
Mathematics

Faculty and Fields of Interest

Mathematics can be pursued as a scholarly discipline of an especially elegant kind—a creative art form—or it can be treated as a valuable tool in an applied discipline.

The program for mathematics majors is designed to provide a solid foundation in the theoretical and applied aspects of mathematics necessary for a variety of professional careers. The flexibility within the third and fourth years was established to enable mathematics majors to concentrate in areas of their interest. The Computer-Oriented Mathematics Program (COMP) is designed for those seeking positions in industry or with the government. The program emphasizes applied and computer mathematics. Students can choose their curricula so as to emphasize that role of mathematics which will be useful to them in later years. For example, students may use our offerings as preparation for

- secondary school teaching;
- graduate school in mathematics, applied mathematics, or computer science;
- a career in applied mathematics in either the public or private sector; and
- graduate school in an area that uses mathematics, such as economics, biology or psychology.

Some mathematics majors have had success in law school, pharmaceutical school, and medical school.

The Department offers both a major and a minor program.

Louis G. Bianco probability, statistics

Maria Blanton mathematics education

Nurit Budinsky nonlinear differential equations, numerical analysis, nonlinear dynamical systems

Richard Faulkenberry linear algebra

Dana Fine applied math, relativity theory

Sigal Gottlieb applied mathematics, scientific computing, parallel computing

Ivona Grzegorzcyk (on leave) algebraic geometry, mathematics education

Adam O. Hausknecht algebra, analysis of algorithms

Stephen Hegedus mathematics education

James J. Kaput algebra, math education and the philosophy of mathematics

Saeja Oh Kim modern algebra

Robert E. Kowalczyk probability, numerical analysis, computer applications

Steven J. Leon numerical analysis, linear algebra

Gary Martin logic

Robert McCabe analysis

Despina Stylianou mathematics education

Ronald Tannenwald (chairperson) dynamical systems

Mathematics Major
BA degree

Requirements
Regular Option

Semester Credits

At the end of the sophomore year, students, aided by their faculty advisors, should plan a course of study for the completion of the college program.

The advanced courses selected during the third and fourth years should be consistent with the students' interests and goals.

Students must earn a grade of C- or higher in all mathematics courses taken at the 200 or higher level in all undergraduate mathematics degree programs.

First Year

MTH 111, 112	Analytic Geometry and Calculus I & II	4	4
CIS 180	Object-Oriented Programming OR	3	
CIS 260	Computer Programming Fortran		
ENL 101, 102	Critical Writing and Reading I, II	3	3
	Humanities, Social Science or		
	Free Electives	3	6
MTH 181, 182	Discrete Structures	3	3
		16	16

Second Year

MTH 211	Analytic Geometry and Calculus III	4	
MTH 212	Differential Equations		3
MTH 221	Linear Algebra	3	
PHY 113, 114	Classical Physics	4	4
	Literature	3	3
	Humanities, Social Science or	3	6
	Free Electives		
		17	16

Third Year

MTH 311	Advanced Calculus I	3	
MTH 312	Advanced Calculus II		3
	Mathematics Electives	3	3
	Humanities or Social Sciences	3	3
	Unspecified Electives	6	6
		15	15

Fourth Year

MTH 441	Modern Algebra	3	
	Mathematics Electives	3	3
	Humanities or Social Science	3	3
	Unspecified Electives	4	6
		13	12

Total credits: 120

Mathematics Major
BS degree

Students may elect to earn a Bachelor of Science degree provided that they complete certain requirements for the BA degree and also take an additional six credits of Natural Science (but only courses that the science departments themselves would credit to a major in their areas). The humanities/social science requirements for the BS degree are a combined total of eighteen credits. At least six must be taken from each area.

