# MATHEMATICS (MATH)

**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.

**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.

**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
**Attributes:** Prof. Studies Students Only

**MATH 0930 - Special Topics**
**Credit(s): 1 or 2 Credits**

**MATH 1200 - College Algebra**
**Credit(s): 0 or 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 0250 with a grade of C- or higher, Math Waiver per Advisor with a minimum score of 0250, MATH 0260 with a grade of C- or higher, or SLUMP with a minimum score of 0260)
**Attributes:** Mathematics BA Req (A&S)

**MATH 1205 - 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 or SLUMP with a minimum score of 1200)
**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, Math Waiver per Advisor with a minimum score of 1200, or SLUMP with a minimum score of 1400)
**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.
**Prerequisite(s):** (MATH 1200 with a grade of C- or higher, Math Waiver per Advisor with a minimum score of 1200, or SLUMP with a minimum score of 1400)
**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, Math Waiver per Advisor with a minimum score of 1200, or SLUMP with a minimum score of 1400)
**Attributes:** Bio-Chemical Biology Elective, Mathematics BA Req (A&S)

**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, Math Waiver per Advisor with a minimum score of 1200, or SLUMP with a minimum score of 1400)
**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, Math Waiver per Advisor with a minimum score of 1200, or SLUMP with a minimum score of 1400)
**Restrictions:**
Students in the Madrid, Spain campus may **not** enroll.

**Attributes:** Prof. Studies Students Only

**MATH 1400 - Pre-Calculus**
**Credit(s): 0 or 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, MATH 1200 with a grade of C- or higher, or SLUMP with a minimum score of 1400)
**Attributes:** Mathematics BA Req (A&S)

**MATH 1510 - Calculus I**
**Credit(s): 0 or 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 Waiver per Advisor with a minimum score of 1400, MATH 1400 with a grade of C- or higher, or SLUMP with a minimum score of 1510)
**Attributes:** Mathematics BA Req (A&S), Mathematics BS Req (A&S)

**MATH 1520 - Calculus II**
**Credit(s): 0 or 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, AP Calculus AB with a minimum score of 4, or SLUMP with a minimum score of 1520)
**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 with a grade of C- or higher, Math Waiver per Advisor with a minimum score of 1200, or SLUMP with a minimum score of 1400)
**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, Math Waiver per Advisor with a minimum score of 1520, or SLUMP with a minimum score of 2530)
**Attributes:** Geospatial Elective, 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, Math Waiver per Advisor with a minimum score of 1510, or SLUMP with a minimum score of 1520)
**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): 0-3 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 or SLUMP with a minimum score of 2530)
**Attributes:** Geospatial Elective

**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 2530; MATH 2660

**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, Math Waiver per Advisor with a minimum score of 1520, or SLUMP with a minimum score of 2530)

**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[*]

[*] Concurrent enrollment allowed.

**MATH 3550 - Differential Equations**
**Credit(s): 3 Credits**
Solution of ordinary differential equations, higher order linear equations, constant coefficient equations, systems of first order equations, linear systems, equilibrium of nonlinear systems, Laplace transformations.
**Prerequisite(s):** (MATH 2530 or Math Waiver per Advisor with a minimum score of 2530)
**Attributes:** Geospatial Elective

**MATH 3600 - Combinatorics**
**Credit(s): 3 Credits**
Advanced counting methods: permutations and combinations, generalized permutations and combinations, recurrence relations, generating functions; algorithms: graphs and digraphs, graph algorithms: minimum-cost spanning trees, shortest path, network flows; depth first and breadth-first searches; combinational algorithms: resource scheduling, bin-packing: algorithmic analysis and NP completeness.
**Prerequisite(s):** (MATH 1510 or Math Waiver per Advisor with a minimum score of 1510)

**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 or SLUMP with a minimum score of 2530)

**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 3850 - 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 MATH 3850 / STAT 3850.
**Prerequisite(s):** MATH 1520
**Attributes:** Bio-Chemical Biology Elective

**MATH 3910 - Internship**
**Credit(s): 1-6 Credits** (Repeatable for credit)

**MATH 3930 - Special Topics**
**Credit(s): 0-3 Credits** (Repeatable for credit)

**MATH 3980 - Independent Study**
**Credit(s): 1-3 Credits** (Repeatable for credit)

**MATH 4050 - History of Mathematics**
**Credit(s): 3 Credits**
The development of several important branches of mathematics, including numeration and computation, algebra, non-Euclidean geometry, and calculus. (Offered periodically)
**Prerequisite(s):** MATH 1520

**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 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

**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.
**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 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. Poincar-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
**Attributes:** Geospatial Elective

**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 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 4840 - 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.
**Prerequisite(s):** (MATH 4800 or STAT 4800)

**MATH 4870 - 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 spring semester)
**Prerequisite(s):** MATH 5011

**MATH 5021 - Introduction to Analysis**
**Credit(s): 3 Credits**
Real number system, functions, sequences, limits, continuity, differentiation, integration and series.
**Attributes:** Bioinformatics & Comp Bio Elec

**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). (Offered every other spring semester)
**Prerequisite(s):** MATH 5021
**Attributes:** Bioinformatics & Comp Bio Elec

**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.
**Attributes:** Bioinformatics & Comp Bio Elec

**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 Lebesque 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. (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. (Offered periodically)
**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 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 6280 - Topics in Analysis**
**Credit(s): 3 Credits** (Repeatable for credit)
Various topics are offered 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 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 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)