

MATHEMATICS (MATC, MATH)

MATC 560 Topics in Mathematics for Teachers (1-3 credits)

Prerequisite: May be specified depending on the nature of the topic. Special topics of relevance to mathematics teachers will be offered from time to time. The topics to be offered will be content focused and directly related to the strands of the Massachusetts Curriculum Framework, as they pertain to mathematics teachers. This course may be repeated for different topics. This course is not part of the MAT in Mathematics.

MATH 100 Precalculus Mathematics (3 credits)

Prerequisite: Mathematics placement test
This course provides a review of algebraic fundamentals (exponents, logarithms, linear and quadratic equations) and a study of functions of various types (polynomial, rational, transcendental). *Either semester* (CMAR)

MATH 105 Selected Topics in Mathematics (3 credits)

Prerequisite: Mathematics placement test
The nature and process of mathematical thinking (inductive, deductive, and algorithmic), as well as applications and results, are the underlying components of this course. Possible topics to be explored include sets, logic, number theory, geometry, graph theory and probability. A selection of three or more such topics will be offered each semester. *Either semester* (CMAR)

MATH 107 Principles of Mathematics I (3 credits)

Prerequisite: Mathematics placement test
Topics include problem solving; numeric and non-numeric patterns; set theory and applications, systems of numeration; elementary number theory and properties of our number systems from integers to reals. *Offered yearly* (CMAR)

MATH 108 Principles of Mathematics II (3 credits)

Prerequisite: MATH 107
Topics include functions and relations; elementary probability; an introduction to data analysis and statistics; two- and three-dimensional geometry; and measurement. (CMAR)

MATH 110 Elementary Statistics I (3 credits)

Prerequisite: Mathematics placement test
Measure of central tendency and variability; elementary probability; binomial, normal and t distributions; hypothesis testing and confidence intervals. *Either semester* (CMAR)

MATH 112 Mathematics for Elementary Teachers I (3 credits)

Prerequisite: FRSK 102 or mathematics placement test. Restricted to majors in Early Childhood, Elementary and Special Education
This course develops student's understanding of the mathematical concepts of number and operations, and the properties of number systems at the deep level required for successful elementary school teaching in ways that are meaningful to pre-service elementary teachers. Topics will include

place value and arithmetic models, mental math, algorithms, prealgebra factors and prime numbers, fractions and decimals, ratio, percentage and rate, integers and elementary number theory. *Offered either semester* (CMAR)

MATH 113 Mathematics for Elementary Teachers II (3 credits)

Prerequisite: MATH 107 or MATH 112. Restricted to majors in Early Childhood, Elementary and Special Education
This course develops student's understanding of the mathematical content of geometry, measurement, probability and statistics at the deep level required for successful elementary school teaching in ways that are meaningful to pre-service elementary teachers. Topics will include two- and three-dimensional geometry, measurement, data analysis, single variable statistics and probability. *Offered either semester* (CMAR)

MATH 114 Mathematics for Elementary Teachers III (3 credits)

Prerequisite: MATH 107 or MATH 112. Restricted to majors in Early Childhood, Elementary and Special Education
This course develops student's understanding of the mathematical content of patterns, functions and algebra at the deep level required for successful elementary school teaching in ways that are meaningful to pre-service elementary teachers. Topics will include concepts of variable and function; linear, quadratic and exponential functions and their graphs; patterns, arithmetic and geometric progressions; solving equations and applications. Connections between arithmetic and algebra will be emphasized. *Offered either semester* (CMAR)

MATH 120 Introduction to Linear Algebra (3 credits)

Prerequisite: Mathematics placement test
Topics include algebra and geometry of vectors in R^n , linear equations, matrices, determinants, basis and dimension, and the use of homogenous coordinates for the matrix representation of linear and geometric transformations and their compositions. *Fall semester* (CMAR)

MATH 130 Discrete Mathematics I (3 credits)

Prerequisite: Mathematics placement test
This course provides some of the mathematical background necessary for computer science. Topics include combinations and discrete probability, discrete functions and graph theory. *Spring semester* (CMAR)

MATH 135-136 Freshman Honors Colloquium (1 credit each semester)

Prerequisite: Open to Commonwealth Honors students and to others at the discretion of instructor
Freshman Honors Colloquia in mathematics allow exceptionally able students to explore a challenging topic in small classes under close faculty supervision. Colloquia meet once a week for fifty minutes and culminate in a paper or scientific project, which provides the major part of the grade. The minimum enrollment is two and the maximum is 12. Topics vary from semester to semester. *MATH 135 fall semester, MATH 136 spring semester*