Mathematics Electives

		code*
MTH 302	Theory of Numbers	T
MTH 310	Modern Methods in Mathematics Teaching	T
MTH 311, 312	Advanced Calculus I, II	T, G, A
MTH 321, 322	Topics in Applied Math I, II	A, G
MTH 331	Probability	A, G
MTH 332	Mathematical Statistics	A, G
MTH 353	Applied Linear Algebra	A
MTH 361, 362	Numerical Analysis I, II	A, G
MTH 381	Combinatorial Theory	A, G
MTH 382	Graph Theory	A, G
MTH 421	Complex Variables	A, G
MTH 441, 442	Modern Algebra I, II	A, G
MTH 443	Applied Modern Algebra	A, G
MTH 451	Differential Geometry	G
MTH 452	Higher Geometry	G, T
MTH 461	Elementary Topology	G
MTH 463	Math Models	A
MTH 487	Math Inquiry I	T, G
MTH 488	Math Inquiry II	T, G
MTH 499	Selected Topics in Math	T, G

*** Code**

- T**—recommended for students preparing to teach
- G**—recommended for students preparing for graduate school
- A**—recommended for students in applied mathematics

Mathematics Major: Computer-Oriented Mathematics Option
BS degree

Requirements
Computer-Oriented Option

Semester Credits

In order to meet the needs of our present-day computer-oriented society, the Mathematics Department presently offers an alternative to the mathematics major program of study—a computer-oriented mathematics program leading to the BS degree in Mathematics. This program requires a core of computer science courses and emphasizes the applied mathematics areas more than the mathematics program. This program allows the student a large choice of electives within the context of computer-oriented mathematics. The student can thus pursue his or her special interests in any particular phase of computer-oriented mathematics.

The program has virtually the same freshman and sophomore years as the other programs in mathematics, computer and information science, computer engineering and electrical engineering. This allows a student to find his or her interests and make a final choice from among these before the end of the second year without any loss of time.

A BS degree in Computer-Oriented Mathematics allows the student to enter graduate programs that specialize in computer-oriented mathematics or enter industrial employment where physical and industrial problems are analyzed mathematically.

The program offers a large choice of electives within the context of computer-oriented mathematics. The student can thus pursue his or her special interests in any particular phase of computer-oriented mathematics.

See requirements on next page.

		First	Second
First Year			
MTH 111, 112	Analytical Geometry and Calculus I, II	4	4
CIS 180	Object-Oriented Programming	3	
CIS 181	Programming Paradigms		3
ENL 101, 102	Critical Writing and Reading I, II	3	3
	Humanities/Social Science Electives	3	3
MTH 181, 182	Discrete Structures I, II	3	3
		16	16
Second Year			
CIS 260	Computer Programming—FORTRAN	1	
MTH 211	Analytical Geometry and Calculus III	4	
MTH 212	Differential Equations		3
CIS 265	Program Design and Data Structures with C	3	
PHY 113, 114	Classical Physics I, II	4	4
	Humanities/Social Science Electives	3	6
MTH 221	Linear Algebra	3	3
		15	16
Third Year			
MTH 321, 322	Topics in Applied Math I, II	3	3
MTH 331	Probability	3	
MTH 332	Mathematical Statistics		3
	Science Electives*	3	3
	Free Electives	3	3
	Literature	3	3
		15	15
Fourth Year			
MTH 361, 362	Numerical Analysis I, II	3	3
	Humanities/Social Science Elective	3	
	Technical Electives**	3	3
	Free Electives	6	4
MTH 353	Applied Linear Algebra		3
		15	13
	Total credits:		121

* The Science Elective is defined as any course in Biology, Chemistry, Physics, or Medical Laboratory Science which is accepted for credit by majors in those programs.

** The Technical Elective is defined as any upper-division Mathematics or Computer and Information Science course.

General Education Departmental Requirements

Students majoring in Mathematics will meet their departmentally-controlled General Education requirements as follows:

- Area E: Students may choose a course from the approved list
- Area I, Tier 2: TBD
- Area W, Tier 2: Students may choose a course from the approved list
- Area O: TBD

Mathematics Minor

The minor in mathematics comprises a central core of required courses followed by opportunities for advanced work and some specialization. Any student of the university is eligible for the designation "Minor in Mathematics" upon completion of the following requirements. Each course for the minor must be completed with a grade of C- or better, and the student must maintain at least a C average (2.0 GPA) in the minor program.

