

# Mathematics (MATH)

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## **MATH 120. Appreciation of Mathematics. 3 Hours.**

An exploration of topics which illustrate the power and beauty of mathematics, with a focus on the role mathematics has played in the development of Western culture. This course is designed for students who are not required to take statistics or calculus as part of their studies. Students who previously earned credit for a math course at the 200-level or higher are not permitted to enroll or earn credit for this course.

## **MATH 140. Statistics. 3 Hours.**

An introduction to statistical thinking and the analysis of data using such methods as graphical descriptions, correlation and regression, estimation, hypothesis testing, and statistical models.

## **MATH 160. Calculus for the Social Sciences. 3 Hours.**

A graphical, numerical and symbolic introduction to the theory and applications of derivatives and integrals of algebraic, exponential, and logarithmic functions, with an emphasis on applications in the social sciences.

## **MATH 181. Calculus I. 3 Hours.**

A graphical, numerical, and symbolic study of the theory and applications of the derivative of algebraic, trigonometric, exponential, and logarithmic functions, and an introduction to the theory and applications of the integral. Suitable for students of both the natural and the social sciences.

## **MATH 182. Calculus II. 3 Hours.**

A graphical, numerical, and symbolic study of the theory, techniques, and applications of integration, and an introduction to infinite series and/or differential equations.

**Prerequisite:** MATH 181 with a minimum grade of D.

## **MATH 201. Modeling & Simulation. 3 Hours.**

A course in scientific programming, part of the inter- disciplinary field of computational science. Large, open-ended, scientific problems often require the algorithms and techniques of discrete and continuous computational modeling and Monte Carlo simulation. Students learn fundamental concepts and implementation of algorithms in various scientific programming environments. Throughout, applications in the sciences are emphasized. Cross-listed as Computer Science 201.

**Prerequisite:** MATH 181 with a minimum grade of D.

## **MATH 210. Multivariable Calculus. 3 Hours.**

A study of the geometry of three-dimensional space and the calculus of functions of several variables.

**Prerequisite:** MATH 182 with a minimum grade of D.

## **MATH 212. Vector Calculus. 3 Hours.**

A study of vectors and the calculus of vector fields, highlighting applications relevant to engineering such as fluid dynamics and electrostatics.

**Prerequisite:** MATH 182 with a minimum grade of D.

## **MATH 220. Linear Algebra. 3 Hours.**

The theoretical and numerical aspects of finite dimensional vector spaces, linear transformations, and matrices, with applications to such problems as systems of linear equations, difference and differential equations, and linear regression.

**Prerequisite:** MATH 182 with a minimum grade of D.

## **MATH 235. Discrete Mathematical Models. 3 Hours.**

An introduction to some of the important models, techniques, and modes of reasoning of non-calculus mathematics. Emphasis on graph theory and combinatorics. Applications to computing, statistics, operations research, and the physical and behavioral sciences.

**Prerequisite:** MATH 182 with a minimum grade of D.

## **MATH 240. Differential Equations. 3 Hours.**

The theory and application of first- and second-order differential equations including both analytical and numerical techniques.

**Prerequisite:** MATH 182 with a minimum grade of D.

## **MATH 250. Introduction to Technical Writing. 1 Hour.**

An introduction to technical writing in mathematics and the sciences with the markup language LaTeX, which is used to typeset mathematical and scientific papers, especially those with significant symbolic content.

## **MATH 260. Introduction to Mathematical Proof. 3 Hours.**

An introduction to rigorous mathematical argument with an emphasis on the writing of clear, concise mathematical proofs. Topics will include logic, sets, relations, functions, and mathematical induction. Additional topics may be chosen by the instructor.

**Prerequisite:** MATH 182 with a minimum grade of D.

## **MATH 280. Selected Topics in Mathematics. 1 to 4 Hours.**

Selected topics in mathematics at the introductory or intermediate level.

## **MATH 310. History of Mathematics. 3 Hours.**

A survey of the history and development of mathematics from antiquity to the twentieth century.

**Prerequisite:** MATH 260 with a minimum grade of D.

## **MATH 320. Mathematical Modeling. 3 Hours.**

The study of problem-solving strategies to solve open-ended, real-world problems.

**Prerequisite:** MATH 210 with a minimum grade of D or MATH 220 with a minimum grade of D or MATH 240 with a minimum grade of D.

## **MATH 330. Numerical Methods. 3 Hours.**

A study of the theory and computer implementation of numerical methods. Topics include error analysis, zeros of polynomials, numerical differentiation and integration, and systems of linear equations.

**Prerequisite:** MATH 220 with a minimum grade of D.

## **MATH 410. Geometry. 3 Hours.**

A study of the foundations of Euclidean geometry with emphasis on the role of the parallel postulate. An introduction to non-Euclidean (hyperbolic) geometry and its intellectual implications.

**Prerequisite:** MATH 260 with a minimum grade of D.

## **MATH 415. Topology. 3 Hours.**

An introduction to topological spaces. Topics will include examples of topological spaces, standard constructions of topological spaces, continuous maps, topological properties, homotopies, homeomorphisms, and simplicial complexes.

