

# Department of Mathematics and Computer Science

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## MISSION STATEMENT: MATHEMATICS

The Mathematics program at Assumption College serves all students interested in mathematics and its applications in a supportive and stimulating learning environment. As mathematics is a founding discipline of the liberal arts, we support the mission of the college through our course offerings in the Core Curriculum. As mathematics is the language of science and quantitative analysis, we offer courses for majors in the sciences and business studies. For those students who become majors or minors in mathematics, we seek to develop their problem-solving skills, their reasoning abilities, and their knowledge of the various fields of mathematics. The major provides a foundation for professional careers, especially the teaching profession, and for graduate study in mathematics.

## MAJOR IN MATHEMATICS (12)

The major consists of a total of twelve (12) required courses, which comprise eight specifically required courses, four electives, and an oral comprehensive examination:

### Required Courses (8)

First Year/Sophomore

MAT 131–132 Elementary Calculus I and II\*

**OR**

MAT 117–118 Calculus I and II

CSC 117 Introduction to Programming

MAT 231–232 Intermediate Calculus I and II (If necessary, may be taken in junior year.)

MAT 202 Discrete Structures

MAT 203 Linear Algebra

Senior Year

MAT 401 Mathematics Seminar, offered fall only

### Electives (4)

A minimum of four additional mathematics courses numbered above 200 or PHY 213 Introduction to Engineering. At least two electives must be 300-level courses, including at least one course chosen from:

MAT 332 Real Analysis

MAT 351 Modern Algebra I

MAT 358 Topology

### Senior Oral Exam

Each mathematics major must pass an oral comprehensive examination administered at the end of the senior year. The exam is based on 8 topics covered in the required mathematics courses. Frequently included topics are Theory of Differentiation; Differentiation Techniques; Theory of Integration; Integration Techniques; Sequences and Series; Discrete Mathematics; Linear Algebra; and topics from the Mathematics Seminar. The required courses are offered every year. Elective courses are offered in alternate years. Students should consult with an advisor in the department to plan their program.

*\*Students considering a major in mathematics are encouraged to take MAT 131–132 rather than MAT 117–118 in their first year.*

## MAJOR IN MATHEMATICS, ELEMENTARY EDUCATION TRACK (10)

The Elementary Track applies only to those students who are pursuing a concurrent Major in Education with a licensure emphasis in Elementary (1–6). If a student withdraws from the Education Major, then the option to pursue the Elementary Track in the Mathematics Major no longer applies. Mathematics Majors who are pursuing licensure in Middle/Secondary Education (5–8; 8–12) would still take the standard 12 courses required Mathematics Major, as given above.

### Required Courses (6)

First Year/Sophomore

MAT 131–132 Elementary Calculus I and II

**OR**

MAT 117–118 Calculus I and II

MAT 150 Numbers and Operations for Educators

MAT 202 Discrete Structures

MAT 203 Linear Algebra

MAT 231 Intermediate Calculus I

Senior Year Mathematics Oral Examination

### Electives (4)

A minimum of four additional mathematics courses numbered above 200. At least two of these courses must be at the 3001 level, including at least one course chosen from:

MAT 332 Real Analysis

MAT 351 Modern Algebra I

MAT 358 Topology

NOTE: The Elementary Track only applies to those students who are pursuing a concurrent Major in Education with a licensure emphasis in Elementary Education (1–6). If a student withdraws from the Education Major, then the option to pursue the Elementary Track in the Mathematics Major no longer applies.

## Course Descriptions

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### MATHEMATICS (MAT)

#### **MAT 111 INTRODUCTORY MATHEMATICS**

An introductory course in basic algebra which covers the following topics: properties of real numbers, linear equations and inequalities, functions and graphs, polynomials, fractional algebra, radicals, and rational exponents. Not open to those who have completed any other mathematics course. (Fall, Spring)

Staff/Three credits

#### **MAT 114 ELEMENTARY FUNCTIONS**

A survey of those topics in algebra, trigonometry, and analytic geometry which provide the background for the study of calculus. Topics to be covered include exponential and logarithmic functions, complex numbers and polynomial functions, trigonometry, plane analytic geometry, and systems of linear equations and inequalities. Not open to those who have completed MAT 117 or 131. Prerequisite: MAT 111 or departmental permission through placement. Counts in the Core Curriculum Requirements as Mathematics Group A. If only one Mathematics course is taken to fulfill the Core requirement in Mathematics, it must be at this level or higher. (Fall, Spring)

