independent Study  
Credit(s): 1-4 Credits (Repeatable for credit)  
Prior approval of sponsoring professor and chair required.  
Attributes: Mathematics BA Req (A&S), Mathematics BS Req (A&S)
MATH 3110 - Linear Algebra for Engineers
Credit(s): 3 Credits
Systems of linear equations, matrices, linear programming, determinants, vector spaces, inner product spaces, eigenvalues and eigenvectors, linear transformations, and numerical methods. Credit not given for both MATH 3110 and MATH 3120. Does not satisfy any requirements for the mathematics major. (Offered in Spring)
Prerequisite(s): MATH 1520 with a grade of C- or higher

MATH 3120 - Introduction to Linear Algebra
Credit(s): 3 Credits
Matrices, row operations with matrices, determinants, systems of linear equations, vector spaces, linear transformations, inner products, eigenvalues and eigenvectors. Credit not given for both MATH 3110 and MATH 3120. (Offered every Fall and Spring)
Prerequisite(s): MATH 2660; MATH 2530

MATH 3230 - Vector Analysis
Credit(s): 3 Credits
Vector algebra, differential and integral calculus of vector functions, linear vector functions and dyadics, applications to geometry, particle and fluid mechanics, theory of vector fields. (Offered periodically)
Prerequisite(s): (MATH 2530 or Math Waiver per Advisor with a minimum score of 2530)

MATH 3240 - Numerical Analysis
Credit(s): 3 Credits
Review of calculus; root finding, nonlinear systems, interpolation and approximation; numerical differentiation and integration.
Prerequisite(s): (MATH 1520 or Math Waiver per Advisor with a minimum score of 1520)

MATH 3270 - Advanced Mathematics for Engineers
Credit(s): 3 Credits
Vector algebra; matrix algebra; systems of linear equations; eigenvalues and eigenvectors; systems of differential equations; vector differential calculus; divergence, gradient and curl; vector integral calculus; integral theorems; Fourier series with applications to partial differential equations. (Offered every Fall and Spring)
Prerequisite(s): MATH 3550

MATH 3280 - Probability and Statistics for Engineers
Credit(s): 3 Credits
Descriptive statistics, probability distributions, random variables, expectation, independence, hypothesis testing, confidence intervals, regression and ANOVA. Applications and theory. Taught using statistical software. Credit not given toward the math major or minors for both MATH 3800 and either MATH 3810 or MATH 4800. (Offered every Fall)
Prerequisite(s): MATH 2530

MATH 3550 - Foundation of Statistics
Credit(s): 3 Credits
Descriptive statistics, probability distributions, random variables, expectation, independence, hypothesis testing, confidence intervals, regression and ANOVA. Applications and theory. Taught using statistical software. Credit not given toward the math major or minors for both MATH 3810 and either MATH 3800 or MATH 3850.
Prerequisite(s): MATH 2530

MATH 3760 - Financial Mathematics
Credit(s): 3 Credits
This course covers the theory of interest material for the Financial Mathematics exam of the Society of Actuaries. Time permitting, supplemental material covering financial derivatives will be discussed.
Prerequisite(s): MATH 1520

MATH 3800 - Elementary Theory of Probability
Credit(s): 3 Credits
Counting theory; axiomatic probability, random variables, expectation, limit theorems. Applications of the theory of probability to a variety of practical problems. Credit not given toward the math major or minors for both MATH 3800 and either MATH 3810 or MATH 4800. (Offered every Fall)
Prerequisite(s): MATH 2530

MATH 3800 - Probability and Statistics for Engineers
Credit(s): 3 Credits
Analyzing and producing data; probability; random variables; probability distributions; expectation; sampling distributions; confidence intervals; hypothesis testing; experimental design; regression and correlation analysis. Credit not given toward the math major or minors for both MATH 3810 and either MATH 3800 or MATH 3850.
Prerequisite(s): MATH 2530

MATH 3810 - Probability and Statistics for Engineers
Credit(s): 3 Credits
Descriptive statistics, probability distributions, random variables, expectation, independence, hypothesis testing, confidence intervals, regression and ANOVA. Applications and theory. Taught using statistical software. Credit not given toward the math major or minors for both MATH 3810 and either MATH 3800 or MATH 3850.
Prerequisite(s): MATH 1520

