

**Master of Arts in Mathematics**  
**Master of Arts in Mathematics Education**  
**Department of Mathematical Sciences**  
**College of Arts and Sciences**

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The Department of Mathematical Sciences offers graduate programs that are designed to prepare graduates for careers in teaching at the secondary and community college level, as well as for further study at the Ph.D. level. Programs emphasize broad training in the mathematical sciences with work in statistics, computing, and applied mathematics in addition to core mathematics.

The following graduate degree programs are offered through the Department of Mathematical Sciences:

- Master of Arts in Mathematics (Major Code: 264\*/27.0101) with a concentration in College Teaching (264B)
- Master of Arts in Mathematics, Education (Major Code: 263\*/13.1311) with a concentration in Secondary School Teaching (263S)[T]

Courses in the following disciplines are offered through the Department of Mathematical Sciences:

- MAT: mathematics courses
- STT: statistics courses

In addition, the Mathematics programs include coursework offered by other departments as follows:

- CI: curriculum and instruction courses (see the Curriculum Specialist program for course descriptions)
- HE: higher education courses (see the Higher Education program for course descriptions)
- LSA: leadership in school administration courses (see the School Administration program for course descriptions)
- SPE: special education courses (see the Special Education program for course descriptions)

**NOTE:** During the first semester of coursework, graduate students will meet with an advisor to design a program of study. Any subsequent changes in the program are made with the counsel and the approval of this committee.

**PEACE CORPS MASTER'S INTERNATIONAL PROGRAM:** The Mathematics Education program is recognized by the Peace Corps as an MI program. Students who are admitted to the English Education program as MI students will apply to the Peace Corps during the graduate admission process or immediately following admission. These students will complete a customized program of study designed to allow for one year of coursework at Appalachian followed immediately by Peace Corps service as a teacher of English. Some additional academic coursework related to the Peace Corps teaching assignment will be completed during the 27 month Peace Corps rotation, and the student will typically return to Appalachian for one semester to complete the master's degree.

**PROGRAM OF STUDY FOR THE MASTER OF ARTS IN MATHEMATICS (Major Code: 264\*/27.0101; Concentration Code: 264B)**

**Admission Requirements:** Baccalaureate degree in mathematics or a related field from an accredited college or university; complete application to the Cratis Williams Graduate School (<http://www.graduate.appstate.edu>), including resume, three letters of recommendation, official GRE general exam scores, and official transcripts from all colleges attended; undergraduate coursework in statistics, linear algebra, differential equations, and analysis. In extenuating circumstances, an applicant may obtain permission to remove deficiencies in coursework after entering the graduate program.

**Basic Criteria for Consideration:** (Undergraduate GPA X 400) + GRE Verbal + GRE Quantitative = 2000

**Hours:** 36 semester hours

**Location:** On Campus

**Required Courses:**

MAT	5415	Seminar in the Pedagogy of Mathematics.....	1+1+1=3
		(3 semesters at 1 s.h. each)	
MAT	5420	Teaching Apprenticeship .....	1+1+1=3
		(3 semesters at 1 s.h. each)	
MAT	5610	Analysis I.....	3
MAT	5620	Analysis II.....	3
STT	5860	Probability Models and Statistical Inference I.....	3
STT	5865	Statistical Inference II .....	3
<b>REQUIRED COURSE HOURS .....</b>			<b>18</b>

**Related Coursework:**

Choose two from the following courses.

MAT	5125	History of Mathematics .....	3
MAT	5210	Abstract Algebra.....	3
MAT	5230	Linear Algebra .....	3
MAT	5330	Mathematical Models.....	3
MAT	5370	Advanced Differential Equations .....	3
<b>RELATED COURSEWORK HOURS .....</b>			<b>6</b>

**Electives:**

(6 s.h. 5000 level or above) Students may with permission take 3 s.h. of courses outside of mathematical sciences. For students interested in pursuing careers in teaching at the college level, the following courses are recommended: HE 5420, HE 5440, HE 5630, or HE 6090.

**ELECTIVE HOURS .....** 6

**Capstone Component:** Choose one of the following 6 s.h. options.

**INTERNSHIP AND RESEARCH**

HE	5900	Higher Education Internship/Field Study (3 s.h.)
MAT	5600	Directed Research in Mathematical Sciences (3 s.h.)