Staff/Three credits

#### **MAT 117 CALCULUS I**

An introductory course in differential calculus. Topics to be covered include limits and continuity, the derivative and applications, and an introduction to integration. Not open to those who complete MAT 131. Prerequisite: MAT 114 or department permission through placement. (Fall, Spring)

Staff/Three credits

### **MAT 118 CALCULUS II**

The continuation of MAT 117. Topics to be covered include the definite integral and applications, elementary techniques of integration, partial derivatives, and first-order differential equations. Not open to those who complete MAT 131 or MAT 132. Prerequisite: MAT 117. (Fall, Spring)

Kelton/Three credits

### **MAT 131 ELEMENTARY CALCULUS I (Honors)**

A more rigorous introduction to calculus for entering students with good backgrounds in mathematics. Recommended for students considering a major in mathematics. Topics include the real numbers, functions, limits, the derivative and applications, the integral and applications, and techniques of integration. Not open to those who complete MAT 117 or MAT 118. Prerequisite: Departmental permission through placement. (Fall)

Carlin/Three credits

### **MAT132 ELEMENTARY CALCULUS II (Honors)**

A more rigorous introduction to calculus for entering students with good backgrounds in mathematics. Recommended for students considering a major in mathematics. Topics include the real numbers, functions, limits, the derivative and applications, the integral and applications, and techniques of integration. Not open to those who complete MAT 117 or MAT 118. Prerequisite: Departmental permission through placement. (Spring)

Carlin/Three credits

### **MAT 150 NUMBERS AND OPERATIONS FOR EDUCATORS**

In this course, students will investigate fundamental mathematics concepts associated with numbers, operations, and patterns. One of the major goals of the course is for students to develop deeper conceptual understandings of the mathematics concepts they will teach in the elementary and middle grades. Not only will students gain computational proficiency but also the ability to explain to students, in multiple ways, why mathematics concepts make sense. The course heavily emphasizes the use of open-ended problem-solving methods of teaching and learning to help students develop their own functional understanding of the major concepts. A significant focus of this course will be on problem solving, reasoning and proof, multiple representations, recognizing connections (across mathematics and other disciplines), and mathematical communication. The course is intended for students planning on pursuing a career in elementary or middle school education. As such, particular attention is given to understanding common misconceptions that children have when learning about specific mathematics concepts and considering the ramifications of these misconceptions for the development of effective classroom instruction. This course is a prerequisite for EDU 324: Mathematics Teaching in the Elementary Classroom. Prerequisite: MAT 114 or higher. (Fall, Spring)

Staff/Three credits

### **MAT 151 ALGEBRA, GEOMETRY, AND DATA ANALYSIS FOR EDUCATORS**

In this course, students will investigate fundamental mathematics concepts associated with algebra, geometry, and data analysis. One of the major goals of the course is for students to develop deeper conceptual understandings of the mathematics concepts they will teach in the elementary and middle grades. Not only will students gain computational proficiency but also the ability to explain to students, in multiple ways, why mathematics concepts make sense. The course heavily emphasizes the use of open-ended problem-solving methods of teaching and learning to help students develop their own functional understanding of the major concepts. A significant focus of this course will be on problem solving, reasoning and proof, multiple representations, recognizing connections (across content areas and disciplines), and mathematical communication. The course is intended for students planning on pursuing a career in elementary or middle school education. As such, particular attention is given to understanding common misconceptions that children have when learning about specific mathematics concepts and considering the ramifications of these misconceptions for the development of effective classroom instruction. Recommended for elementary education majors and middle/secondary mathematics education majors. Prerequisite: MAT 114 or higher. (Spring)

Staff/Three credits

### **MAT 202 DISCRETE STRUCTURES**

This course is an introduction to mathematical logic and discrete systems. Topics include Boolean algebra, mathematical proof, sets, relations, functions, induction, combinatorics, graph theory, and applications. Prerequisite: MAT 118 or MAT 132 must be completed or taken concurrently. (Fall)