MATH 141 Elements of Calculus I (3 credits)

Prerequisite: MATH 100 or a mathematics placement test

This course introduces the student to the main concepts, methods, and techniques of differential calculus. Emphasis is on how these arise from problems in several areas, rather than from a rigorous development of the theory. A principal objective of this course is to illustrate how mathematics is used to model physical reality and how such a mathematical model facilitates the solution of problems. This course does not satisfy mathematics major requirement. Credit cannot be given for both MATH 141 and MATH 144. *Either semester (CMAR)*

MATH 142 Elements of Calculus II (3 credits)

Prerequisite: MATH 141

The topics include the integral and its applications as well as multivariable calculus. Additional topics are selected from: differential equations, Taylor series and probability distributions. This course does not satisfy mathematics major requirements. *Either semester (CMAR)*

MATH 144 Applied Calculus for Business (3 credits)

Prerequisite: MATH 100 or a mathematics placement test

This is a one-semester course in applied differential and integral calculus with emphasis on business applications. Topics to be covered include derivatives of algebraic, logarithmic and exponential functions, optimization problems, antiderivatives and the fundamental theorem of calculus, techniques of integration, functions of several variables and partial derivatives. This course does not satisfy mathematics major requirements. (CMAR)

MATH 151 Calculus I (3 credits)

Prerequisite: MATH 100 or a mathematics placement test

This course introduces the student to a rigorous development of the differential calculus. Emphasis is on the development of the concepts of calculus as typical of a cohesive mathematical theory. *Fall semester (CMAR)*

MATH 152 Calculus II (3 credits)

Prerequisite: MATH 151

This course is an intensive study of the integral and its applications, transcendental functions, conic sections and additional techniques of integration. *Spring semester (CMAR)*

MATH 180 Transition to Advanced Mathematics (3 credits)

Prerequisite: MATH 151, which may be taken concurrently.

This course is an introduction to formal mathematics and provides a transition from computation-based mathematics to the more theoretical approach used in advanced mathematics courses. Topics covered include mathematical logic, set theory, concepts of relation, function and cardinality, and the design and structure of axioms and axiomatic systems are discussed. A large emphasis is placed on reading, analyzing and learning to produce proofs of mathematical statements. (CLOR)

MATH 199 First Year Seminar (3 credits)

Prerequisite: Open to all freshmen with a writing placement score of 3 or above or a SAT score of 500 or above. Students with 24 or more transfer credits will have this requirement waived.

First Year Seminars (FYS) are writing-intensive, topic courses that introduce students to academic thought, discourse and practices. FYS courses prepare and orient students toward productive and fulfilling college careers by actively engaging them in a specific academic area of interest. Students will improve their writing, reading, research and basic information and technology skills while learning to work both collaboratively and independently. These courses will fulfill the First Year Seminar requirement and may fulfill other requirements for the core curriculum. Each course may fulfill different requirements and topics may change each semester. Only one FYS course may be taken for credit. (CFYS)

MATH 200 Probability and Statistics (3 credits)

Prerequisite: MATH 142 or MATH 152

Permutations and combinations; types of events, conditional probability, elementary probability distributions, elementary cumulative distributions, mathematical expectation, measures of central tendency, variance and standard deviation, and normal distributions. Additional statistics topics as time allows.

MATH 202 Linear Algebra (4 credits)

Prerequisite: MATH 142 or MATH 152

Vector spaces, linear transformations, matrices, systems of linear equations and determinants. *Spring semester*

MATH 214 Introduction to Modern Algebra (3 credits)

Prerequisite: MATH 105 or MATH 100 or MATH 107 or consent of the department

Linear congruencies, groups, matrices and linear systems. *Offered alternate years, fall semester*

MATH 251 Calculus III (3 credits)

Prerequisite: MATH 152

This course covers infinite sequences and series and multivariable calculus including partial differentiation, directional derivatives, max/min theory and multiple integration. *Fall semester*

MATH 252 Calculus IV (3 credits)

Prerequisite: MATH 251

This course covers, with an emphasis on techniques, the topics of vector differentiation and integration, line integrals and Green's theorem. This course also includes a rigorous reexamination of the calculus topics of limits, continuity, differentiability and integrability.

