

# MATHEMATICS (MATH)

## MATH 0235 - Intro Elementary Algebra

3 Credits

Prerequisite: Math Assessment.

Attributes: Prof. Studies Students Only

## MATH 0240 - Intro Elementary Algebra I

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

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 0261 - Intermediate Algebra Support Lab

2 Credits

Intermediate Algebra Support Lab MATH 0261 is required for all students retaking Intermediate Algebra MATH 0260. MATH 0260 and MATH 0261 must be taken concurrently. This course fills gaps in mathematical knowledge and builds the necessary study skills to succeed with further mathematics and its applications.

Corequisite(s): MATH 1000

## MATH 0300 - Math Skills for College

1 Credit

Math Skills for College is a self-guided course aimed at enabling students to improve their ALEKS placement scores, possibly saving a semester of coursework. This course uses an adaptive homework system to identify and fill gaps in mathematical knowledge and builds the necessary study skills to succeed with further mathematics and its applications. The class is composed of homework, quizzes, and group discussions.

## MATH 0930 - Special Topics

1 or 2 Credits

## MATH 1000 - Intermediate Algebra

0 or 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 0240 or SLU Math Placement with a minimum score of 0240)

## MATH 1010 - Progress Towards College Algebra

1 Credit

Progress Towards College Algebra is designed for students scoring a 30-45 on their ALEKS placement scores. It is a self-guided course aimed at enabling students to improve their ALEKS placement scores, possibly saving a semester of coursework. This course uses an adaptive homework system to identify and fill gaps in mathematical knowledge and builds the necessary study skills to succeed with further mathematics and its applications. The class is composed of homework, quizzes, and tests.

## MATH 1020 - Progress towards Precalculus

2 Credits

Progress Towards Math 1400 Pre-Calculus is designed for students scoring a 46-60 on their ALEKS placement scores. It is a self-guided course aimed at enabling students to improve their ALEKS placement scores, possibly saving a semester of coursework. This course uses an adaptive homework system to identify and fill gaps in mathematical knowledge and builds the necessary study skills to succeed with further mathematics and its applications. The class is composed of homework, quizzes, and group discussions.

## MATH 1200 - College Algebra

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, SLU Math Placement with a minimum score of 1200, or MATH 1000 with a grade of C- or higher)

Attributes: Mathematics BA Req (A&S)

## MATH 1220 - Finite Mathematics

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, MATH 0260 with a grade of C- or higher, SLU Math Placement with a minimum score of 0260, or MATH 1000 with a grade of C- or higher)

Attributes: Mathematics BA Req (A&S), UUC:Quantitative Reasoning

## MATH 1240 - Mathematics and the Art of M.C. Escher

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 SLU Math Placement with a minimum score of 1400)

Attributes: Mathematics BA Req (A&S), UUC:Quantitative Reasoning

## MATH 1250 - Math Thinking in Real World

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 SLU Math Placement with a minimum score of 1400)

Attributes: Mathematics BA Req (A&S), UUC:Quantitative Reasoning

**MATH 1260 - Statistics Including Sports and Politics**

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 1270 - Math Media: Reading News with Mathematical Eyes**

3 Credits

An inquiry course open to all undergraduates. This course introduces students to math which carries important weight in our decisions and lives. The methodology is focused on the discussion of contemporary news, through the lens of mathematical concepts. The course explores topics in probability, trigonometry, pattern recognition, math modeling, graph theory, geometry, descriptive statistics, and logic. The course emphasizes applications of mathematics to law, health, society, politics, analyzing meaning from data, and current events.

**Attributes:** UUC:Quantitative Reasoning

**MATH 1300X - Elementary Statistics with Computers**

3 Credits

Data production and analysis; probability basics, distributions; sampling, estimation with confidence intervals, hypothesis testing, t-test; correlation and regression; Cross tabulations and chi-square. Students learn to use a statistical package such as SPSS. Credit not given for STAT 1300 and any of the following: MATH 1300 or OPM 2070.

**Prerequisite(s):** (1 Course from MATH 1200-4999, Math Waiver per Advisor with a minimum score of 1200, or SLU Math Placement with a minimum score of 1200)

**Attributes:** Bio-Chemical Biology Elective, Mathematics BA Req (A&S), UUC:Quantitative Reasoning

**MATH 1320 - Survey of Calculus**

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.

**Prerequisite(s):** (MATH 1200 with a grade of C- or higher, Math Waiver per Advisor with a minimum score of 1200, or SLU Math Placement with a minimum score of 1400)

**Attributes:** Mathematics BA Req (A&S), UUC:Quantitative Reasoning

**MATH 1400 - Pre-Calculus**

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 SLU Math Placement with a minimum score of 1400)

**Attributes:** Mathematics BA Req (A&S), UUC:Quantitative Reasoning

**MATH 1510 - Calculus I**

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.

