# MATHEMATICS (MATH)

**MATH 110 — Topics In Mathematics** Course count: 1
Consideration of diverse subjects in mathematics. Content varies from semester to semester with specific subject matter for each course announced just prior to enrollment. Designed for non-majors who wish to study mathematics other than calculus. This is the preferred course for students interested in taking just one mathematics course at the College.

Students who have taken Math 120, 133, 134, 135, 136 are not eligible to enroll in the class
GPA units: 1
Common Area: Mathematical Science
Typically Offered: Annually

**MATH 123 — Discrete Mathematics** Course count: 1
This course serves two primary purposes. It provides an introduction to mathematical reasoning, logic and proof. It also provides an introduction to a variety of important topics frequently used in mathematics and computer science, including sets, functions, relations, binary operations, combinatorics, graphs, and elementary number theory.

GPA units: 1
Common Area: Mathematical Science
Typically Offered: Fall, Spring

**MATH 133 — Calculus 1 with Fundamentals** Course count: 1
A version of Mathematics 135 that is designed for students who require more class time to make the transition to college-level mathematics. See the description of Introductory Courses before choosing this course. See the description of Mathematics 135 for the course content. This course meets five hours per week.

Students who have taken MATH 135 may not enroll in this class.
GPA units: 1.25
Common Area: Mathematical Science
Typically Offered: Fall, Spring

**MATH 135 — Calculus 1** Course count: 1
This is the standard version of Calculus at the College. Considers the calculus of real-valued functions of one variable for students who are planning further course work in mathematics, a major in the social or physical sciences, or the premedical program. Emphasis is placed on a conceptual understanding of calculus, presenting material from symbolic, numerical, and graphical points of view. The concepts of limit, continuity, and derivative are developed and applied to algebraic, logarithmic, exponential and trigonometric functions.Applications of the derivative are explored. This course meets three hours per week.

Students who have earned credit for a course equivalent to Calculus 1 or above cannot enroll in MATH 135.
GPA units: 1
Common Area: Mathematical Science
Typically Offered: Fall, Spring

**MATH 136 — Calculus 2** Course count: 1
Considers the calculus of real-valued functions of one variable for students who are planning further course work in mathematics, a major in the social or physical sciences, or the premedical program. Emphasis is placed on a conceptual understanding of the calculus, presenting material from symbolic, numerical, and graphical points of view. Course content include the theory, evaluation, and applications of integration, sequences and series including Taylor polynomials and series, and an introduction to ordinary differential equations. This course is the prerequisite for Mathematics 241. This course meets four hours per week.

Students who have earned credit for a course equivalent to Calculus 2 or above cannot enroll in MATH 136. Intended for students who have completed one year of Calculus at the high school level.
GPA units: 1.25
Common Area: Mathematical Science
Typically Offered: Fall, Spring

**MATH 241 — Multivariable Calculus** Course count: 1
A study of the calculus of functions of several variables. Concerns the theory and applications of differentiation and integration of functions of several variables, vector fields, line integrals, Green's theorem.This course meets four hours per week.

Prerequisite: MATH 134 or MATH 136 or equivalent
GPA units: 1.25
Common Area: Mathematical Science
Typically Offered: Fall, Spring

**MATH 243 — Mathematical Structures** Course count: 1
An introduction to the primary algebraic and analytic structures in abstract mathematics. Emphasis is placed on using the language of sets, equivalence relations and functions, and on developing techniques of proof, including elementary logic and mathematical induction, basic group theory, and limits.

Prerequisite: MATH 134 or MATH 136 or equivalent
GPA units: 1
Common Area: Mathematical Science
Typically Offered: Fall, Spring

**MATH 244 — Linear Algebra** Course count: 1
Designed to acquaint students with the basic techniques of linear algebra. Topics include matrices, vector spaces, subspaces, linear transformations, bilinear forms, determinants, eigenvalue theory, and the finite dimensional spectral theorem. Applications and additional topics are included as time permits.

Prerequisite: MATH 134 or 136
GPA units: 1
Common Area: Mathematical Science
Typically Offered: Fall, Spring

**MATH 301 — Topics In Geometry** Course count: 1
Centers on some area of geometry other than differential geometry. Possible topics include Euclidean and non-Euclidean geometry, projective geometry, the geometry of transformation groups, and the elementary geometry of algebraic curves.