**THESIS**

MAT	5999	Thesis (6 s.h.)
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**COURSE AND RESEARCH**

MAT	5600	Directed Research in Mathematical Sciences (3 s.h.)
3 s.h. in the mathematical sciences (5000 level or above)		

**CAPSTONE COMPONENT HOURS.....** 6

**TOTAL HOURS FOR THE MA DEGREE .....** 36

**Thesis:** Optional part of capstone

**Proficiency:** Demonstrated proficiency in the use of technology, subject to the approval of the program director.

**Comprehensive:** Written and oral examinations are required.

**Product of Learning:** Not Required

**PROGRAM OF STUDY FOR THE MASTER OF ARTS IN MATHEMATICS EDUCATION (Major code: 263\*/13.1311; Concentration Code 263S) +**

**+Leads to NC Teacher Licensure:** Requirements for this degree were designed, and have been approved by the appropriate bodies at the state level, to meet the advanced competencies as mandated in the North Carolina Excellent Schools Act for Master-level teacher education programs.

**Admission Requirements:** Baccalaureate degree in mathematics or a related field from an accredited college or university; North Carolina “A” license or the equivalent from another state; complete application to the Cratis Williams Graduate School (<http://www.graduate.appstate.edu>), including resume, three letters of recommendation, official GRE general exam scores, and official transcripts from all colleges attended; undergraduate coursework in linear algebra, geometry, and either probability or statistics, as well as a sequence of courses in calculus. In extenuating circumstances, an applicant may obtain permission to remove deficiencies in coursework after entering the graduate program.

**Basic Criteria for Consideration:** (Undergraduate GPA X 400) + GRE Verbal + GRE Quantitative = 2000

**Hours:** 36 semester hours

**Location:** Academic Year Off Campus; Summers On Campus

**Required Courses:**

CI/SPE	5045	Advanced Topics in Diversity.....	3
CI/LSA	5585	Teacher Leadership and School Improvement.....	3
MAT	5525	Product of Learning.....	1-3
MAT	5910	Investigation in the Teaching of Mathematics .....	2
MAT	5920	Linear Algebra for Teachers.....	4
MAT	5930	Analysis for Teachers.....	4
MAT	5950	Mathematical Modeling-Analytical Models .....	2
MAT	5951	Mathematical Modeling-Empirical Models.....	2
<b>REQUIRED COURSE HOURS .....</b>			<b>21-23</b>

**Electives (5000 level or above):** (13-15 s.h. required)

Elective courses must be approved by the Graduate Advisory Committee.

The list below contains suggested mathematical sciences electives;

up to 3 s.h. of 5000 level coursework in education may be chosen.

MAT	5941	Technology for Secondary School Mathematics (3 s.h.)	
MAT	5952	Problem Solving (3 s.h.)	
MAT	5970	Number Theory Concepts (3 s.h.)	
MAT	5980	Special Topics in Mathematics Education (1-3 s.h.)	
<b>ELECTIVE HOURS .....</b>			<b>13-15</b>

**TOTAL HOURS FOR THE MA DEGREE .....** **36**

**Thesis:** An optional part of Product of Learning

**Proficiency:** None required

**Comprehensive:** Written and oral examinations are required.

**Product of Learning:** Required

**GRADUATE COURSES IN MATHEMATICS (MAT)**

**MAT 5125. History of Mathematics/(3).On Demand.** The history and development of mathematical thought and theory from ancient to modern times, with particular attention to the history of geometry, algebra, calculus, differential equations, linear algebra, and statistics, and to the persons who made significant contributions to these areas of mathematics.

**MAT 5160. Complex Variables/(3).On Demand.** An introduction to the study of complex variables to include such topics as line integrals, the Cauchy theorem, the Cauchy integral formula, Morera's theorem, and the Laurent series.

**MAT 5210. Abstract Algebra/(3).F.** A study of group theory including quotient groups, the fundamental theorem of finite Abelian groups, and the Sylow theorems. Includes an introduction to rings with emphasis on Euclidean rings and other principal ideal domains. Prerequisite: MAT 3110 (Modern Algebra) or permission of the instructor. [Dual-listed with MAT 4720.]

**MAT 5220. Ring Theory/(3).On Demand.** A study of rings including Euclidean and polynomial rings. Modules on Euclidean rings will be emphasized. Included will be an introduction to fields and field extensions. Prerequisite: MAT 5210 or permission of the instructor.

**MAT 5230. Linear Algebra/(3).F.** A study of finite dimensional vector spaces. Among the topics covered are matrices, linear transformations, change of basis, eigenvalues, canonical forms, quadratic forms and quasi-inverses. Prerequisite: MAT 2240 (Linear Algebra) or MAT 3110 (Modern Algebra).

**MAT 5310. Numerical Analysis with Computer Applications/(3).On Demand.** A study of methods of solving systems of linear and non-linear equations, differential equations and numerical integrations with emphasis on convergence properties and error analysis. Prerequisites: MAT 3220 (Real Variables), and CS 1440 (Computer Programming). Corequisite: MAT 5610. (Same as CS 5310.)

**MAT 5330. Mathematical Models/(3).S.Odd-numbered years.** A problems oriented course. The student uses mathematics to model a number of different situations. Among the tools used will be statistics, linear programming, differential equations, and computer simulation. Prerequisites: CS 1440 (Computer Programming) and background in at least two of the utilized tools.