MATH 286-287 Sophomore Honors Colloquium (1 credit each semester)

Prerequisite: Open to Commonwealth Honors students and to others at the discretion of instructor

Sophomore Honors Colloquia in mathematics allow exceptionally able students to explore a challenging topic in small classes under close faculty supervision. Colloquia meet once a week for

tMay be taken for graduate-level credit

fifty minutes and culminate in a paper or scientific project, which provides the major part of the grade. The minimum enrollment is two and the maximum is twelve. Topics vary from semester to semester. *MATH 286 fall semester, MATH 287 spring semester*

MATH 298 Second Year Seminar (Speaking Intensive) **(3 credits)**

Prerequisite: _____199; Open to all sophomores and juniors who have completed ENGL 101, and the speaking skills requirement. Students with 54 or more transfer credits will have this requirement waived. Cannot be taken if _____299 is taken for credit.

Second Year Seminars (SYS) are speaking-intensive, topic courses that build on the academic skills and habits introduced in the First Year Seminar. SYS courses engage students in a specific academic area of interest and provide them with the opportunity to reinforce, share and interpret knowledge. Students will improve their speaking, reading, research and basic information and technology skills while building the connections between scholarship and action that are required for lifelong learning. These courses will fulfill the Second Year Seminar requirement and may fulfill other requirements for the core curriculum. Each course may fulfill different requirements and topics may change each semester. Only one SYS course may be taken for credit. (CSYS)

MATH 299 Second Year Seminar (Writing Intensive) **(3 credits)**

Prerequisite: _____199; Open to all sophomores and juniors who have completed ENGL 101 and ENGL 102. Students with 54 or more transfer credits will have this requirement waived. Cannot be taken if _____298 is taken for credit.

Second Year Seminars (SYS) are writing-intensive, topic courses that build on the academic skills and habits introduced in the First Year Seminar. SYS courses engage students in a specific academic area of interest and provide them with the opportunity to reinforce, share and interpret knowledge. Students will improve their writing, reading, research and basic information and technology skills while building the connections between scholarship and action that are required for lifelong learning. These courses will fulfill the Second Year Seminar requirement and may fulfill other requirements for the core curriculum. Each course may fulfill different requirements and topics may change each semester. Only one SYS course may be taken for credit. (CSYS)

MATH 301 Abstract Algebra I (3 credits)

Prerequisite: MATH 202

Study of relations, functions, and binary operations. Introduction to the theory of rings, integral domains and fields through a study of integers, rational numbers, real numbers, complex numbers and polynomials, and elementary group theory. *Fall semester*

MATH 302 Abstract Algebra II (3 credits)

Prerequisite: MATH 301

Group theory, linear groups, rings and ideals, extensions of rings and fields.

MATH 303 Number Theory (3 credits)

Prerequisite: MATH 202 or consent of the department

Development of the number system, the Euclidean Algorithm and its consequences, theory of congruencies, number-theoretic functions, Diophantine equations and quadratic residues.

MATH 316 Differential Equations (3 credits)

Prerequisite: MATH 251

Ordinary differential equations of first and second order, linear differential equations with constant coefficients, the Laplace transformation and applications.

MATH 318 Quantitative Methods for Management **(3 credits)**

Prerequisite: MATH 142 or MATH 144 or MATH 152; and MATH 110 or ECON 210 or equivalent

Selected mathematical tools and techniques for analysis of business and economic problems as an aid to decision-making in management. Models and applications related to decision theory, linear programming, inventory, queuing, forecasting and other standard qualitative concepts. *Either semester*

MATH 325 Foundations of Geometry (3 credits)

Prerequisite: MATH 202

In this course, students will broaden their understanding of Euclidean geometry; study finite geometries, geometric transformations and non-Euclidean geometries; write geometric proofs; construction problems; and apply geometric concepts to real-world situations. *Either semester*

MATH 326 Projective Geometry (3 credits)

Prerequisite: MATH 120 or consent of the department

A synthetic and analytic study of the axioms and properties of the projective plane; the projective group of transformations, its subgeometries and their invariant properties.

MATH 330 Discrete Mathematics II (3 credits)

Prerequisite: MATH 130 and COMP 102

Course topics will include formal logic, automata and formal languages, and an introduction to the analysis of algorithms. *Either semester*

MATH 338-339 Honors Tutorial (3 credits each semester)

Prerequisite: Consent of the department

Special topics in mathematics. Open to Commonwealth and Departmental Honors students. Three hourly meetings weekly. *MATH 338 fall semester, MATH 339 spring semester*

MATH 340 Graph Theory (3 credits)

Prerequisite: MATH 202 or consent of instructor

This course introduces the basic definitions, concepts, topics and theorems of graph theory including the structure, connectivity and vulnerability of graphs. A wide range of examples such as the traveling salesperson problems, Dijkstra's algorithm, Huffman codes and Fleury's algorithm will also be examined.

tMay be taken for graduate-level credit

Note: This section is arranged in course number order. See pages 237-238 (course prefix key) for assistance in locating department sections.

