

Mathematics

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The General Education Requirement

All students must satisfy a general education requirement consisting of eleven (11) courses outside of the major department (see page 52). The General Education Goal 2 (Quantitative) requirement is satisfied through the completion of the Mathematics major.

Course Prerequisites

Courses may have specified conditions for enrollment, such as prior completion of less advanced courses, permission of the instructor, or appropriate placement test scores. Students should refer to course descriptions in the department listings for prerequisite requirements.

Placement Testing

Each incoming student must take placement examinations in writing, mathematics, and reading, which are administered prior to orientation for new students. Information regarding Placement Testing dates and times may be found at <http://www.framingham.edu/studentaffairs/placement.htm>. Contact the Office of First Year Programs located in the Center for Academic Support and Advising (CASA) for reservations.

Mathematics Code Interpretation

- 1 Indicates student may not take a credit-bearing math course at Framingham State College. Student must first complete MATH 095 General Mathematics or similar remedial course at another college.
- 2 Indicates student may enroll in non-algebraic math courses: MATH 110 College Mathematics I (for Coordinate majors in Education), MATH 117 Introduction to Statistics, and MATH 119 Math for the Liberal Arts.
- 3 Indicates remedial coursework equivalent of MATH 095 General Mathematics accepted as transfer coursework and student may take any 100-level math course listed above, as well as MATH 123 College Algebra.
- 4 Indicates student may take any 100-level math course listed above, as well as MATH 123 College Algebra.
- 5 Indicates student may enroll in MATH 200 Precalculus or, after consultation with the Mathematics Department, MATH 219 Calculus I; or any 100-level mathematics course appropriate for the student's major discipline.

Mathematics Major

All students must complete the following ten (10) core courses:

MATH 215	Finite Mathematics
MATH 219	Calculus I
MATH 220	Calculus II
MATH 221	Calculus III
MATH 226	Linear Algebra and Applications
MATH 231	Euclidean Geometry
MATH 310	Number Theory
MATH 319	Abstract Algebra
One (1) computer science course	

One (1) course in probability and statistics:

MATH 117	Introduction to Statistics
MATH 208	Biostatistics
MATH 307	Intermediate Statistics

MATH 348	Mathematical Statistics I
MATH 349	Mathematical Statistics II

Concentrations in Mathematics

General (UMAG):

In addition to the ten (10) core requirements above, each student must complete:

MATH 222	Differential Equations
MATH 317	Higher Geometry
MATH 427	Real Analysis

One (1) elective in mathematics at the 300-level or above

Six (6) electives from mathematics (at the 200-level or above), physics, computer science, or an approved minor

Mathematics with Minor in Secondary Education (UMAT):

In addition to the ten (10) core requirements above, each student must complete:

MATH 222	Differential Equations
MATH 317	Higher Geometry
MATH 427	Real Analysis

One (1) elective in mathematics at the 300-level or above

Choose Option A or B:

Option A: Minor in Secondary Education – Middle School (Grades 5-8)

EDUC 200	Education in American Society with Field Study I
EDUC 316	Professional Preparation and Field Study II: Methods, Special Education and Technology - Middle School (Credit - two course credits)
EDUC 410	Student Teaching Practicum and Seminar I- Secondary (Credit - two course credits)
EDUC 411	Student Teaching Practicum and Seminar II - Secondary (Credit - two course credits)
PSYC 200	Psychology of Development (Gen. Ed. Goal 9)

Option B: Minor in Secondary Education – High School (Grades 9-12)

EDUC 200	Education in American Society with Field Study I
EDUC 315	Professional Preparation and Field Study II: Methods, Special Education and Technology - High School (Credit - two course credits)
EDUC 410	Student Teaching Practicum and Seminar I- Secondary (Credit - two course credits)
EDUC 411	Student Teaching Practicum and Seminar II - Secondary (Credit - two course credits)
PSYC 200	Psychology of Development (Gen. Ed. Goal 9)

Note: Mathematics Department prerequisites for EDUC 315 Professional Preparation and Field Study II - High School and EDUC 316 Professional Preparation and Field Study II - Middle School are completion of:

All required mathematics courses except:

MATH 319	Abstract Algebra
MATH 427	Real Analysis

Prerequisites for EDUC 410 Student Teaching Practicum and Seminar I: High School and EDUC 411 Student Teaching Practicum and Seminar II: High School or EDUC 414 Student Teaching Practicum and Seminar I: Middle School and EDUC 415 Student Teaching Practicum and Seminar II: Middle School are completion of all department requirements and completion of EDUC 315 Professional Preparation and Field Study II: Methods, Special Education and Technology for High School or EDUC 316 Professional Preparation and Field Study II: Methods, Special Education and Technology for Middle School, depending on the level.