**Prerequisite:** MATH 260 with a minimum grade of D.

## **MATH 421. Probability and Statistics I. 3 Hours.**

A study of probability models, random variables, estimation, hypothesis testing, and linear models, with applications to problems in the physical and social sciences.

**Prerequisite:** MATH 210 with a minimum grade of D and MATH 260 with a minimum grade of D.

**MATH 422. Probability and Statistics II. 3 Hours.**

A study of probability models, random variables, estimation, hypothesis testing, and linear models, with applications to problems in the physical and social sciences.

**Prerequisite:** MATH 421 with a minimum grade of D.

**MATH 424. Advanced Game Theory. 3 Hours.**

Game Theory is an analytical tool that models strategic interactions. It is widely used in economics, political science, biology, sociology, and psychology. This advanced class is intended to provide a more rigorous introduction to the main concepts and techniques of the field. These techniques will be used to investigate relevant social phenomena, such as evolutionary games, auction theory, the "prisoner's dilemma," the "tragedy of the commons," tacit collusion, competition among firms, and strategic interactions in labor, credit, and product markets. The most important classes of games will be analyzed (zero-sum games, cooperation problems, coordination games, bayesian games, signaling games, etc.), as well as the most important solution concepts (rationalizability, nash equilibrium in pure and mixed strategies, bayesian nash equilibrium, and evolutionarily stable strategies). This course will also introduce students to the main techniques of game-theoretic mathematical modelling.

**Prerequisite:** MATH 210 with a minimum grade of D.

**MATH 431. Abstract Algebra I. 3 Hours.**

The axiomatic development of abstract algebraic systems, including groups, rings, integral domains, fields, and vector spaces.

**Prerequisite:** MATH 220 with a minimum grade of D and MATH 260 with a minimum grade of D.

**MATH 432. Abstract Algebra II. 3 Hours.**

The axiomatic development of abstract algebraic systems, including groups, rings, integral domains, fields, and vector spaces.

**Prerequisite:** MATH 431 with a minimum grade of D.

**MATH 435. Cryptology. 3 Hours.**

An introduction to cryptology and modern applications. Students will study various historical and modern ciphers and implement select schemes using mathematical software. Cross-listed with COSC 435.

**Prerequisite:** MATH 220 with a minimum grade of D and (MATH 235 with a minimum grade of D or MATH 260 with a minimum grade of D).

**MATH 439. Elementary Number Theory. 3 Hours.**

A study of the oldest branch of mathematics, this course focuses on mathematical properties of the integers and prime numbers. Topics include divisibility, congruences, diophantine equations, arithmetic functions, primitive roots, and quadratic residues.

**Prerequisite:** MATH 260 with a minimum grade of D.

**MATH 441. Mathematical Analysis I. 3 Hours.**

A rigorous study of the fundamental concepts of analysis, including limits, continuity, the derivative, the Riemann integral, and sequences and series.

**Prerequisite:** MATH 210 with a minimum grade of D and MATH 260 with a minimum grade of D.

**MATH 442. Mathematical Analysis II. 3 Hours.**

A rigorous study of the fundamental concepts of analysis, including limits, continuity, the derivative, the Riemann integral, and sequences and series.

**Prerequisite:** MATH 441 with a minimum grade of D.

**MATH 445. Nonlinear Dynamics and Chaos Theory. 3 Hours.**

The study of differential equations from a geometric perspective that allows for exploration of two and three-dimensional systems. Topics will include linear systems of equations, linear stability analysis, and bifurcations of nonlinear systems, and chaos theory.

**Prerequisite:** MATH 220 with a minimum grade of D and MATH 240 with a minimum grade of D.

**MATH 446. Partial Differential Equations. 3 Hours.**

A detailed introduction to partial differential equations. Students will develop familiarity with the derivation and solution techniques for various equations including transport equations, the heat equation, wave equation, and Laplace equation.

**Prerequisite:** (MATH 210 with a minimum grade of D or MATH 212 with a minimum grade of D) and MATH 240 with a minimum grade of D.

**MATH 448. Functions of a Complex Variable. 3 Hours.**

An introduction to the analysis of functions of a complex variable. Topics will include differentiation, contour integration, power series, Laurent series, and applications.

**Prerequisite:** MATH 260 with a minimum grade of D.

**MATH 470. Independent Study in Math. 1 to 3 Hours.**

Independent study of selected topics in Mathematics at an advanced level. Specific topics vary from semester to semester.

**MATH 480. Advanced Topics in Mathematics. 1 to 4 Hours.**

Advanced topics in undergraduate mathematics offered occasionally to meet special needs. Typical topics include number theory, foundations of mathematics, topology, and complex variables.

**MATH 500. Honors Course. 3 Hours.**

At the discretion of the faculty, students may undertake a six-hour independent course of study in the senior year in order to broaden their educational experience within their major area of study. Students must meet specific GPA standards and arrange a faculty sponsor. The honors course criteria are outlined in the Academic Honors portion of the catalog.