**MAT 5340. Introduction to Operations Research/(3).On Demand.** A thorough study of linear programming including duality theory and sensitivity analysis. At least two other topics related to mathematical applications in the management sciences queuing theory, Markov processes, game theory, decision analysis, network analysis, etc. will be covered. Prerequisites: MAT 2240 (Linear Algebra) and either STT 3850 (Probability and Statistics) or STT 4250 (Probability Modeling with Applications). [Dual-listed with MAT 4340.]

**MAT 5360. Methods of Applied Mathematics/(3).On Demand.** The content may vary depending on the instructor. Suggested topics are: Fourier series; Sturm-Liouville problems; special functions and transforms; partial differential and nonlinear differential equations with applications; numerical methods. Prerequisites: MAT 3130 (Differential Equations) with MAT 3220 (Real Variables) recommended. Knowledge of computers might be helpful. [Dual-listed with MAT 4560.]

**MAT 5370. Advanced Differential Equations/(3). F.Even-numbered years.** Usual topics include: power series solutions; special functions; methods and theory of systems; existence and uniqueness theorems and continuations of solutions; Sturm theory; nonlinear differential equations; numerical methods. Prerequisites: MAT 2240 (Linear Algebra), MAT 3130 (Differential Equations), with MAT 3220 (Real Variables) recommended. [Dual-listed with MAT 4570.]

**MAT 5380. Partial Differential Equations/(3).On Demand.** Topics include: classification and properties of elliptic, hyperbolic, and parabolic equations; separation of variables; Laplace and Fourier transforms; initial and boundary value problems; eigenfunction expansions; solution of Laplace, wave and heat equations; and solitons. Prerequisite: MAT 3130 (Differential Equations). MAT 3220 (Real Variables) recommended. [Dual-listed with MAT 4580.]

**MAT 5390. Numerical Linear Algebra/(3).S.On Demand.** Methods for solving systems of linear equations with an emphasis on large, sparse systems. LU factorization including storage schemes, graph theory, ordering algorithms, and block factorization. Iterative methods including Jacobi, SOR, and conjugate gradient. Eigenvalue methods including power method, QR factorization, and Lanczos methods. Parallel matrix computations. Prerequisite: MAT 4310 (Numerical Methods). (Same as CS 5990). [Dual-listed with MAT 4990.]

**MAT 5415. Seminar in the Pedagogy of Mathematics/ (1).F;S.** Topics from mathematics and pedagogy are examined, such as research methods, recent advances in mathematics, alternative learning styles, teaching developmental and adult students, and teaching with technology. Students will share their experiences from the corequisite teaching apprenticeship. This course may be repeated for a total credit of three semester hours. Corequisite: MAT 5420, Teaching Apprenticeship.

**MAT 5420. Teaching Apprenticeship/(1).F;S.** This course provides a supervised experience in college teaching through direct participation in a classroom situation. Each student will work closely with a faculty mentor teaching an undergraduate course and will be actively engaged in the development of activities and assignments. Students will share their experiences in the corequisite seminar. This course may be repeated for a total credit of three semester hours. Corequisite: MAT 5415, Seminar in the Pedagogy of Mathematics.

**MAT 5500. Independent Study/(1-3).F;S.** Prerequisite: 12 hours of graduate mathematics.

**MAT 5525. Product of Learning/(1-3).F;S.On Demand.** Graded on an S/U basis.

**MAT 5530-5549. Selected Topics/(1-4).On Demand.**

**MAT 5600. Directed Research in Mathematical Sciences/(3). On Demand.** A research project will be chosen, formulated, and executed by the student under the guidance of a faculty member. The project may investigate a mathematical sciences or a mathematics pedagogy topic. A final written report and presentation are required.

**MAT 5610. Analysis I/(3).F.** A rigorous treatment of sequences, series, basic topology, continuity, and differentiation. Prerequisite: MAT 4220 (Real Analysis) or permission of the instructor.

**MAT 5620. Analysis II/(3).S.** A continuation of MAT 5610, including a rigorous development of the Riemann-Stieltjes integral, sequences and series of functions, functions of several variables, and Lebesgue theory. Prerequisite: MAT 5610 or permission of the instructor.

**MAT 5710. Introduction to Topology/(3).F.** A study of the basic concepts of general topological space including such topics as compactness, connectedness, product spaces, metric spaces, and continuous functions. Prerequisite: MAT 3110 (Modern Algebra). [Dual-listed with MAT 4710.]

**MAT 5720. Topology/(3).On Demand.** A study of topology to include such topics as general product spaces, complete metric spaces, compactifications, embedding, metrization theorems, and quotient spaces. Prerequisite: MAT 5710.