Coordinate Major in Early Childhood or Elementary Education (UMAE)

I. Mathematics requirements

In addition to the ten (10) core requirements listed above, each student must complete:

MATH 110	College Mathematics I
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Two (2) electives in mathematics: one (1) at the 200-level or above; one (1) at the 300-level or above.

It is strongly recommended that students select MATH 201 Intuitive Geometry and MATH 301 Problem Solving and Modeling in Mathematics as the two mathematics electives among the core courses.

II. Choose A or B**A. Coordinate Major in Early Childhood Education (Pre-K - Grade 2 Licensure)**

EDUC 200	Education in American Society with Field Study I
EDUC 320	The Young Child: Emerging Literacy with Field Study II
EDUC 374	Early Childhood Curriculum: Mathematics and Science with Field Study III
EDUC 376	Early Childhood Curriculum: Reading, Social Studies, and Special Needs The Professional Semester (two courses – four course credits):
EDUC 431	Early Childhood Professional Practicum A (First half of semester (Credit - two course credits)
EDUC 432	Early Childhood Professional Practicum B (Second half of semester (Credit - two course credits)
PSYC 200	Psychology of Development (Gen. Ed. Goal 9)

B. Coordinate Major in Elementary Education (Grades 1 - 6 Licensure)

EDUC 200	Education in American Society with Field Study I
EDUC 322	The Child and Literacy with Field Study II
EDUC 341	Elementary Curriculum: Mathematics with Field Study III
EDUC 346	Elementary Curriculum: Science, Social Studies and Special Needs
PSYC 200	Psychology of Development (Gen. Ed. Goal 9)

The Professional Semester (two courses – four course credits):

EDUC 437	Elementary Professional Practicum A (First half of the semester) (Credit - two course credits)
EDUC 438	Elementary Professional Practicum B (Second half of semester) (Credit - two course credits)

Note: PSYC 200 may be used to fulfill the college requirement for general education.

Minor in Mathematics (5 Courses)

MATH 219 Calculus I and four (4) courses at or above the 200-level. Students may substitute MATH 117 Introduction to Statistics for MATH 200 Precalculus but only one of these courses may receive credit towards the mathematics minor. These courses are to be chosen under the guidance of a member of the Mathematics Department.

Minor in Statistics (5 Courses)**Required courses:**

MATH 117	Introduction to Statistics
MATH 307	Intermediate Statistics
MATH 308	Applied Statistical Data Processing

Plus two (2) electives from:

BADM 470	Applied Econometrics for Economics and Business
CSCI____	A computer science course (only one computer science course may be used as an elective towards a minor in statistics).
MATH 215	Finite Mathematics
MATH 348	Mathematical Statistics I
MATH 349	Mathematical Statistics II
PSYC 251	Research Methods in Psychology I
PSYC 351	Research Methods in Psychology II

Mathematics Courses Appropriate for General Education (Gen. Ed.)

Courses:	Goal
MATH 110 College Mathematics I	2
MATH 117 Introduction to Statistics	2
MATH 119 Mathematics for the Liberal Arts	2
MATH 123 College Algebra	2
MATH 200 Precalculus	2
MATH 219 Calculus I	2