MATH 3810 - Probability and Statistics for Engineers
Credit(s): 3 Credits
Analyzing and producing data; probability; random variables; probability distributions; expectation; sampling distributions; confidence intervals; hypothesis testing; experimental design; regression and correlation analysis. Credit not given toward the math major or minors for both MATH 3810 and either MATH 3800 or MATH 3850.
Prerequisite(s): MATH 2530

MATH 3850 - Financial Mathematics
Credit(s): 3 Credits
This course covers the theory of interest material for the Financial Mathematics exam of the Society of Actuaries. Time permitting, supplemental material covering financial derivatives will be discussed.
Prerequisite(s): MATH 1520

MATH 3910 - Internship
Credit(s): 1-3 Credits
MATH 3800 and either MATH 3810 or MATH 4800. (Offered every Fall)
Prerequisite(s): MATH 2530

MATH 3910 - Internship
Credit(s): 1-3 Credits
MATH 3800 and either MATH 3810 or MATH 4800. (Offered every Fall)
Prerequisite(s): MATH 2530

MATH 3930 - Special Topics
Credit(s): 0-3 Credits
(MATH 3800 or MATH 3850).

MATH 3980 - Independent Study
Credit(s): 1-3 Credits
(MATH 3800 or MATH 3850).

MATH 3980 - Independent Study
Credit(s): 1-3 Credits
(MATH 3800 or MATH 3850).

MATH 3910 - Internship
Credit(s): 1-3 Credits
(MATH 3800 or MATH 3850).

MATH 3930 - Special Topics
Credit(s): 0-3 Credits
(MATH 3800 or MATH 3850).

MATH 3980 - Independent Study
Credit(s): 1-3 Credits
(MATH 3800 or MATH 3850).

MATH 3980 - Independent Study
Credit(s): 1-3 Credits
(MATH 3800 or MATH 3850).

MATH 3980 - Independent Study
Credit(s): 1-3 Credits
(MATH 3800 or MATH 3850).

MATH 4110 - Introduction to Abstract Algebra
Credit(s): 3 Credits
Elementary properties of the integers, sets and mappings, groups, rings, integral domains, division rings and fields. (Offered every Fall)
Prerequisite(s): MATH 3120

MATH 4120 - Linear Algebra
Credit(s): 3 Credits
Advanced linear algebra, including linear transformations and duality, elementary canonical forms, rational and Jordan forms, inner product spaces, unitary operators, normal operators and spectral theory. (Offered every Spring)
Prerequisite(s): MATH 4110
MATH 4150 - Number Theory
Credit(s): 3 Credits
Introduction to algebraic number theory. Topics will include primes, Chinese remainder theorem, Diophantine equations, algebraic numbers and quadratic residues. Additional topics will vary from year to year. (Offered periodically)
Prerequisite(s): MATH 4110

MATH 4210 - Introduction to Analysis
Credit(s): 3 Credits
Real number system, functions, sequences, limits, continuity, differentiation, integration and series. (Offered every Fall)
Prerequisite(s): MATH 2530; MATH 3120 with a grade of C- or higher

MATH 2530; MATH 3120 with a grade of C- or higher

MATH 4220 - Metric Spaces
Credit(s): 3 Credits
Set theory, metric spaces, completeness, compactness, connected sets, category. (Offered every Spring)
Prerequisite(s): MATH 4210

MATH 4230 - Multivariable Analysis
Credit(s): 3 Credits
Introduction to analysis in multidimensional Euclidean space. Sequences and Series of functions, Differentiability, Integrability, Inverse and Implicit function theorems, Fundamental Theorems of Multivariable Calculus (Green's Theorem, Stokes' Theorem, Divergence Theorem). (Offered every Spring)
Prerequisite(s): MATH 4210

MATH 4310 - Introduction to Complex Variables
Credit(s): 3 Credits
Complex number system and its operations, limits and sequences, continuous functions and their properties, derivatives, conformal representation, curvilinear and complex integration, Cauchy integral theorems, power series and singularities. (Offered every Fall)
Prerequisite(s): (MATH 2530 or Math Waiver per Advisor with a minimum score of 2530)

