

MATHEMATICS

Chair: Walter Czarneck

Professors: Walter Czarneck, Thomas Koshy,
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Associate Professors: Anita Goldner, Mohammad Salmassi

Assistant Professors: Michelle Capozzoli, Joyce Cutler,
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Computing Facilities Include:

Novell LAN (Netware 2.15) with 60 PCs
Four (4) networked UNIX workstations-5 M
Amiga 3000UXs running UNIX System V release 4

The General Education Requirement

All students must satisfy a general education requirement consisting of eleven (11) courses outside of the major department (see page 34). 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 a placement examination in mathematics, which is administered during orientation for new students. Shown below are additional dates and times for the examinations during the 2004-2005 academic year. Contact the Center for Academic Support and Advising (CASA) for reservations.

Wednesday, September 1, 2004	9:30 am
Wednesday, September 1, 2004	4:30 pm
Tuesday, October 26, 2004	4:30 pm
Wednesday, October 27, 2004	1:30 pm
Wednesday, January 19, 2005	4:30 pm
Wednesday, March 30, 2005	1:30 pm
Thursday, March 31, 2005	4:30 pm

Mathematics Code Interpretation

0 May not take a credit-bearing math course at Framingham State College. Student should first

complete 43.095 General Mathematics or similar course at another campus.

Q Student may enroll in **non**-algebraic math courses: 43.110 College Math I (for Coordinate majors in Education), 43.117 Introduction to Statistics, and 43.119 Math for the Liberal Arts.

1 Student may take any 100-level math course listed above, as well as 43.123 College Algebra.

2 Student may enroll in any 100-level math course, plus 43.200 Precalculus or, after consultation with the Mathematics Department, 43.219 Calculus I.

MATHEMATICS MAJOR

All students must complete the following twelve (12) core courses:

43.215 Finite Mathematics
43.219 Calculus I
43.220 Calculus II
43.221 Calculus III
43.226 Linear Algebra and Applications
43.310 Number Theory
43.317 Introduction to Higher Geometry
43.319 Abstract Algebra

One (1) computer science course

One (1) course in probability and statistics

Two (2) electives in mathematics: one at the 200 level or above; one at the 300 level or above.

PROGRAMS IN MATHEMATICS

GENERAL (MAG):

In addition to the twelve (12) core requirements above, each student must complete:

43.222 Differential Equations
43.427 Real Analysis

Six (6) electives from mathematics, physics, computer science, or an approved minor

MATHEMATICS WITH MINOR IN SECONDARY EDUCATION (MAT):

In addition to the twelve (12) core requirements above, each student must complete:

43.222 Differential Equations
43.427 Real Analysis
42.200 Psychology of Development

- 14.200 Education in American Society with Field Study I
 14.315/ Professional Preparation and Field Study II: Methods, Special Education and Technology: High School/Middle School (Credit - two courses)
 14.410 Student Teaching Practicum and Seminar I- Secondary (Credit-two courses)
 14.411 Student Teaching Practicum and Seminar II - Secondary (Credit-two courses)

Note: Mathematics Department prerequisites for 14.315 Professional Preparation and Field Study II - High School and 14.316 Professional Preparation and Field Study II - Middle School are completion of:

- All required mathematics courses except:
 43.319 Abstract Algebra
 43.427 Real Analysis

Prerequisites for 14.410-411 Student Teaching Seminar and Practicum I-II - High School and 14.414-15 Student Teaching Seminar and Practicum I-II - Middle School are completion of all department requirements, plus 14.315 Professional Preparation and Field Study II - High School or 14.316 Professional Preparation and Field Study II - Middle School, depending on the level.

COORDINATE MAJOR IN EARLY CHILDHOOD OR ELEMENTARY EDUCATION (MAE)

I. Mathematics requirements

In addition to the twelve (12) core requirements listed above, each student must complete:

- 43.110 College Mathematics I

It is strongly recommended that students select 43.201 Intuitive Geometry and 43.301 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)

- 14.200 Education in American Society with Field Study I
 42.200 Psychology of Development
 14.320 The Young Child: Emerging Literacy with Field Study II
 14.374 Early Childhood Curriculum: Mathematics and Science with Field Study III
 14.376 Early Childhood Curriculum: Reading, Social Studies, and Special Needs

The Professional Semester (four courses):
 14.431 Early Childhood Professional Practicum A (Credit—two courses)

- 14.432 Early Childhood Professional Practicum B (Credit—two courses)

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

- 14.200 Education in American Society with Field Study I
 42.200 Psychology of Development (Gen.Ed.)
 14.322 The Child and Literacy with Field Study II
 14.341 Elementary Curriculum: Mathematics with Field Study III
 14.346 Elementary Curriculum: Science, Social Studies and Special Needs

The Professional Semester (four courses):
 14.437 Elementary Professional Practicum A (Credit—two courses)
 14.438 Elementary Professional Practicum B (Credit—two courses)

Note: 42.200 may be used to fulfill the college requirement for general education.

MINOR IN MATHEMATICS (5 courses)

43.219 Calculus I and four (4) courses at or above the 200-level. Students may substitute 43.117 Introduction to Statistics for 43.200 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:

- 43.117 Introduction to Statistics
 43.307 Intermediate Statistics
 43.308 Applied Statistical Data Processing

Plus two (2) electives from:

- 12.470 Applied Econometrics for Economics and Business
 42.251 Research Methods in Psychology I
 42.351 Research Methods in Psychology II
 43.215 Finite Mathematics
 43.348 Mathematical Statistics I
 43.349 Mathematical Statistics II
 63.____ A computer science course (only one computer science course may be used as an elective towards a minor in statistics).