Mathematics Course Descriptions

Subject Code	Course Number	Course Description
MATH	095	<p>General Mathematics (no course credit)</p> <p>A review of introductory algebra including real numbers, exponents, polynomials, rational expressions, linear equations and inequalities, quadratic equations, graphing, and systems of linear equations. Note: This is a non-credit course.</p>
MATH	110	<p>College Mathematics I (Gen. Ed. Goal 2)</p> <p>An exploration of numbers, their representations, relationships, and uses; arithmetic; elementary set theory; basic logic; geometry; measurement; probability; and statistics. This course offers a college-level treatment of content areas of interest to prospective early childhood and elementary teachers. Problem-solving and the communication of mathematical ideas, both verbally and algebraically, are woven throughout the course. Note: Students may not receive credit for both MATH 110 and MATH 113 Introduction to College Mathematics. <i>Prerequisite: Satisfactory score on the mathematics placement examination or permission of the Mathematics Department.</i></p>
MATH	117	<p>Introduction to Statistics (Gen. Ed. Goal 2)</p> <p>An introduction to the discipline of statistics, emphasizing both statistical thinking and its application to analyzing data. Topics include sampling, design of experiments, organizing and exploring data, probability distributions such as the normal distribution, sampling distributions, hypothesis testing and confidence intervals, correlation and regression. Students are expected to express results of statistical procedures in ordinary non-technical language. Real world applications of statistical topics are emphasized throughout the course. <i>Prerequisite: Satisfactory score on the mathematics placement examination or permission of the Mathematics Department.</i></p>
MATH	119	<p>Mathematics for the Liberal Arts (Gen. Ed. Goal 2)</p> <p>A survey of the beauty and effectiveness of mathematics in describing natural and social phenomena. Topics may include pattern recognition, logic, sets, number systems, counting methods, probability, statistics, symmetry, population growth, voting systems, or consumer mathematics. This course is recommended for students whose major does not require MATH 110 College Mathematics I, or MATH 117 Introduction to Statistics, or MATH 123 College Algebra. <i>Prerequisite: Satisfactory score on the mathematics placement exam.</i></p>
MATH	120	<p>College Mathematics II</p> <p>A continuation of MATH 110 College Mathematics I, providing further exploration of numbers and arithmetic, geometry, measurement, probability, and statistics from the point of view of prospective early childhood and elementary school teachers. As in MATH 110, problem solving and the communication of mathematical ideas, both verbally and algebraically, are strands that unite the course. <i>Prerequisite: MATH 110 College Mathematics I.</i></p>
MATH	123	<p>College Algebra (Gen. Ed. Goal 2)</p> <p>Designed to provide the algebraic skills needed in the natural sciences, social sciences, and precalculus. The course emphasizes problem-solving skills, modeling and real-world applications, and explores multiple approaches (numerical, graphical, and symbolic) to algebraic concepts and problems. Topics include the real number system, algebraic expressions, functions and graphs, polynomial and exponential functions, matrices and systems of equations, and complex numbers. Note: A student may not receive credit for both MATH 123 and 43.115 College Algebra and Trigonometry. <i>Prerequisite: MATH 095 General Mathematics or a satisfactory score on the mathematics placement examination.</i></p>