MATH 4320 - Complex Variables II
Credit(s): 3 Credits
This course is a continuation of MATH 4310. Topics covered include series, residues and poles, conformal mapping, integral formulas, analytic continuation, and Riemann surfaces. (Offered every Spring)
Prerequisite(s): MATH 4310

MATH 4360 - Geometric Topology
Credit(s): 3 Credits
An introduction to the geometry and topology of surfaces and three dimensional spaces. Topics covered include Euclidean, spherical and hyperbolic geometry, topology of surfaces, knot theory, and the fundamental group.
Prerequisite(s): MATH 4310

MATH 4410 - Foundations of Geometry
Credit(s): 3 Credits
Historical background of the study of Euclidean geometry; development of two-dimensional Euclidean geometry from a selected set of postulates. (Offered periodically)
Prerequisite(s): (MATH 1510 or Math Waiver per Advisor with a minimum score of 1510)

MATH 4430 - Non-Euclidean Geometry
Credit(s): 3 Credits
The rise and development of the non-Euclidean geometries with intensive study of plane hyperbolic geometry. (Offered periodically)
Prerequisite(s): (MATH 1510 or Math Waiver per Advisor with a minimum score of 1510)

MATH 4480 - Differential Geometry
Credit(s): 3 Credits
Classical theory of smooth curves and surfaces in 3-space. Curvature and torsion of space curves, Gaussian curvature of surfaces, the Theorema Egregium of Gauss. (Offered occasionally)
Prerequisite(s): MATH 2530

MATH 4550 - Nonlinear Dynamics and Chaos
Credit(s): 3 Credits
Bifurcation in one-dimensional flows. Two-dimensional flows, fixed points and linearization, conservative systems, index theory, limit cycles. Poincaré–Bendixson theory, bifurcations. Chaos, the Lorenz equation, discrete maps, fractals, and strange attractors.
Prerequisite(s): MATH 3550

MATH 4570 - Partial Differential Equations
Credit(s): 3 Credits
Fourier series, Fourier Integrals, the heat equation, Sturm-Liouville problems, the wave equation, the potential equation, problems in several dimensions, Laplace transforms numerical methods.
Prerequisite(s): MATH 3550

MATH 4630 - Graph Theory
Credit(s): 3 Credits
Basic definitions and concepts, undirected graphs (trees and graphs with cycles), directed graphs, and operation on graphs, Euler's formula, and surfaces. (Offered periodically)
Prerequisite(s): (MATH 2530 or Math Waiver per Advisor with a minimum score of 2530)

MATH 4650 - Cryptography
Credit(s): 3 Credits
Classical cryptographic systems, public key cryptography, symmetric block ciphers, implementation issues. Related and supporting mathematical concepts and structures.
Prerequisite(s): MATH 1520

MATH 4800 - Probability Theory
Credit(s): 3 Credits
Axioms of probability, conditional probability. Discrete and continuous random variables, expectation, jointly defined random variables. Transformations of random variables and limit theorems. Theory and applications, taught using statistical software. Credit not given toward the math major or minors for any two of MATH 3800, MATH 4800 and MATH 4810.
Prerequisite(s): (MATH 3850 or STAT 3850); MATH 2530; (MATH 1660 or MATH 2660)

MATH 4810 - Time Series
Credit(s): 3 Credits
Applied time series. Topics include exploratory data analysis, regression, ARIMA. Spectral analysis, state-space models. Theory and applications, taught using statistical software.
Prerequisite(s): (MATH 3850 or STAT 3850)
MATH 4850 - Mathematical Statistics
Credit(s): 3 Credits
Theory of estimators, sampling distributions, hypothesis testing, confidence intervals, regression, bootstrapping, and resampling. Theory and applications, taught using statistical software. Students may not take both MATH 4850 and MATH 4820.
Prerequisite(s): (MATH 4800 or STAT 4800)

MATH 4860 - Applied Regression
Credit(s): 3 Credits
Linear regression, model selection, nonparametric regression, classification and graphical models. Theory and applications using statistical software.
Prerequisite(s): (MATH 3850 or STAT 3850); (MATH 3110 or MATH 3120)

MATH 4910 - Internship
Credit(s): 1-6 Credits (Repeatable for credit)

MATH 4930 - Special Topics
Credit(s): 3 Credits (Repeatable for credit)

MATH 4980 - Advanced Independent Study
Credit(s): 0-6 Credits (Repeatable for credit)
Prior permission of sponsoring professor and chair required.