Creek/Three credits

**MAT 203 LINEAR ALGEBRA**

Linear systems of equations, matrix algebra, determinants, vector spaces, linear transformations, matrix representations of linear transformations, and applications. Prerequisite: MAT202. (Spring)

Staff/Three credits

**MAT 204 NUMBER THEORY**

Divisibility theory, prime factorization, congruences, Fermat's theorems, the phi-function, Euler's Theorem, and applications. Prerequisite: MAT 202. (Spring 2020, Spring 2022)

Staff/Three credits

**MAT 207 ACTUARIAL MATHEMATICS**

Mathematical theory and practical application of compound interest, including the measurement of interest, annuity calculations, loan repayment, and security valuation. Stress laid on theoretical foundations, derivations, and proofs. Introduction to financial simulation. Prerequisite: MAT 202. (Fall 2018, Fall 2020)

Katcher/Three credits

**MAT 208 PROBABILITY THEORY**

Combinatorial problems, conditional probability, dependence and independence, probability measures, distributions, and stochastic processes. Prerequisite: MAT 118. (Spring)

Staff/Three credits

**MAT 231 CALCULUS III**

A second-year course in calculus, designed to follow either MAT 118 or MAT 132. Topics to be covered include improper integrals, sequences and series, parametric curves, polar coordinates, and vector geometry. Prerequisite: MAT 118 or MAT 132. (Fall)

Creek/Three credits

**MAT 232 MULTIVARIABLE CALCULUS**

A course in the calculus of functions of several variables. Topics to be covered include multivariable functions, partial derivatives, multiple integrals and the theorems of Green, Gauss, and Stokes. Prerequisite: MAT 231. (Spring)

Creek/Three credits

**MAT 332 REAL ANALYSIS**

A course in classical real analysis. Topics to be covered include the real number system; convergence of sequences; limits and continuity of functions; differentiation; and integration. Prerequisite: MAT 232 or permission of instructor. (Fall 2019, Fall 2021)

Staff/Three credits

**MAT 351 MODERN ALGEBRA I**

An introductory course in abstract algebra. This course will cover the theory of groups and the definitions of rings and fields. Prerequisite: MAT 202. (Fall 2018, Fall 2020)

Kelton/Three credits

**MAT 352 MODERN ALGEBRA II**

The continuation of MAT 351. Topics include advanced group theory, and the theory of rings and fields. Prerequisite: MAT 351. (Spring 2019, Spring 2021)

Staff/Three credits

**MAT 353 ADVANCED EUCLIDEAN GEOMETRY**

Theorems of Menelaus and Ceva. Euler line and nine-point circle. Cross-ratio, harmonic division, and orthogonality of circles. Inversive geometry. Theorems of Pappus, Desargues, and Pascal. Elementary transformations. Prerequisite: MAT 118 or MAT 132. (Fall 2019, Fall 2021)

Andersen/Three credits

**MAT 355 DIFFERENTIAL EQUATIONS**

First and second order differential equations. Linear differential equations and linear systems. Existence and uniqueness theorems. Applications. Prerequisite: MAT 232 must be completed or taken concurrently. (Spring 2019, Spring 2021)

**MAT 356 NUMERICAL ANALYSIS**

Roots of equations. Analysis of errors. Convergence. Interpolation and polynomial approximation. Numerical differentiation and integration. Solving linear systems, unstable matrices. The computer is used throughout the course. Prerequisite: MAT 118 or MAT 132. (Spring 2020, Spring 2022)

Staff/Three credits

**MAT 358 TOPOLOGY**

An introductory treatment of both point-set and combinatorial topology. Topics to be covered include topological spaces and metric spaces, classification of surfaces, homology (mod 2), and map-coloring theorems. Prerequisite: MAT 202, and MAT 232 or permission of instructor. (Spring 2020, Spring 2022)

Staff/Three credits

**MAT 401 MATHEMATICS SEMINAR**

The topic is determined by the instructor. Emphasis is placed on student oral presentations. Required course for senior mathematics majors. (Fall)

Alfano/Three credits

**MAT 402 MATHEMATICS THESIS**

Available only to highly qualified students. Under the direction of an individual instructor, each student will complete a thesis (either expository or research) on some advanced topic in mathematics. (Spring)

Staff/Three credits

*NOTE: Semesters given with a year indicate courses that are offered in alternate years.*