MATH	200	Precalculus (Gen. Ed. Goal 2) A thorough introduction to the basic mathematical functions used in the sciences and the background needed to study calculus. After a brief in-depth review of the required algebra and analytical geometry, topics include functions and graphs, polynomial and rational functions, exponential and logarithmic functions, and trigonometric functions. Note: A student may not receive credit for MATH 200 Precalculus and 43.133 Precalculus, or for MATH 200 Precalculus and 43.115 College Algebra and Trigonometry. <i>Prerequisite: MATH 123 College Algebra or a satisfactory score on the mathematics placement examination.</i>
MATH	201	Intuitive Geometry An introduction to the fundamental ideas of geometry for prospective teachers. Geometric objects and relationships are studied through intuitive, coordinate, vector and synthetic approaches. The course builds from an informal approach, stressing visualization in two and three dimensions, to the development of mathematical reasoning. <i>Prerequisite: One credit-bearing course in college mathematics or permission of the instructor.</i>
MATH	208	Biostatistics A course that covers statistical methods as they apply to the biological, health, and food sciences. The major emphasis is on hypothesis testing, including regression and analysis of variance. Descriptive statistics is also included. The statistical package Minitab is used. Note: A student may not receive credit for both MATH 208 Biostatistics and MATH 117 Introduction to Statistics or BIOL 304 Biometrics. <i>Prerequisite: One credit-bearing course in college mathematics.</i>
MATH	215	Finite Mathematics A study of mathematical models in various disciplines. Topics include logic, sets, functions, combinatorics, probability, matrices, Markov chains, linear programming, game theory, and digraphs. <i>Prerequisite: MATH 200 Precalculus or permission of the instructor.</i>
MATH	219	Calculus I (Gen. Ed. Goal 2) A study of functions, limits, continuity, the derivative, rules of differentiation of algebraic, trigonometric, exponential and logarithmic functions, applications of differentiation, definite and indefinite integrals, and the Fundamental Theorem of Calculus. <i>Prerequisite: MATH 200 Precalculus or a satisfactory score on the mathematics placement examination.</i>
MATH	220	Calculus II A study of the applications of integration, first-order linear and separable differential equations, techniques of integration, improper integrals, sequences, series, and Taylor and Maclaurin Series. <i>Prerequisite: Completion of MATH 219 Calculus I with a minimum grade of C- (1.70) or better.</i>
MATH	221	Calculus III A study of conic sections; vectors in two and three dimensions; dot and cross products and their applications to geometry; equations of lines and planes; quadratic surfaces; polar, cylindrical, and spherical coordinates; and functions of several variables, partial derivatives, differentials, directional derivatives, gradients, optimization problems, multiple integrals and their applications. <i>Prerequisite: MATH 220 Calculus II.</i>
MATH	222	Differential Equations A study of the methods for solving linear and elementary nonlinear differential equations with special emphasis on applications in the sciences. Topics covered include equations of the variable separable type; exact, homogeneous and Bernoulli equations; the method of substitution; approximation methods; linear equations; series techniques; Laplace transforms; systems of equations; and the Sturm-Liouville theory. <i>Prerequisites: MATH 220 Calculus II and MATH 226 Linear Algebra and Applications.</i>

MATH	226	Linear Algebra and Applications A study of vector spaces, subspaces, linear dependence, bases, dimension, linear mappings, linear equations, matrices, inner products and norms, determinants, quadratic forms, and the spectral theorem. Applications to various fields outside of mathematics are examined. <i>Prerequisites: MATH 215 Finite Mathematics and MATH 219 Calculus I.</i>
MATH	231	Euclidean Geometry An investigation of the various approaches to the study of Euclidean geometry including the metric and synthetic approaches as axiomatic systems. Topics include Polyhedra, tessellations, symmetry groups, and coordinate geometry. Geometric proofs are emphasized throughout the course. An introduction to non-Euclidean geometries allows for comparisons to and contrasts with Euclidean geometry. <i>Prerequisite: MATH 215 Finite Mathematics</i>
MATH	292	Discrete Mathematics I A mathematical foundation for computer science. Topics include logic, boolean algebra, sets, functions, sequences, and summations, matrices, mathematical induction, study of algorithms, recursion, combinatorics, graphs, and trees. Note: A student may not receive credit for both MATH 292 Discrete Mathematics I and MATH 320 Discrete Mathematics. <i>Prerequisites: MATH 200 Precalculus and CSCI 252 Computer Science II Using Java, or permission of the instructor.</i>
MATH	294	Discrete Mathematics II A study of discrete mathematical structures. Topics include a brief review of sets and an exploration of relations, graphs, trees, digraphs, finite-state machines, formal languages, boolean algebra, and combinatorial circuits. <i>Prerequisite: MATH 292 Discrete Mathematics I.</i>
MATH	301	Problem Solving and Modeling in Mathematics A study in problem solving with the development of banks of problems appropriate to various grade levels and selected from arithmetic, informal geometry, logic, measurement, number sequences, probability, and statistics, challenging enough to provoke interest, but realistic enough for successful experiences. Heuristics, problem solving techniques, Polya's stages of problem solving, specific strategies, and pedagogical issues are studied. <i>Prerequisite: MATH 201 Intuitive Geometry and MATH 215 Finite Mathematics.</i>
MATH	307	Intermediate Statistics A study of regression and correlation analysis, chi square tests and contingency tables, design of experiments, analysis of variance, non-parametric statistics, and introduction to data analysis. <i>Prerequisite: MATH 117 Introduction to Statistics or MATH 208 Biostatistics.</i>
MATH	308	Applied Statistical Data Processing Practical aspects of data analysis using statistical computer packages such as MINITAB, SPSSX, AND BMDP. Multivariate statistical methods including multiple regression, analysis of covariance, factor analysis, multidimensional scaling, discriminant analysis and linear models for cross-classified categorical data are emphasized. Students do individual data analysis projects. <i>Prerequisite: MATH 307 Intermediate Statistics.</i>
MATH	310	Number Theory A study of properties of numbers. Topics include mathematical induction, divisibility, primes, congruences, the Chinese remainder theorem, primitive roots, quadratic reciprocity, continued fractions, partitions, and history of classical problems. <i>Prerequisite: MATH 215 Finite Mathematics and MATH 220 Calculus II.</i>
MATH	313	Numerical Methods A study of topics from elementary numerical analysis: finite differences, solution of equations, interpolation, numerical integration, and numerical linear algebra. Computer exercises and applications. This course is recommended as preparation for the numerical analysis half of the Part 3 Actuarial Exam. <i>Prerequisite: MATH 220 Calculus II and CSCI 152 Computer Science I Using Java. Recommended: MATH 226 Linear Algebra and Applications.</i>

