

# MATHEMATICS

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Karnoutsos Hall, Room 506  
201-200-3201  
<http://www.njcu.edu/department/mathematics> (<http://www.njcu.edu/department/mathematics/>)

The Mathematics Department is a member of the Mathematical Association of America and the National Council of Teachers of Mathematics. Faculty scholarship includes research ranging from methods for teaching mathematics to historical and analytical studies of mathematics.

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Various discipline-specific concentrations that will prepare students for multiple fields of employment or areas of additional graduate study are noted below. Course requirements for each concentration are explained in detail. The requirements for graduation, in addition to completion of the major area, are listed on "Completing a Graduate Program (<https://catalog.njcu.edu/graduate/academic-requirements-policies-procedures/>)."

- Mathematics Education, M.A. (<https://catalog.njcu.edu/graduate/arts-sciences/mathematics/mathematics-education-ma/>)

## Mathematics (MATH)

The Department offers three types of courses. "Professionalized subject matter" courses generally approach mathematics in a way that enhances the depth of understanding and teaching, of mathematics in the elementary, middle, or secondary school. "Pure mathematics" courses encourage the student to strengthen the knowledge of mathematics with a possible goal of pursuing an additional advanced degree. "Applied mathematics" courses provide students with a mathematical approach and computational processes to solve problems in science, engineering, and other related fields.

### MATH 501 Mathematics Content PRAXIS Review (1 Credit)

A review of the mathematical concepts included in the ETS PRAXIS (Professional Assessments for Beginning Teachers) Mathematics Content Knowledge secondary teachers' examination. (PASS/FAIL) Requirement: 24 credits in mathematics or permission of the Department Chairperson.

### MATH 503 Computers in Mathematics (3 Credits)

This course provides students, who have basic computer literacy and some elementary knowledge of computer programming, specific skills in using mathematical software. Problems and projects are taken from a variety of mathematical subjects including: precalculus, calculus, number theory, geometry, linear algebra, abstract algebra, and statistics. Explanations and introductions to these subjects are provided.

### MATH 508 Professionalized Subject Matter in Arithmetic (3 Credits)

This course offers a study of procedures in arithmetic. Attention is given to concepts in manipulative and problem solving areas. Various services for diagnostic and remedial measures are introduced and evaluated.

### MATH 510 Professionalized Subject Matter in Algebra (3 Credits)

This course provides the student with a reappraisal of the fundamental concepts of algebra. Emphasis is placed on the manner in which these concepts can be used to teach algebra more effectively. This course demands evidence of effective use of taught concepts in the student's own classroom. Topics include: number, set, relations, functions, operation structure, and problem solving.

**MATH 511 Professionalized Subject Matter in Middle School Mathematics (3 Credits)**

This course stresses mathematical concepts and skills required of children entering the junior high school curriculum in recent years, as well as those, which are appropriate for junior high students with less interest and ability in mathematics. The student will be required to show evidence of use of some of these in the student's own classroom. Topics include: modular arithmetic, numeration, geometry, descriptive statistics, algebra, and mathematical games.

**UG Pre-requisite:** Perm of Chair for Undergraduates only

**MATH 512 Professionalized Subject Matter in Geometry (3 Credits)**

This course provides a review of fundamental concepts of geometry and an investigation of their significance in the teaching of secondary school mathematics. Concepts to be analyzed include: logic, proof, and axiomatic systems; physical and geometric models; sets, relations, and transformation; non-metric and metric concepts, duality and dimensionality; and coordination of spaces. Attention is given to: historical considerations bearing on the teaching of geometry; integration of geometry with algebra and science; and significant literature on the subject. This course requires evidence that the student is making effective use of these concepts in the student's own classroom.

**MATH 514 Professionalized Subject Matter in Pre-Calculus Mathematics (3 Credits)**

This course presents pre-calculus topics, particularly trigonometry and matrix operations. Attention is given to historical considerations and to current trends in teaching this content. This course requires evidence that the student is making effective use of these concepts in the student's own classroom.

**MATH 515 Math Manipulatives I (3 Credits)**

This course explores the use of manipulative such as geoboards, Cuisenaire rods, number lines, software and CD ROM materials in the teaching of mathematics in elementary and middle schools. Both commercial and teacher-made manipulative are utilized.

**MATH 516 Mathematics Manipulative II (3 Credits)**

This course continues the exploration of using manipulatives to teach mathematics. The student is required to show evidence of the ability to use these concepts and skills in a classroom.