Requirements

		Credits
MTH 111	Analytic Geometry and Calculus I	4
MTH 112	Analytic Geometry and Calculus II	4
MTH 211	Analytic Geometry and Calculus III	4

At least one of the following courses:

MTH 212	Differential Equations	3
MTH 221	Linear Algebra	
MTH 227	Linear Algebra for Applied Science	

At least three additional three-credit courses, numbered 300 or higher. 9

Total 24

Mathematics Courses

MTH 100 three administrative credits *

Basic Algebra

An introductory level algebra course intended primarily for those with weak or no skills or those who have been away from the subject for some time. This course provides the algebra background required for all entry level courses in mathematics.

MTH 101 three credits **M**

Elements of College Mathematics I

MTH 101, 102 comprise a terminal course of study for students whose curriculum calls for one year of mathematics. MTH 101 is also a prerequisite for MTH 231. The first semester covers selected topics from algebra, set theory, matrix algebra, and elementary functions.

MTH 102 three credits **M**

Elements of College Mathematics II

Prerequisite: MTH 101 or MTH 103
Introduction to differential and integral calculus.

MTH 103 three credits **M**

Finite Mathematics

Will cover selected topics from Logic, Set Theory, Vectors and Matrices, Linear Programming, Probability, Graphs and Theory of Games. May be taken in lieu of MTH 101.

MTH 104 three credits **M**

Fundamentals of Statistics

The mathematical techniques involved in organizing data, averages and variation, elementary probability theory, the binomial distribution, normal distributions and related topics, estimation, hypothesis testing, regression and correlation, Chi Square- tests of independence, Chi Square- goodness of fit and analysis of variance: comparing several sample means.

MTH 105 three credits

Technical Calculus I

First semester of a four-term calculus sequence required of technology students and recommended for non-physical science majors desiring a basic introduction to analysis. The first term will review those topics from algebra and trigonometry needed in the sequel. Then the basic concepts of the differential calculus will be studied.

MTH 106 three credits

Technical Calculus II

Prerequisite: MTH 105
Continuation of MTH 105. Further study of algebraic and transcendental functions of one variable and topics from the integral calculus of these functions.

MTH 107 three credits **M**

Elements of College Mathematics Enhanced

Elements of college mathematics in application to business, selected to emphasize interpretation and explanation and to de-emphasize computation.

MTH 108 three credits **M**

Modern Math for Elementary Teachers

Problems of the changing modern mathematics curriculum. Current issues, attitudes, and learning theories will be studied, including the mathematical foundations of the elementary school curriculum.

MTH 109 two credits

Mathematical Problem Solving and Reasoning I

Basic mathematical problem solving and reasoning skills development. The course uses an intensive hands-on, problem-centered approach to develop mathematical thinking skills, frequently using computer software and group work. The course begins with simple thinking skills and mathematical ideas, and "what to do when you're stuck" strategies. The goal is to develop strategies for solving hard problems and understanding complex or abstract ideas.

MTH 110 three credits **M**

Mathematical Problem Solving and Reasoning II

Continuation of MTH 109.

MTH 111 four credits

Analytic Geometry and Calculus I

Prerequisite: Trigonometry
First semester of a four term sequence required of majors in mathematics, the physical sciences and engineering. Recommended for others desiring a thorough background in elementary analysis. Term 1 will cover topics in analytic geometry, the concepts of function and limit, continuity, differentiability and integrability of elementary algebraic and transcendental functions. Techniques of differentiation and applications will then be studied.

* Administrative credits do not count towards the total credits required for graduation.

Gen Ed note: Mathematics courses satisfy the Mathematics requirement. Those marked **M** below are appropriate for non-science/engineering majors.