MATH 5011 - Introduction to Abstract Algebra
Credit(s): 3 Credits
Elementary properties of the integers, sets and mappings, groups, rings, integral domains, division rings and fields.

MATH 5012 - Linear Algebra
Credit(s): 3 Credits
Advanced linear algebra including linear transformations and duality, elementary canonical forms, rational and Jordan forms, inner product spaces, unitary operators, normal operators, and spectral theory. (Offered every other spring semester)

MATH 5015 - Number Theory
Credit(s): 3 Credits
Introduction to algebraic number theory. Topics will include primes, Chinese remainder theorem, Diophantine equations, algebraic numbers and quadratic residues. Additional topics will vary from year to year. (Offered every other year)
Prerequisite(s): MATH 5011

MATH 5021 - Introduction to Analysis
Credit(s): 3 Credits
Real number system, functions, sequences, limits, continuity, differentiation, integration and series.

MATH 5022 - Metric Spaces
Credit(s): 3 Credits
Set theory, real line, separation properties, compactness, metric spaces, metrization. (Offered every other spring semester)
Prerequisite(s): MATH 5021

MATH 5023 - Multivariable Analysis
Credit(s): 3 Credits
Sequences and Series of functions, Differentiability, Integrability, Inverse and Implicit function theorems, Fundamental Theorems of Multi-variable Calculus (Green's Theorem, Stokes Theorem, Divergence Theorem).
Prerequisite(s): MATH 5021

MATH 5080 - Probability Theory
Credit(s): 3 Credits
Axioms of probability, conditional probability. Discrete and continuous random variables, expectation, jointly defined random variables. Transformations of random variables and limit theorems. Theory and applications, taught using statistical software.

MATH 5110 - Algebra I
Credit(s): 3 Credits
Simple properties of groups, groups of transformations, subgroups, homomorphisms and isomorphisms, theorems of Schreier and Jordan-Hölder; mappings into a group, rings, integral domains, fields, polynomials, direct sums and modules. (Offered every Fall)

MATH 5120 - Algebra II
Credit(s): 3 Credits
Rings, fields, bases and degrees of extension fields, transcendental elements, normal fields and their structures. Galois theory, finite fields; solutions of equations by radicals, general equations of degree n. (Offered every Spring)
Prerequisite(s): MATH 5110

MATH 5210 - Real Analysis
Credit(s): 3 Credits
The topology of the reals, Lebesgue and Borel measurable functions, properties of the Lebesgue integral, differential of the integral. Offered every Fall semester.

MATH 5220 - Complex Analysis
Credit(s): 3 Credits
Holomorphic and Harmonic functions and power series expansions. Complex integration. Cauchy's theorem and applications. Laurent series, singularities, Runge's theorem, and the calculus of residues. Additional topics may include Analytic continuation, Riemann surfaces, and conformal mapping. MATH 4310 is recommended. (Offered periodically)
Prerequisite(s): MATH 5210; MATH 5310

MATH 5230 - Functional Analysis
Credit(s): 3 Credits
Banach and Hilbert spaces. Linear functions and linear operators. Dual spaces, weak and weak topologies. Hahn-Banach, Closed Graph and Open Mapping Theorems. Topological Vector spaces. (Offered periodically)
Prerequisite(s): MATH 5210; MATH 5310

MATH 5240 - Harmonic Analysis
Credit(s): 3 Credits
Fourier Series on the circle, Convergence of Fourier series, Conjugate and maximal functions, Interpolation of Linear Operators, Lacunary Sequences, Fourier Transform on the line, Fourier transform on locally compact Abelian groups. MATH 5310 is recommended.
Prerequisite(s): MATH 5210

MATH 5310 - General Topology I
Credit(s): 3 Credits
Topological spaces, convergence, nets, product spaces, metrization, compact spaces, connected spaces. (Offered every Fall)
MATH 5320 - General Topology II  
Credit(s): 3 Credits  
Compact surfaces, fundamental groups, force groups and free products,  
Seifert-van Kampen theorem, covering spaces. Offered every Spring  
semester.  
Prerequisite(s): MATH 5310  

MATH 5910 - Internship  
Credit(s): 1-3 Credits  

MATH 5930 - Special Topics in Mathematics  
Credit(s): 1-3 Credits (Repeatable for credit)  

MATH 5980 - Graduate Reading Course  
Credit(s): 1-3 Credits (Repeatable for credit)  
Prior permission of instructor and chairperson required.  