**Prerequisite(s):** (Math Waiver per Advisor with a minimum score of 1400, MATH 1400 with a grade of C- or higher, or SLU Math Placement with a minimum score of 1510)

**Attributes:** Mathematics BA Req (A&S), Mathematics BS Req (A&S), UUC:Quantitative Reasoning

**MATH 1520 - Calculus II**

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 SLU Math Placement with a minimum score of 1520)

**Attributes:** Mathematics BA Req (A&S), Mathematics BS Req (A&S), UUC:Quantitative Reasoning

**MATH 1660 - Discrete Mathematics**

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 SLU Math Placement with a minimum score of 1400)

**Attributes:** Mathematics BA Req (A&S), Mathematics BS Req (A&S)

**MATH 1930 - Special Topics**

1-3 Credits (Repeatable for credit)

**Attributes:** Mathematics BA Req (A&S), Mathematics BS Req (A&S)

**MATH 1980 - Independent Study**

1-3 Credits (Repeatable for credit)

**Attributes:** Mathematics BA Req (A&S), Mathematics BS Req (A&S)

**MATH 2530 - Calculus III**

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 SLU Math Placement with a minimum score of 2530)

**Attributes:** Geospatial Elective, Mathematics BA Req (A&S), Mathematics BS Req (A&S), UUC:Quantitative Reasoning

**MATH 2660 - Principles of Mathematics**

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 SLU Math Placement with a minimum score of 1520)

**Attributes:** Mathematics BA Req (A&S), Mathematics BS Req (A&S), UUC:Quantitative Reasoning

**MATH 2690 - Mathematical Problem Solving**

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**

1-4 Credits (Repeatable for credit)

**Attributes:** Mathematics BA Req (A&S), Mathematics BS Req (A&S)

**MATH 2980 - Independent Study**

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**

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 SLU Math Placement with a minimum score of 2530)

**Attributes:** Geospatial Elective

**MATH 3120 - Introduction to Linear Algebra**

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**

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 SLU Math Placement with a minimum score of 2530)

**MATH 3270 - Advanced Mathematics for Engineers**

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**

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**

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; combinatorial algorithms: resource scheduling, bin-packing: algorithmic analysis and NP completeness.

**Prerequisite(s):** (MATH 1510, Math Waiver per Advisor with a minimum score of 1510, or SLU Math Placement with a minimum score of 1520)

**MATH 3760 - Financial Mathematics**

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 SLU Math Placement with a minimum score of 2530)

**MATH 3800 - Elementary Theory of Probability**

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**

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**

1-6 Credits (Repeatable for credit)

**Prerequisite(s):** (CORE 1000 or UUC Ignite Seminar Waiver with a minimum score of S); CORE 1500\*

\* Concurrent enrollment allowed.

**Attributes:** UUC:Reflection-in-Action

**MATH 3930 - Special Topics**

0-3 Credits (Repeatable for credit)

**MATH 3980 - Independent Study**

1-3 Credits (Repeatable for credit)

**MATH 4050 - History of Mathematics**

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**

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**

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**

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**

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**

3 Credits

Set theory, metric spaces, completeness, compactness, connected sets, category. (Offered every Spring)

**Prerequisite(s):** MATH 4210**MATH 4230 - Multivariable Analysis**

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**

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**

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**

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**

3 Credits

The rise and development of the non-Euclidean geometries with intensive study of plane hyperbolic geometry. (Offered periodically)

**Prerequisite(s):** (0 Course from MATH 1510-2530 or Math Waiver per Advisor with a minimum score of 1510)**MATH 4550 - Nonlinear Dynamics and Chaos**

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**

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**

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**

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**

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**

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**

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**

1-6 Credits (Repeatable for credit)

**Prerequisite(s):** (CORE 1000 or UUC Ignite Seminar Waiver with a minimum score of S); CORE 1500\*

\* Concurrent enrollment allowed.

**Attributes:** UUC:Reflection-in-Action**MATH 4930 - Special Topics**

3 Credits (Repeatable for credit)



**MATH 4980 - Advanced Independent Study**

0-6 Credits (Repeatable for credit)

Prior permission of sponsoring professor and chair required.

**MATH 5011 - Introduction to Abstract Algebra**

3 Credits

Elementary properties of the integers, sets and mappings, groups, rings, integral domains, division rings and fields.