**MATH 517 Calculators in the K-8 Classroom (3 Credits)**

This course explores the use of calculators in the teaching of mathematics K-8. Topics include using calculators to reinforce the elementary and middle school mathematics curriculum and constructing student projects which make use of the calculator.

**MATH 518 Calculators in the Secondary Classroom (3 Credits)**

This course explores the use of graphing calculators in the teaching of secondary school mathematics. The use of calculators is demonstrated for algebra, geometry, trigonometry, and calculus. Student projects are constructed which make use of the calculator.

**MATH 526 Algorithmic Number Theory (3 Credits)**

This course presents number theory from an historical point of view and emphasizes significant discoveries from ancient to modern times, as well as presenting unsolved problems and areas of current interest. Topics include: prime numbers and related theorems; Euclidean algorithm and quadratic reciprocity; Pythagorean numbers and continued fractions.

**MATH 531 Numerical Analysis (3 Credits)**

Topics include iterative methods of solving equations; interpolation and polynomial approximation; numerical differentiation and integration; numerical solution of differential equations; solution of linear systems by direct and iterative methods; matrix inversion and calculation of eigenvalues and eigenvectors of matrices. Selected algorithms may be programmed in FORTRAN and APL for solution on electronic computers at NJCU Computer Center.

**MATH 536 Mathematical Modeling (3 Credits)**

The main objectives of this course are: to explore mathematical models of real world situations, to set up such models, and to review the mathematics needed to treat such models. Analysis of computer simulations of the models plays a major role in this course.

**MATH 540 Graph Theory (3 Credits)**

Topics studied in this course include paths, walks, networks, trees, connected graphs, subgroups and related applications.

**MATH 598 Mathematical Principles of Computer Graphics (3 Credits)**

Topics include: two dimensional algorithms; transformations, scaling, translations, rotations, matrix notation, line clipping, b-spline curve fitting, and recursion. Geometric tools for three-dimensional algorithms, and affine and projective geometry are included. Viewing and perspective transformations, wire frame models, algorithms for the triangle decomposition of polygons and hidden-line elimination are included. Object-oriented programming using C++ is included.

**MATH 602 Elements of Modern Mathematics (Pre-Calculus) (3 Credits)**

This course includes an introduction to sets; elementary work with unordered fields, finite fields, and ordered fields; elements of number theory; systems of numeration; introduction to logic; nonmetric and informal geometry; and growth of the number system.

**MATH 604 Mathematics Curriculum in the Urban Schools (3 Credits)**

This course, designed primarily for in-service elementary urban school teachers, stresses the study of modern mathematics—its organization, its underlying psychological and philosophical principles, and creative teaching techniques important to the teacher of mathematics. Students are exposed to some of the significant research programs currently being undertaken by mathematics educators.

**MATH 606 Survey Of Modern Mathematics (3 Credits)**

This course offers a review of modern trends in mathematics, with emphasis given to experimental programs. Analyses are made of recommendations for new mathematics curricula.

**MATH 607 Mathematics in Secondary School (3 Credits)**

A presentation of objectives and techniques in major areas of junior and senior high mathematics is provided. Topics include: basic approaches to arithmetic; teaching of algebra; formal and informal geometry; status of general mathematics, senior (12th grade) mathematics; and current literature on the teaching of mathematics.

**MATH 608 Seminar in Modern Elementary School Mathematics (3 Credits)**

This course includes classroom applications of the following ideas: distinction between number and numeral structure in arithmetic; the use of set ideas in understanding the fundamental operations in arithmetic; and a modern approach to the solution of verbal problems, open sentences, number families, patterns in arithmetic, geometry, and informal proofs. (This course does not count towards the MA in Math Education.)

**MATH 609 Statistics for Classroom Teachers (3 Credits)**

This course is designed to develop an appreciation and general understanding of statistics. It offers an interpretation of fundamental statistical concepts as applied in the fields of education. A mathematics background (i.e., advanced mathematics courses) is not required.

**MATH 614 Calculus for Teachers I (3 Credits)**

This course is designed for teachers to investigate the concepts, techniques, and applications of elementary calculus. Topics include: the foundations of calculus, differentiation, and integration of both algebraic functions and transcendental functions, and applications of calculus to the arts and sciences, professional studies and education.

**MATH 615 Calculus for Teachers II (3 Credits)**

This course provides an intermediate level knowledge of mathematical concepts, techniques, and applications related to calculus and their application to the arts and sciences, professional studies and education.