MATH	317	<p>Higher Geometry A precise, rigorous examination of the axioms and concepts of various geometries. Euclidean, non-Euclidian, and transformational geometries are investigated. Ruler-compass constructions are discussed. <i>Prerequisite: MATH 231 Euclidean Geometry.</i></p>
MATH	319	<p>Abstract Algebra A study of algebraic structures and related concepts including groups, rings, integral domains, fields, and polynomials. Note: A student may not receive credit for both MATH 319 Abstract Algebra and 43.335 Algebraic Structures I. <i>Prerequisite: MATH 226 Linear Algebra and MATH 310 Number Theory</i></p>
MATH	324	<p>Applied Mathematics The study of problems arising from real-world situations and the mathematical methods used in their solution. Topics include mathematical modeling, continuous and discrete models, linear systems, Fourier series, partial differential equations, and computer implementation of solutions. <i>Prerequisite: MATH 222 Differential Equations, CSCI 152 Computer Science I Using Java Using C, and a course in probability, statistics or finite mathematics; or permission of the instructor.</i></p>
MATH	348	<p>Mathematical Statistics I Sample spaces, events as subsets of a sample space, probability axioms, combinatorics applied to probability problems, random variables and their distributions, special distributions, multivariate distributions, central limit theorem, and topics in statistical inference. <i>Prerequisite: MATH 221 Calculus III plus either MATH 215 Finite Mathematics or MATH 226 Linear Algebra and Applications.</i></p>
MATH	349	<p>Mathematical Statistics II Estimation, decision theory and hypotheses testing, linear models, regression, analysis of variance, analysis of categorical data, and nonparametric inference. <i>Prerequisite: MATH 348 Mathematical Statistics I.</i></p>
MATH	404	<p>Seminar An exploration of an advanced topic in mathematics or computer science. The particular topic is announced at least one semester in advance. <i>Prerequisite: Permission of the instructor.</i></p>
MATH	427	<p>Real Analysis Set theory, relations and functions, properties of the real number system, topology of the real line, introduction to metric spaces, limits of sequences and functions, continuous functions, differentiation, and the Riemann-Stieltjes integral. <i>Prerequisite: MATH 221 Calculus III.</i></p>
MATH	490	<p>Directed Study Student research on a topic or topics in higher mathematics or computer science. Suggested areas include applied algebra, numerical analysis, and mathematical physics. The student should make arrangements with the faculty member who is to direct the work one semester in advance of the work.</p>
MATH	495	<p>Internship in Mathematics The student is encouraged (and assisted to whatever extent possible) by the Mathematics Department to seek employment during summers or part time during the school year, involving non-trivial applications of mathematics. In this manner the student can earn up to three (3) course credits, the amount of credit being decided by the student's advisor and the department chair. <i>Prerequisite: Approval of the chair.</i></p>