Prerequisite: MATH 243
GPA units: 1
Typically Offered: Alternate Years

**MATH 302 —  Differential Geometry** Course count: 1
A first course in the differential geometry of curves and surfaces for students who have completed Mathematics 241 and a semester course in linear algebra. Topics include the Frenet-Serret formulas, smooth surfaces in 3-space, fundamental forms, differentiable manifolds, vector fields, connections and a brief introduction to Riemannian geometry.

Prerequisite: MATH 241 and MATH 244
GPA units: 1
Typically Offered: Alternate Years

**MATH 303 —  Mathematical Models** Course count: 1
Introduction to the role of mathematics as a modeling tool, including the construction, interpretation and application of mathematical models. Applications chosen to illustrate various modeling paradigms such as deterministic, probabilistic, discrete and continuous modeling and may include population dynamics, biomedical applications, stock market analysis, and network and traffic flows.

Prerequisite: MATH 241 and MATH 244 or equivalent or permission from Instructor.
GPA units: 1
Typically Offered: Alternate Years

**MATH 304 —  Ordinary Differential Equations** Course count: 1
Linear differential equations are studied; basic existence theorems are proved. Separation of variables, Laplace transforms, first- and second-order equation and linear systems, and topics in nonlinear systems are considered. Breadth area: Applied Mathematics/Statistics.

Prerequisite: MATH 241 and MATH 244
GPA units: 1
Typically Offered: Alternate Years

**MATH 305 —  Complex Analysis** Course count: 1
The fundamentals of complex analysis. Topics include the complex number system, analytic functions, the Cauchy-Riemann equations, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, the calculus of residues and conformal mapping.

Prerequisite: MATH 241 and MATH 243
GPA units: 1
Typically Offered: Alternate Years

**MATH 351 —  Modern Algebra 1** Course count: 1
An in-depth study of the structure of groups, rings and fields. Depending on the instructor, applications to Galois theory, number theory, geometry, topology, physics, etc., are presented.

Prerequisite: MATH 243 244
GPA units: 1
Typically Offered: Fall, Spring

**MATH 352 —  Modern Algebra 2** Course count: 1
A continuation of Mathematics 351 exploring advanced topics and applications in modern algebra.

Prerequisite: MATH 351
GPA units: 1
Typically Offered: Alternate Years

**MATH 353 —  Number Theory** Course count: 1
Elementary number theory is concerned with properties of numbers (integers, primes, etc.) as well as patterns and relationships among certain sets of numbers. Topics will include divisibility, congruences, special types of primes, the distribution of primes throughout the integers, number-theoretic functions, quadratic residues, and continued fractions. Further study may include the RSA code, a superior encryption algorithm based on elementary number theory, and a discussion of one of the most famous problems in mathematics - Fermat's Last Theorem - conjectured in 1630 yet unsolved until the 1990s.

Prerequisite: MATH 243 and 244 or permission of the instructor.
GPA units: 1
Typically Offered: Alternate Years

**MATH 357 —  Combinatorics** Course count: 1
An introduction to the subject that discusses a representative sampling of combinatorial problems and general techniques for solving them, including a selection of counting techniques, techniques for existence questions, and a variety of examples. Examples may include partitions, graphs and trees, tournaments, graph coloring and chromatic polynomials, magic squares, Latin rectangles and squares, and combinatorial block designs.

Prerequisite: MATH 243.
GPA units: 1
Typically Offered: Alternate Years

**MATH 361 —  Real Analysis 1** Course count: 1
Topological ideas are introduced through a treatment of metric space topology. After the study of open, closed, compact and connected spaces with emphasis on their behavior under continuous mappings, selected topics from functional analysis are considered. These include lim sup and lim inf, relation of uniform convergence to differentiation and integration, and the Stone-Weierstrass approximation theorem.

Prerequisite: MATH 243
GPA units: 1
Typically Offered: Fall, Spring

**MATH 362 —  Real Analysis 2** Course count: 1
A continuation of Mathematics 361 exploring advanced topics, including an introduction to Lebesgue-Stieltjes integration, Hilbert space and other material from linear space theory.