MTH 112 four credits
Analytic Geometry and Calculus II
Prerequisite: MTH 111
Continuation of MTH 111. Topics from the integral calculus, stressing techniques of integration (including numerical methods). Infinite series.

MTH 113 four credits
Calculus for Applied Science and Engineering I
Prerequisite: Trigonometry
Corequisites: PHY 111, EGR 107
Functions, limits, differentiation and integration of elementary algebraic and transcendental functions. Vectors, vector operations, vector fields and line integrals will be introduced. Technological tools and a computer algebra system will be used extensively throughout the course.

MTH 114 four credits
Calculus for Applied Science and Engineering II
Prerequisite: MTH 113 or MTH 111
Corequisites: PHY 112, EGR 108
Continuation of MTH 113 or MTH 111. Techniques of integration, improper integrals, applications of integrals, series, polar coordinates and an introduction to differential equations. Selected topics from multivariable calculus will include partial differentiation, double and triple integrals, line integrals and flux.

MTH 117 three credits **M**
Fractals and Chaos via Elementary Mathematics
Prerequisite: Above average score on the MTH 101 placement test
The new science of chaos revealed through its fascinating history and stimulating examples. The connection will be demonstrated between such seemingly unrelated topics as weather and stock prediction, management and scientific decisions, the erratic motion of a pendulum and the delicate design of snowflakes, clouds, or the fjords of Sweden. Students will create their own fractals and play the chaos game using computer software, calculators, or even just pencil and paper.

MTH 118 three credits **M**
Mathematics for Artists
Prerequisite: satisfactory score on mathematics placement exam
Relationships between fine art and mathematics, with an emphasis on understanding geometric patterns and concepts. Topics include art-related examples and hands-on experiences which give basic mathematical

background for future artistic students' endeavors.

MTH 119 three credits **M**
Math and Music
Prerequisite: minimal ability to read music
Topics which emphasize and explore the close connection between mathematics and music. Historical connections will be studied, as well as the mathematics behind acoustics, rhythm, and 20th century music, and mathematical theories of randomness, leading to fractal music and fractal noise. The mathematical structures behind non-Western musical theories such as pentatonic and quarter-tone scalings, and polyrhythms will be explored.

MTH 120 three credits **M**
Quantitative Reasoning
Prerequisite: Satisfactory score on mathematics placement exam
Fundamentals of quantitative literacy including inductive-deductive reasoning, paradoxes, and problem-solving strategies. Numeracy including estimation, scaling, uncertainty, and infinity will be discussed. Rate of change, linear and exponential models will be explored. Applications of quantitative reasoning to the social sciences will be emphasized.

MTH 127 three credits **M**
Evolution of Mathematics As the Language of Nature
Prerequisite: above average score on MTH 101 placement test; or permission of instructor
Eratosthenes measured the earth without encircling it more than two thousand years ago. Elementary mathematics will be used to rediscover Eratosthenes and other human giants' methods in measuring the distance from Earth to the moon, the sun or other heavenly stars, to find out the precise orbit of Mars, and to prove that the planets (including Earth) do accelerate towards the sun. Philosophy and the foundation of principles in science will be discussed, such as quantitative verses, qualitative principles, and the discovery that Nature is written in the language of mathematics.

MTH 131 three credits **M**
Pre-calculus
This course is designed to provide students with the precalculus background necessary for MTH 111 or MTH 105. The course covers topics in algebra, trigonometry and finite mathematics.

MTH 181/182 three credits each

Introduction to Discrete Structures I, II
Review of set algebra including mappings and relations, algebraic structures including semigroups and groups. Elements of the theory of directed and undirected graphs. Boolean algebra and propositional logic. Applications of these structures to various areas of computers.

MTH 203 three credits
Technical Calculus III
Prerequisite: MTH 106
Continuation of MTH 106. Topics include conic sections, polar coordinates, functions of two variables, partial differentiation, multiple integration and infinite series.