MATH 5990 - Thesis Research  
Credit(s): 0-6 Credits (Repeatable for credit)  

MATH 6110 - Algebra III  
Credit(s): 3 Credits  
Categories and functors, properties of Hom and Tensor, projective and  
injective modules, chain conditions, decomposition and cancellation of  
modules, theorems of Masche, Wedderburn, and Artin-Wedderburn, tensor  
geometries. Offered every other year.  
Prerequisite(s): MATH 5120  

MATH 6180 - Topics in Algebra  
Credit(s): 3 Credits  
Various topics are discussed to bring graduate students to the forefront  
of a research area in algebra. Times of offering in accordance with  
research interests of faculty. Offered occasionally.  

MATH 6210 - Lie Groups and Lie Algebras  
Credit(s): 3 Credits  
Lie groups and Lie algebras, matrix groups, the Lie algebra of a Lie group  
homogeneous spaces, solvable and nilpotent groups, semi-simple Lie  
groups. Offered every other year.  
Prerequisite(s): MATH 5110; MATH 5220; MATH 5310  

MATH 6220 - Rep Theory of Lie Groups  
Credit(s): 3 Credits  
Representation theory of Lie groups, irreducibility and complete  
reducibility, Cartan subalgebra and root space decomposition, root  
system and classification, coadjoint orbits, harmonic analysis on  
homogeneous spaces. Offered every other year.  
Prerequisite(s): MATH 6210  

MATH 6280 - Topics in Analysis  
Credit(s): 3 Credits (Repeatable for credit)  
Various topics are discussed to bring graduate students to the forefront of a  
research area in analysis. Times of offering in accordance with research  
interests of faculty. Offered occasionally.  

MATH 6310 - Algebraic Topology  
Credit(s): 3 Credits  
Homotopy theory, homology theory, exact sequences, Mayer-Vietoris  
sequences, degrees of maps, cohomology, Künneth formula, cup and cap  
products, applications to manifolds including Poincaré-Lefshetz duality.  
Offered every other year.  
Prerequisite(s): MATH 5320  

MATH 6320 - Topology of Manifolds  
Credit(s): 3 Credits  
Examples of manifolds, the tangent bundle, maps between manifolds,  
embeddings, critical values, transversality, isotopies, vector bundles  
and tubular neighborhoods, cobordism, intersection numbers and  
Euler characteristics. May be taught in either the piecewise linear or  
differentiable categories. Offered every other year.  
Prerequisite(s): MATH 6310  

MATH 6380 - Topics in Topology  
Credit(s): 3 Credits (Repeatable for credit)  
Various topics are offered to bring graduate students to the forefront of a  
research area in topology. Times of offering in accordance with research  
interests of faculty. Offered occasionally.  

MATH 6410 - Differential Geometry I  
Credit(s): 3 Credits  
The theory of differentiable manifolds, topological manifolds, differential  
calculus of several variables, smooth manifolds and submanifolds, vector  
fields and ordinary differential equations, tensor fields, integration and De  
Rham cohomology. Offered every Fall semester.  
Prerequisite(s): MATH 5320  

MATH 6420 - Differential Geometry II  
Credit(s): 3 Credits  
Continuation of MATH-6410. (Offered every Spring)  
Prerequisite(s): MATH 6410  

MATH 6480 - Topics in Geometry  
Credit(s): 3 Credits  
Various topics are offered to bring graduate students to the forefront of a  
research area in geometry. Times of offering in accordance with research  
interests of faculty. Offered occasionally.  
Prerequisite(s): MATH 5320  

MATH 6930 - Special Topics  
Credit(s): 3 Credits (Repeatable for credit)  

MATH 6980 - Graduate Reading Course  
Credit(s): 1-3 Credits (Repeatable for credit)  
Prior permission of instructor and chairperson required.  

MATH 6990 - Dissertation Research  
Credit(s): 0-6 Credits (Repeatable for credit)