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

Courses	Goal
43.110 College Mathematics I	2
43.117 Introduction to Statistics	2
43.119 Mathematics for the Liberal Arts	2
43.123 College Algebra	2
43.200 Precalculus	2
43.219 Calculus I	2

COURSE DESCRIPTIONS

43.095 General Mathematics (no course credit)

A non-credit course covering the essentials of high school algebra. Time will be spent on common arithmetic difficulties and elementary metric geometry.

Prerequisite: Permission of the Mathematics Department.

43.110 College Mathematics I (Gen.Ed. Goal 2)

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 43.110 and 43.113 Introduction to College Mathematics.

Prerequisite: Satisfactory score on the mathematics placement examination **or** permission of the Mathematics Department.

43.117 Introduction to Statistics (Gen.Ed. Goal 2)

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 dis-

tributions, 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.

Prerequisite: Satisfactory score on the mathematics placement examination **or** permission of the Mathematics Department.

43.119 Mathematics for the Liberal Arts (Gen.Ed. Goal 2)

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 43.110 College Mathematics I, or 43.117 Introduction to Statistics, or 43.123 College Algebra.

Prerequisite: Satisfactory score (1 or higher) on the mathematics placement exam.

43.120 College Mathematics II

A continuation of 43.110 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 43.110, problem solving and the communication of mathematical ideas, both verbally and algebraically, are strands

that unite the course.

Prerequisite: 43.110 College Mathematics I.

43.123 College Algebra (Gen.Ed. Goal 2)

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 43.123 and 43.115 College Algebra and Trigonometry.

Prerequisite: 43.095 General Mathematics **or** a satisfactory score on the mathematics placement examination.

43.200 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 43.200 Precalculus and 43.133 Precalculus, or for 43.200 Precalculus and 43.115 College Alge-

bra and Trigonometry.

Prerequisite: 43.123 College Algebra **or** a satisfactory score on the mathematics placement examination.

43.201 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.

Prerequisite: One credit-bearing course in college mathematics **or** permission of the instructor.

43.208 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 43.208 Biostatistics and 43.117 Introduction to Statistics or 23.304 Biometrics.

Prerequisite: One credit-bearing course in college mathematics.

43.215 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.

Prerequisite: 43.200 Precalculus or permission of the instructor.

43.219 Calculus I (Gen.Ed. Goal 2)

A study of functions, limits, continuity, the derivative, rules of differentiation of algebraic and trigonometric functions, applications of differentiation, definite and indefinite integrals, the Fundamental Theorem of Calculus, and applications of integration.

Prerequisite: 43.200 Precalculus **or** a satisfactory score on the mathematics placement examination.

43.220 Calculus II

A study of the applications of the integration, logarithmic and exponential functions, elementary differential equations (first order linear and separable variables), techniques of integration, improper integrals, L'Hospital's Rule, sequences, series, Taylor and Maclaurin Series, application of series.

Prerequisite: 43.219 Calculus I.

43.221 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.

Prerequisite: 43.220 Calculus II.

43.222 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.

Prerequisites: 43.220 Calculus II and 43.226 Linear Algebra and Applications.

43.226 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.

Prerequisites: 43.215 Finite Mathematics and 43.220 Calculus II.

43.292 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 43.292 Discrete Mathematics I and 43.320 Discrete Mathematics.

Prerequisites: 43.200 Precalculus and 63.252 Computer Science II, **or** permission of the instructor.

43.294 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.

Prerequisite: 43.292 Discrete Mathematics I.

43.301 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.

Prerequisite: 43.201 Intuitive Geometry and 43.215 Finite Mathematics.

43.307 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.

Prerequisite: 43.117 Introduction to Statistics **or** 43.208 Biostatistics.

43.308 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 cate-

gorical data are emphasized. Students do individual data analysis projects.

Prerequisite: 43.307 Intermediate Statistics.

43.310 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.

Prerequisite: 43.220 Calculus II.

43.313 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.

Prerequisite: 43.220 Calculus II and 63.152 Computer Science I. Recommended: 43.226 Linear Algebra and Applications.

43.317 Introduction to Higher Geometry

A precise, rigorous examination of the axioms and concepts of various geometries. Euclidean, non-Euclidean, and transformational geometries are investigated. Ruler-compass constructions are discussed.

Prerequisites: 43.219 Calculus I

43.319 Abstract Algebra

A study of algebraic structures and related concepts including sets, logic, mappings, the integers, the division algorithm, groups, rings, integral domains, fields, and polynomials. **Note:** A student may not receive credit for both 43.319 Abstract Algebra and 43.335 Algebraic Structures I.

Prerequisite: 43.310 Number Theory.

43.323 Advanced Calculus

Vector differential calculus, vector integral calculus including the theorems of Green, Gauss and Stokes, maxima and minima for functions of several variables, Language multipliers, uniform convergence of sequences and series of functions, inverse and implicit function theorems, and Jacobians.

Prerequisite: 43.221 Calculus III, 43.226 Linear Algebra and Applications.

43.324 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.

Prerequisite: 43.222 Differential Equations, 63.152 Computer Science I Using C, and a course in probability, statistics or finite mathematics; **or** permission of the instructor.

43.348 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.

Prerequisite: 43.221 Calculus III plus either 43.215 Finite Mathematics **or** 43.226 Linear Algebra and Applications.

43.349 Mathematical Statistics II

Estimation, decision theory and hypotheses testing, linear models, regression, analysis of variance, analysis of categorical data, and nonparametric inference.

Prerequisite: 43.348 Mathematical Statistics I.

43.404 Seminar

An exploration of an advanced topic in mathematics or computer science. The particular topic is announced at least one semester in advance.

Prerequisite: Permission of the instructor.

43.427 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.

Prerequisite: 43.221 Calculus III.

43.490 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.

43.496 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.

Prerequisite: Approval of the chair.