MTH 204 three credits
Elementary Differential Equations
Prerequisite: MTH 203
Techniques in the solutions of ordinary differential equations, and applications from engineering. Similar to MTH 212 with less emphasis on theory and more on applications. The natural continuation of MTH 203.

MTH 211 four credits
Analytic Geometry and Calculus III
Prerequisite: MTH 112
Continuation of MTH 112. Two and three dimensional vectors, partial differentiation, multiple integrals and applications.

MTH 212 three credits
Differential Equations I
Prerequisite: MTH 112
Continuation of MTH 211. Ordinary differential equations of the first order, linear differential equations of the n th order, some nonlinear second order equations, series solutions and Laplace transforms.

MTH 213 four credits
Calculus for Applied Science and Engineering III
Prerequisite: MTH 114
Continuation of MTH 114. An introduction to multivariable and vector calculus. The course covers multivariable functions, partial differentiation, multiple integrals, parameterized curves and surfaces, vector fields, line integrals, flux and divergence.

MTH 221 three credits
Linear Algebra
Prerequisite: MTH 111
Required of all second-year mathematics majors and recommended for students in the physical, natural, behavioral and management sciences. Course material includes systems of linear equations, matrix

theory, vector spaces, linear transformations, Eigenvalues.

MTH 227 three credits
Linear Algebra for Applied Sciences

Prerequisite: MTH 111
A first course in linear algebra covering general theory of matrices and linear systems. Topics include: Matrices and linear systems, determinants, vector spaces, orthogonality, and eigenvalues. Computer laboratory exercises included.

MTH 231 three credits
Elementary Statistics I

Prerequisite: MTH 101 or equivalent
Fundamental business statistics. The text, examples, and applications are all business-oriented. The first-semester topics include descriptive statistics, probability, estimation, statistical inference and sampling.

MTH 232 three credits
Elementary Statistics II

Prerequisite: MTH 231
Continuation of MTH 231. Regression and correlation analysis. Analysis of variance. Goodness-of-fit tests. An introduction to Bayesian decision methods.

MTH 233 three credits
Elementary Applied Statistics (Honors)

Prerequisites: College Algebra and at least a score of 570 on Math SAT, or permission of the instructor
Topics in descriptive and inferential statistics including summary measures, discrete probability, normal density functions, point and interval estimation, hypothesis testing procedures, t-tests, analysis of variance, chi-square tests, correlation, and regression analysis. A statistical computer software package will be extensively utilized. Condensing the topics covered in MTH 231 and 232, this course satisfies the MTH 231/2 requirement of most business-related majors.

MTH 298 one to six credits
Experiential Learning

Prerequisites: At least sophomore standing; permission of the instructor, department chairperson, and college dean
Work experience at an elective level supervised for academic credit by a faculty member in an appropriate academic field. Conditions and hours to be arranged. Graded CR/NC. For specific procedures and regulations, see section of catalogue on Other Learning Experiences.

MTH 302 three credits
Theory of Numbers

A study of the integers, divisibility properties, diophantine equations, congruences, quadratic residues, Pythagorean triangles and selected higher topics.

MTH 310 three credits
Modern Methods in Mathematics Teaching

Prerequisite: mathematics major
The use of techniques and materials in teaching the mathematical sciences in grades 8-12. Special attention will be given to new information technology and its use in enhancing learning and problem-solving abilities. This course will concentrate on the integration of commercially-available computer software into the mathematics curriculum in algebra, geometry, statistics, and precalculus, as well as with more traditional materials. This course is for mathematics majors intending to teach.

MTH 311 three credits
Advanced Calculus I

Prerequisite: MTH 212
This course is a rigorous analysis of the concept of limits, continuity, the derivative and other selected areas.

MTH 312 three credits
Advanced Calculus II

Prerequisite: MTH 311
Continuation of MTH 311 with emphasis on uniform convergence and related topics.