Prerequisite: MATH 361
GPA units: 1
Typically Offered: Alternate Years

**MATH 363 —  Topics In Topology** Course count: 1
Considers various aspects of topology of surfaces and solids, including orientability, the Euler number, and the fundamental group. One of the goals of the course is the topological classification of surfaces.

Prerequisite: MATH 241, MATH 243 and Prereq or Coreq MATH 244
GPA units: 1
Typically Offered: Alternate Years

**MATH 371 —  Methods of Numerical Analysis** Course count: 1

The numerical solution of problems using computers. Considerable time is devoted to selecting the appropriate algorithm for a given problem and analyzing the resulting numerical errors. Includes such topics as error analysis of computer arithmetic, approximation of functions, solution of equations, numerical integration, numerical solution of ordinary differential equations.

Prerequisite: MATH 241, and either MATH 244 or PHYS 221. Students who have taken MATH 136 and CSCI 131, see instructor for permission .
GPA units: 1
Typically Offered: Alternate Years

**MATH 373 —  Partial Differential Equations** Course count: 1

Provides an understanding of a wide spectrum of phenomena through the use of mathematical ideas, abstractions, and techniques. Topics included are partial differential equations, including the heat and wave equations, Fourier analysis, eigenvalue problems, Green's functions.

Prerequisite: MATH 241 and 244
GPA units: 1
Typically Offered: Alternate Years

**MATH 374 —  Dynamical Systems** Course count: 1

An introduction to the theory of discrete dynamical systems. Topics include iteration of functions, graphical analysis, periodic points, stable sets, chaos, symbolic dynamics, the dynamics of functions of a complex variable and the Mandelbrot set. The major theorems will be studied along with their proofs and the computer will be used as a research tool to do experiments which motivate and illustrate the theory.

Prerequisite: MATH 241 and MATH 243.
GPA units: 1
Typically Offered: Alternate Years

**MATH 392 —  Seminar** Course count: 1

Provides an opportunity for individual and group investigation of topics not covered in ordinary course work. Active participation on the part of the students is normally required. Subject matter varies to suit individual students and is often related to the research activity of the professor. Examples of areas of study: Lie groups, functional analysis, complex analysis, probability theory, commutative algebra, applied mathematics, the classical groups, mathematical logic, automata and formal languages, topics in discrete modeling, and qualitative theory of differential equations.

Prerequisite: MATH 241 and MATH 244.
GPA units: 1
Typically Offered: Annually

**MATH 399-S01 —  Data Modeling With Python** Course count: 1

Prerequisite: MATH 241 and MATH 244 or permission of the instructor
GPA units: 1

**MATH 400 —  Directed Reading** Course count: 1

An independent reading project for upper division students. Normally this is on a topic that is not covered by the regular course offerings. Permission of the instructor and the department chair is required for this course.

GPA units: 1
Typically Offered: Fall, Spring

**MATH 410 —  Directed Project** Course count: 1

A project course for upper division students under the direction of a faculty member. Normally the project will provide an introduction to research on a topic that is not covered by the regular course offerings. Course requirements are to be arranged in consultation with the instructor. Permission of the instructor and the department chair is required for this course.

GPA units: 1
Typically Offered: Fall, Spring

**MATH 495 —  Mathematics Honors Thesis** Course count: 1

A large project extending over the course of the fourth year. It can consist of original research or be of an expository nature and is written under the guidance of one or more members of the department. Normally, a student will earn one unit in the spring semester of the fourth year for successful completion of an honors thesis, unless the thesis work is done as part of the student's participation in a departmental seminar. In that case, no extra credit is given above the credit for the seminar itself. For a particularly extensive project, and with the permission of the department chair, a student may earn one unit in each semester of the fourth year for completion of the thesis.

GPA units: 0
Typically Offered: Fall

**MATH 496 —  Mathematics Honors Thesis** Course count: 1

A large project extending over the course of the fourth year. It can consist of original research or be of an expository nature and is written under the guidance of one or more members of the department. Normally, a student will earn one unit in the spring semester of the fourth year for successful completion of an honors thesis, unless the thesis work is done as part of the student's participation in a departmental seminar. In that case, no extra credit is given above the credit for the seminar itself. For a particularly extensive project, and with the permission of the department chair, a student may earn one unit in each semester of the fourth year for completion of the thesis.

GPA units: 2
Typically Offered: Spring