Note: See Catalog Web Addenda at www.bridgew.edu/catalog/addenda as that information supersedes the published version of this catalog.

MATH 345 Combinatorics (3 credits)

Prerequisite: MATH 202 or consent of instructor

Methods examined in this course are permutations, combinations, the sum and product rules, ordered and unordered selection with or without repetition, identical and distinct ranges, the pigeonhole principle, binomial coefficients, inclusion/exclusion, derangements, partitions, recurrence relations, generating functions and ramsey theory. Special topics may include latin squares, graph theory, network flows, coding theory, designs, ploya counting, partially ordered sets and lattices.

MATH 349 Foundations of Mathematics (3 credits)

Prerequisite: MATH 202

The course axiomatically develops the number systems as algebraic structures starting with the construction of the natural numbers using the Peano postulates and continuing to the ordered integral domain of integers, the ordered field of rationals, and the complete ordered field of real numbers by using Cauchy sequences.

MATH 399 Topics in Advanced Mathematics (3 credits)

Special topics selected from the general areas of algebra, analysis and applied mathematics. This course may be repeated for different topics.

MATH 401 Introduction to Analysis I (3 creditst)

Prerequisite: MATH 202 and MATH 252

Logic and proof techniques are followed by basic theorems on the topology of real numbers, compactness, limits, sequences, continuity and differentiability. *Spring semester*

MATH 403 Probability Theory (3 creditst)

Prerequisite: MATH 251

All elementary probability topics: permutations and combinations, types of events, conditional probability, Bayes' Theorem and so on. A calculus approach to probability distribution and cumulative distributions, moment and moment generating functions.

MATH 408 History of Mathematics (3 creditst)

Prerequisite: MATH 202 and MATH 252

A historical development of mathematics from ancient time to the Middle Ages (c. 3500 B.C. to c. 1400 A.D.). Some of the topics covered include Egyptian, Babylonian and Mayan Numeration Systems; Greek mathematics, including the Pythagorean, Platonic and Alexandrian schools; Asian contributions and the Arabic Hegemony; and principal mathematicians of the European Middle Ages, including Alcuin, Fibonacci and Oresme. (CWRM)

MATH 415 Numerical Analysis (3 creditst)

Prerequisite: MATH 251

Solution of algebraic and transcendental equations, general iteration method, Newton-Raphson method. Approximation of functions and curve fitting, Lagrange interpolation formula, Newton's forward difference method, method of least squares, orthogonality, numerical integration and Euler-Cauchy technique.

MATH 416 Applied Mathematics (3 creditst)

Prerequisite: MATH 251

Fourier analysis, solutions of partial differential equations, special functions, and line and surface integrals. (CWRM)

MATH 445 Logic Programming (3 credits)

Prerequisite: Junior or senior mathematics major or equivalent background; and consent of the department

The propositional and first order predicate logic from an axiomatic point of view will be studied. Algorithmic methods of theorem proving will be emphasized.

MATH/COMP 460 Introduction to Robotics (3 creditst)

Prerequisite: COMP 330

An introduction to the theory of the motion of robot manipulators, along with the mathematics, programming and control of manipulators will be emphasized. Also examined will be issues of sensing and planning.

MATH 485 Honors Thesis (3 credits)

This course is open to Commonwealth and Departmental Honors students. One-hour weekly meetings with the thesis director will culminate in an honors thesis. With the consent of the Departmental Honors Committee and the thesis director, this course may be extended into a second semester for three additional credits depending upon the scope of the project. Whether the final version of the thesis qualifies the student to graduate with honors will be determined by the Departmental Honors Committee. *Either semester*

MATH 490 Mathematics Seminar (3 creditst)

Prerequisite: MATH 251 and MATH 202 and MATH 301; or consent of the department

Topics to be selected from algebra, geometry and analysis. May be offered as a quarter or semester course.

MATH 499 Directed Study in Mathematics (1-3 credits)

Prerequisite: Consent of the department; formal application required
Directed study is open to juniors and seniors who have demonstrated critical and analytical abilities in their studies and who wish to pursue a project independently. May be taken twice for a maximum of six credits. *Either semester*

MATH 502 Research (credit to be arranged)

Prerequisite: Consent of the department; formal application required
Original research undertaken by the graduate student in their field. For details, consult the paragraph entitled "Directed or Independent Study" in the "School of Graduate Studies" section of this catalog. This course may be repeated.

MATH 503 Directed Study (credit to be arranged)

Prerequisite: Consent of the department; formal application required
Directed study is designed for the graduate student who desires to study selected topics in a specific field. For details, consult the paragraph entitled "Directed or Independent Study" in the "School of Graduate Studies" section of this catalog. This course may be repeated.