MTH 321 three credits
Topics in Applied Mathematics I

Prerequisite: MTH 212
A study of Fourier Series and Integrals, Fourier and Laplace Transforms, Partial Differential Equations.

MTH 322 three credits
Topics in Applied Mathematics II

Prerequisite: MTH 321
Continuation of MTH 321. The course covers Bessel functions and Legendre polynomials; calculus of variations, vector analysis.

MTH 331 three credits
Probability

Prerequisite: MTH 112
A calculus-based introduction to statistics. This course covers probability and combinatorial problems, discrete and continuous random variables and various distributions including the binomial, Poisson, hypergeometric normal, gamma and chi-square. Moment generating functions, transformation and sampling distributions are studied.

MTH 332 three credits
Mathematical Statistics

Prerequisite: MTH 331
Continuation of MTH 331. Classical estimation methods and hypothesis testing are studied. This course also covers Chi square tests for goodness-of-fit and independence, regression and correlation analysis, and one-way and two-way analysis of variance including factorial designs and tests for the separation of means.

MTH 353 three credits
Applied Linear Algebra

Prerequisites: MTH 221, CIS 261
Orthogonality and least square problems. Other topics include applications of eigenvalue, quadratic forms, Numerical Linear Algebra.

MTH 361 three credits
Numerical Analysis I

Prerequisites: MTH 221, 212, CIS 261, (MTH 221 may be taken concurrently)
Theory and computer-oriented practice in obtaining numerical solutions of various problems. Topics include stability and conditioning, nonlinear equations, systems of linear equations, interpolation and approximation theory.

MTH 362 three credits
Numerical Analysis II

Prerequisite: MTH 361
Numerical methods for solving initial value problems. Topics include: numerical differentiation and integration, Euler method and Taylor's series method, Runge-Kutta methods, multi-step methods, and stiff equations.

MTH 381 three credits
Combinatorial Theory

Prerequisites: MTH 111, 112, 181, 182, 221
Techniques of counting: elementary enumerative methods, generating functions, partitions, recurrence relations, inclusion-exclusion principle, the Polya theory of counting, generalizations of the pigeonhole principle and selected topics from experimental design and coding theory.

MTH 382 three credits
Graph Theory

Prerequisites: MTH 111, 112, 181, 182, 221
A study of graph theory and its applications. Topics included are Hamiltonian and Eulerian properties, matching, trees, connectivity, coloring problems, and planarity. Emphasis will be on applications

including optimization of graphs and networks.

MTH 421 three credits

Complex Analysis

Prerequisite: MTH 211

Analytic functions, differentiation, integration, conformal mapping, calculus of residues and infinite series.

MTH 441 three credits

Modern Algebra I

Prerequisite: MTH 221

The study of relations, functions, groups, rings and fields.

MTH 442 three credits

Modern Algebra II

Prerequisites: MTH 221, 441

This course deals primarily with the following: Sylow theorems, polynomials, field extensions and Galois theory.

MTH 451 three credits

Differential Geometry

Prerequisite: MTH 312

Analysis of curves and surfaces. Frenet-Serret formulae. First and second fundamental forms for surfaces, Gaussian and mean curvature, theorems of Meusnier and Rodrigues, and the Gauss-Bonnet theorem are also studied.

MTH 452 three credits

Introduction to Higher Geometry

Prerequisite: MTH 211

A survey of the history of geometry, emphasizing the scholars of antiquity. Topics from modern (college) geometry, projective and non-Euclidean geometries.

MTH 461 three credits

Elementary Topology

Prerequisite: MTH 312

An introduction to point-set and combinatorial topology.

MTH 463 three credits

Math Modeling

Selected topics from the areas of linear programming, dynamic programming, Markov chains and game theory. Mathematical model building will be developed through the use of numerous case studies from the natural and social sciences, e.g., ecological models, network models, scheduling models, urban structure, traffic flow, growth, etc.