**MATH 5012 - Linear Algebra**

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**

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**

3 Credits

Real number system, functions, sequences, limits, continuity, differentiation, integration and series.

**Attributes:** Bioinformatics & Comp Bio Elec, Health & Rehab Sci Research**MATH 5022 - Metric Spaces**

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**

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, Health & Rehab Sci Research**MATH 5080 - Probability Theory**

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, Health & Rehab Sci Research**MATH 5110 - Algebraic Structures I**

3 Credits

This course is intended as a graduate-level introduction to groups, rings, and fields. These algebraic objects are of fundamental importance to numerous branches of mathematics, including algebraic number theory, algebraic geometry, representation theory, analysis, topology, differential geometry, and partial differential equations. This course will provide the algebraic foundations for further study in more specialized topics.

**MATH 5120 - Algebra II**

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 5130 - Computational Algebra**

3 Credits

This course is an introduction to computational methods in algebra.

The course will cover a selection of computer algebra topics such as factorization and greatest common divisors, fast multiplication (FFT), solving polynomial equations, lattice reduction, linear difference equations, Groebner bases, and elimination theory. Additional topics may be introduced at the instructors discretion. The course will include a general introduction to the topics as well as a discussion of algorithms and applications.

**MATH 5140 - Algebraic Combinatorics**

3 Credits

This course is intended as a graduate-level introductory course in algebraic combinatorics. Algebraic combinatorics is defined as the interactions between algebra and combinatorics. The goal of this course is to provide some fundamental ideas and notions of combinatorics and to use combinatorial techniques to solve problems in algebra and vice versa.

**MATH 5210 - Measure Theory**

3 Credits

The topology of the reals, Lebesgue and Borel measurable functions, properties of the Lebesgue integral, differential of the integral.

**MATH 5220 - Complex Analysis**

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 5240 - Harmonic Analysis**

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 - Point Set Topology**

3 Credits

Topological spaces, convergence, nets, product spaces, metrization, compact spaces, connected spaces.

**MATH 5320 - General Topology II**

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 5350 - Differential Topology**

3 Credits

This course will be an introduction to elementary differential topology. Topics covered include manifolds and smooth maps, morse functions, manifolds with boundary, transversality, intersection numbers, orientation, vector fields, the Euler Characteristic, and vector bundles.

**MATH 5360 - Applied Topology and the Shape of Data**

3 Credits

This graduate course will involve a brief introduction to elementary algebraic topology and some of its applications, including topological data analysis. The course will be a mixture of proofs and computations which help illuminate the theory.

**MATH 5910 - Internship**

1-3 Credits

**MATH 5930 - Special Topics in Mathematics**

1-3 Credits (Repeatable for credit)

**MATH 5980 - Graduate Independent Study in Mathematics**

1-3 Credits (Repeatable for credit)

Prior permission of instructor and chairperson required.

**MATH 5990 - Thesis Research**

0-6 Credits (Repeatable for credit)

**MATH 6120 - Algebraic Number Theory and Commutative Algebra**

3 Credits

This course is an introduction to algebraic number theory and related aspects of commutative algebra. The main objects of study are algebraic number fields, finite extensions of the rational numbers, and their rings of integers. The course will cover topics in ideal theory, Dedekind domains, integral elements, units and unit groups, class groups, valuations, and local-global principles. Applications such as to Diophantine equations will be included as appropriate. Additional topics may be introduced at the instructor's discretion.

**Prerequisite(s):** MATH 5110

**MATH 6180 - Topics in Algebra**

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 6230 - Functional Analysis**

3 Credits

Banach and Hilbert spaces. Linear functionals and linear operators. Dual spaces, weak and weak-\* topologies. Hahn-Banach, Closed Graph and Open Mapping Theorems. Topological Vector spaces.

**MATH 6280 - Topics in Analysis**

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**

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-Lefschetz duality.

**Prerequisite(s):** MATH 5310

**MATH 6380 - Topics in Topology**

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**

3 Credits

This course is an introduction to Riemannian manifolds, including much on the behavior of geodesics. A key highlight is the Hopf-Rinow Theorem on completeness.

**Prerequisite(s):** MATH 5320

**MATH 6420 - Differential Geometry II**

3 Credits

Continuation of MATH-6410. (Offered every Spring)

**Prerequisite(s):** MATH 6410

**MATH 6930 - Special Topics**

3 Credits (Repeatable for credit)

**MATH 6980 - Graduate Independent Study in Mathematics**

1-3 Credits (Repeatable for credit)

Prior permission of instructor and chairperson required.

**MATH 6990 - Dissertation Research**

0-6 Credits (Repeatable for credit)