MATH 507 Topology (3 credits)

Prerequisite: MATH 251 and MATH 301 or equivalent; and admission to the MAT in Mathematics program; or consent of instructor
Elements of point set topology, closed sets and open sets in metric spaces, continuous mappings, connection, separation theorems, and compactness.

MATH 508 History of Mathematics (3 credits)

Prerequisite: Admission to the MAT in Mathematics program or consent of instructor

A historical development of mathematics from ancient time to the Middle Ages (c. 3500 B.C. to c. 1400 A.D.). Some of the topics covered include Egyptian, Babylonian and Mayan Numeration Systems; Greek mathematics, including the Pythagorean, Platonic and Alexandrian schools; Asian contributions and the Arabic Hegemony; and principal mathematicians of the European Middle Ages, including Alcuin, Fibonacci and Oresme. Students will be required to complete two projects that will culminate in formal presentations.

MATH 510 Group Theory (3 credits)

Prerequisite: MATH 301 or equivalent; and admission to the MAT in Mathematics program

Groups, subgroups, homomorphisms, normal subgroups and quotient groups, generators, normal structure and the Jordan-Holden Theorem, direct products of groups.

MATH 511 Ring Theory (3 credits)

Prerequisite: MATH 301 or equivalent; and admission to the MAT in Mathematics program; or consent of instructor

Examples of rings, ideals and homomorphisms, the Jacobson radical, direct sums, Boolean rings and rings with chain conditions.

MATH 518 Topics in Analysis (3 credits)

Prerequisite: MATH 202 and MATH 252; and admission to the MAT in Mathematics program; or consent of instructor

The course consists of a detailed discussion of limits, continuity, and applications of differential and integral calculus, and the real number system. Group and/or individual projects will be required as part of the course. This course is designed to provide graduate-level mathematics education students with an introduction to analysis, appropriate to the needs of secondary school mathematics teachers.

MATH 522 Complex Analysis (3 credits)

Prerequisite: MATH 401 and admission to the MAT in Mathematics program; or consent of instructor

Analytic functions of a complex variable, differentiation and integration in the complex plane. Cauchy's theorems, infinite series, Laurent expansions and theory of residues.

MATH 525 Mathematics in Science (3 credits)

Prerequisite: High school/middle school teacher of mathematics or science; and admission to the MAT in Mathematics program; or consent of instructor

This course contains the mathematical background necessary for a variety of science applications. Topics include linear algebra,

statistics, discrete mathematics, geometry, calculus and numerical analysis as well as computer software to enhance their application to problem solving in science.

MATH 551 Topics in Finite Mathematics (3 credits)

Prerequisite: Admission to the MAT in Mathematics program or consent of instructor

This course is designed for teachers of mathematics, and will extend and enrich the topics of finite mathematics. Possible topics include sets, logic, probability, statistics, combinatorics and graph theory.

MATH 552 Topics in Analytic Geometry (3 credits)

Prerequisite: Admission to the MAT in Mathematics program or consent of instructor

Properties, definitions and applications of conic sections will be studied. Vectors, polar coordinates and calculus will be used to enhance the presentation and to develop formulas for tangent lines, areas and volumes. Translation and rotation of axis and invariants under translation will be covered. Quadric surfaces and their graphs, along with homogeneous coordinates, will be discussed.

MATH 561 Topics in Number Theory (3 credits)

Prerequisite: Admission to the MAT in Mathematics program or consent of instructor

Topics will include an in-depth study of primes, divisibility, congruence, number theoretic functions, numeration systems and other related topics selected by the instructor.

MATH 562 Topics in Geometry (3 credits)

Prerequisite: Admission to the MAT in Mathematics program or consent of instructor

This course employs classical and modern tools to explore topics that extend and enrich the standard high school geometry curriculum. Possible topics include transformations, tessellations, non-Euclidean geometrics and fractals.

MATH 582 Topics in Problem Solving Using Technology (3 credits)

Prerequisite: Admission to the MAT in Mathematics program or consent of instructor

This course will include an in-depth study of problem-solving techniques in mathematics using technology. Application problems will include topics from physical and social sciences.

MATH 596 Topics in Mathematics (3 credits)

Prerequisite: Admission to the MAT in Mathematics or consent of instructor

Topics are chosen from various areas of study in mathematics, such as theory of holors, applied mathematics, introduction to field theory and other mathematics topics. This course may be repeated twice for credit with different topics for a total of nine credits.

Other Approved Courses

MATH 520 Real Analysis