MTH 464 three credits

Simulations

Deterministic and nondeterministic

simulation. Random number generators, Monte Carlo techniques, discrete simulation techniques and simulation computer languages (e.g., GPSS, SIMSCRIPT) are studied. Standard Simulations Models, such as the national economy model, inventory control, banking, blackjack, etc., will also be covered.

MTH 487 three credits

Mathematical Inquiry I

Prerequisite: MTH 212

Course is conducted as a seminar. An elementary question is posed to the students who must generate their own mathematics in an attempt to find a solution. The aim is to develop student independence and creativity.

MTH 488 three credits

Mathematical Inquiry II

Prerequisite: MTH 212

A second semester of inquiry, independent of the first.

MTH 495 variable credit

Independent Study

Prerequisites: Upper-division standing; permission of instructor, department chairperson, and college dean
Study under the supervision of a faculty member in an area not otherwise part of the discipline's course offerings. Conditions and hours to be arranged.

MTH 196, 296, 396, 496 three credits

Directed Study

Prerequisites: Permission of the instructor, department chairperson, and college dean
Study under the supervision of a faculty member in an area covered in a regular course not currently being offered. Conditions and hours to be arranged.

MTH 499 three credits

Selected Topics in Mathematics

Prerequisites: MTH 212 and permission of department

A special course to meet the needs of students for material not encountered in other courses. Topics dealt with require the approval of the departmental chairperson.

Graduate Courses in Mathematics and Mathematics Education

MAE 507 three credits

Probability for Teachers

Prerequisite: Permission of instructor or undergraduate algebra

Probability for Teachers is an introduction to the discrete probability theory in an experimental hands-on way. The stress is put on pedagogical contents, including common misconceptions and misunderstandings in probability. The course also examines the modern educational technology and software used in probability.

MAE 508 three credits

Statistics for Teachers

Prerequisite: Permission of instructor or MAE 507

Statistics for Teachers surveys the statistical methods used in science and everyday life and addresses the problem of pedagogy and statistical misconceptions. The course also examines the modern educational technology and software used in statistics.

MAE 511 three credits

Calculus and Analysis for Teachers

Prerequisite: Permission of instructor or undergraduate calculus

Calculus and Analysis for Teachers assumes successful completion of a standard university calculus sequence. It addresses the key underlying idea of the mathematics change: notions of variation, rate, mean value, and accumulation across many contexts and representations, as well as the connections between rates and accumulation as embodied in the Fundamental Theorem of Calculus. It also addresses relations between discrete and continuous models of change, including conceptions of limit.

MAE 520 three credits

Discrete Math for Teachers

Prerequisite: Permission of instructor or modern algebra

Topics in Discrete Mathematics, including combinatorics, logic and set theory, algorithms, linear algebra, relations and functions, elements of number theory, and chaos/fractals. The focus will be on the connections and deep structural themes unifying these areas, and on using discrete math to gain a deeper understanding of high-school algebra and calculus.

MAE 521 three credits

Geometry for Teachers

Prerequisite: Permission of instructor or

undergraduate geometry

Geometry for Teachers surveys the new types of geometry made possible by dynamic computer graphics as well as topics that help students deepen their understanding of the key ideas of Euclidean geometry. The course also examines the forms and purposes of proof, and student development of spatial and logical reasoning.

MAE 522 three credits

Algebraic Structures for Teachers

Prerequisite: Permission of instructor or undergraduate algebra

Algebraic Structures for Teachers examines the many forms of algebraic reasoning and their conceptual underpinnings, the fundamental shift in the place of algebra in school mathematics, and the potential unifying role of abstract and general algebraic structures at the upper secondary level. The course will engage students in vigorous critique of traditional and innovative algebra learning materials and technologies.

MAE 591/2 three credits

Topics in Mathematics for Teachers

Prerequisite: Permission of instructor

Individual and/ or group study under supervision of a faculty member in an area of mathematics for teachers that is not otherwise part of graduate course offerings.