**Pre-Requisite(s):** MATH 614 - Calculus for Teachers I

**MATH 620 Selected Topics in Advanced Calculus I (3 Credits)**

Prefaced by a careful examination of the foundations of calculus, this course provides an extension of fundamental concepts of calculus that are taught in undergraduate calculus courses. Topics include: generalized mean value theorem, functions of several variables, partial differentiation, transformation, and mappings.

**MATH 621 Selected Topics Advanced Calculus II (3 Credits)**

This course studies: vector, multiple integrals, curves and surfaces, theory of integration, and infinite and power series. Prerequisite:

MATH 620 Selected Topics in Advanced Calculus II.

**Pre-Requisite(s):** MATH 620

**MATH 622 Selected Topics in Abstract Algebra (3 Credits)**

This course extends the concepts that are taught in an undergraduate introduction to abstract algebra. Topics include: finite and infinite groups, rings, ideals, and integral domains and fields.

**MATH 623 Selected Topics in Linear Algebra (3 Credits)**

This course studies: vector spaces, Euclidean space, sets of linear transformations and matrices, and bi-linear and quadratic forms.

**MATH 624 Selected Topics in Modern Geometry (3 Credits)**

This course is prefaced by a careful examination of the foundations of geometry. Major topics include: finite geometry, synthetic and coordinate-projected geometry, hyperbolic geometry, elliptic geometry, differential geometry, and topology. Considerable attention is given to the modern alliance of geometry with linear and abstract algebra.

**MATH 626 Differential Equations (3 Credits)**

This is a course in ordinary and partial differential equations including topics such as separating variables, linear first and higher order differential equations and applications. In addition to many applications, the course includes an examination of the theory supporting various techniques for solution. Computer software is used as needed.

**MATH 627 Probability and Statistics (3 Credits)**

Prefaced by a study of the foundations of probability and statistics, this course is an extension of the elements of probability and statistics introduced in an undergraduate course. Topics include: unlimited sequences, random variables, expectation, law of large numbers, and generating functions.

**MATH 629 Topics in Topology (3 Credits)**

This course stresses the merging of fundamental ideas of analysis, algebra, and geometry. Topics include: open sets, closed sets, topological spaces, continuity, connectedness, compactness, and separation properties.

**MATH 630 Complex Variables (3 Credits)**

This course extends the concepts of elementary calculus to include the domain of complex numbers. Topics include: differentiation and integration of complex functions, analytic function, analytic continuation, and Cauchy's theorems.

**MATH 639 Structured Programming in C Language (3 Credits)**

Topics include: Fractal geometry (Basic Definitions), metric spaces, classification of subsets, the space of fractals, transformations on metric spaces, contraction mappings, construction of fractals, recursion and fractals, Sierpinski triangle, Hilbert curve, dragon curves, trees, chaotic dynamics on fractals, fractal dimension and programming principles using C or C++.

**Pre-Requisite(s):** Approval by Chair of Math Department

**MATH 640 History of Mathematics (3 Credits)**

This course is a survey of the present state of mathematics, its origins, and its probable future development. Topics cover the content, methods, and meaning of the different mathematical disciplines. Readings include biographies of many of the contributors to mathematics in both the distant and more recent past.

**MATH 651 Advanced Numerical Analysis (3 Credits)**

This course examines the theoretical foundations of numerical methods and studies in detail existing numerical methods for solving many standard mathematical problems in analysis, algebra, theory of chaos and nonlinear dynamics. Error analysis will be developed for all methods. A very recent advancement like polynomial chaos will also be presented.

**MATH 655 Numerical Linear Algebra (3 Credits)**

This course examines the theoretical foundations of linear algebra and studies in detail the related numerical methods for analyzing linear algebra problems. Students will learn how to solve large systems of linear equations using different numerical methods, and computer software with the understanding and knowledge of the underlying mathematical concepts.

**MATH 659 Independent Study (3 Credits)****MATH 660 Research Seminar in Mathematics (2 Credits)**

This seminar may involve the student in experimentation and research in mathematics. Emphasis is placed on skills and techniques appropriate for mathematics education. Each student may formulate and complete a classroom experiment involving the presentation of new material, analysis of student difficulties, or some other similar activity.

**MATH 661 Research Credit in Mathematics (3 Credits)**

The candidate may elect to do independent research by enrolling in this course.

**MATH 665 Research Credit in Mathematics (1 Credit)**

The candidate who did not finish a thesis while enrolled in Math 661 may enroll in this course one time only to finish the thesis. (Prerequisite: MATH 661 and permission of the chairperson)