**MAT 5910. Investigation in the Teaching of Mathematics/(2).SS.** An examination of recent research and experimental programs in the teaching of secondary school mathematics. Students are encouraged to write experimental designs for potential research problems. Prerequisite: undergraduate mathematics major or permission of the instructor.

**MAT 5920. Linear Algebra for Teachers/(4).SS.Odd-numbered years.** Elementary concepts of linear algebra extending to a rigorous level of algebraic proof are studied. Prerequisite: undergraduate major in mathematics.

**MAT 5930. Analysis for Teachers/(4).SS.Even-numbered years.** This course is a rigorous study of elementary calculus extending to a treatment of fundamental concepts of analysis involving functions of a real variable. Prerequisite: undergraduate major in mathematics.

**MAT 5935. Basic Concepts of Probability and Statistics/(3).On Demand.** This course examines the concepts underlying the elementary and middle school curriculum in probability and statistics. Probability models will be studied using both mathematical approaches and simulations. Statistics will be presented as a problem solving process involving question formulation, data collection, data analysis and the interpretation of results. Prerequisite: MAT 3910 or MAT 3920 (Logic and Structure of Math) or permission of the instructor. [Dual-listed with MAT 4930.]

**MAT 5941. Technology for Secondary School Mathematics/(3).On Demand.** The use of current computer and calculator technology in various mathematics content areas will be studied. Technology use in these areas will involve problem solving, exploring patterns, experimentation, conjecturing and generalization of findings. Appropriate use of technology will be stressed. Prerequisite: undergraduate major in mathematics, or permission of the instructor.

**MAT 5950. Mathematical Modeling-Analytical Models/(2).On Demand.** This course is an introduction to the mathematical modeling of phenomena from business and science with an emphasis on analytical models. Topics to be covered include the modeling process, modeling using functions and differential equations, linear programming, optimization, population growth, discrete versus continuous models. The course will be project-based, with both team and individual written and oral presentations an integral part of the grading scheme. Prerequisites: knowledge of college algebra, calculus and linear algebra.

**MAT 5951. Mathematical Modeling-Empirical Models/(2).On Demand.** This course is an introduction to the mathematical modeling of phenomena from business and science with an emphasis on empirical and stochastic models. Topics covered in this course include the modeling process, modeling using data, regression, curve fitting, probability and simulation, population growth, Markov chains. The course will be project-based, with both team and individual written and oral presentations as an integral part of the grading scheme. Prerequisites: knowledge of college algebra, calculus and linear algebra.

**MAT 5952. Problem Solving/(3).On Demand.** Problem solving is the focus of this course. There is an emphasis on building new mathematical knowledge through work with problems and applying a wide variety of strategies to solve problems and adapt the strategies to new situations. Problems may be drawn from algebra, geometry, number theory, calculus, probability and statistics. Prerequisites: knowledge in all the areas from which the problems will be drawn.

**MAT 5961. Foundations of Geometry/(3).SS.** A treatment of projective geometry including both the synthetic and the analytic approach. Also to be considered is a study of the relation of Euclidean, affine and hyperbolic geometries to projective geometry. Prerequisites: MAT 2240 (Linear Algebra) and MAT 3610 (Geometry). [Dual-listed with MAT 4610.]

**MAT 5965. Informal Geometry/(3).F.** An informal treatment of all aspects of geometry. The topics considered include congruence, measure of segments and angles, constructions, parallels and parallelograms, similarity, space geometry, areas and volumes, and measurements related to circles. Prerequisite: MAT 3910 or MAT 3920 (Logic and structure of Math) or permission of the instructor. [Dual-listed with MAT 4910.]

**MAT 5970. Number Theory Concepts/(3).SS.** Designed primarily for secondary teachers, this course is a study of the traditional number theory concepts and theorems with special attention to those of significance to the high school curriculum. Emphasis will be on the historical as well as the theoretical development of the subject. Prerequisites: undergraduate major in mathematics; MAT 3250, or permission of the instructor.

**MAT 5971. Number Systems and Algebra for Middle Grades Teachers/(3).On Demand.** Designed primarily for teachers of mathematics at Grades 6-8, this course is a deep and connected study of number and operations, and of algebra, including rational numbers, proportional reasoning, and linear relations. Emphasis will be on rich tasks using representational tools and models to explore mathematical relationships. Problem solving, reasoning and proof, and mathematical communication will also be emphasized. Does not count for the Master of Arts in Mathematics. Prerequisite: enrollment in the Master of Arts in Middle Grades Education program, or permission of the instructor.

**MAT 5972. Geometry and Measurement for Middle Grades Teachers/(3).On Demand.** Designed primarily for teachers of mathematics at Grades 6-8, this course is a deep and connected study of geometry and measurement, including the van Hiele model of geometric learning; shape, size, and symmetry; perimeter, area, surface area, and volume; classical and transformational geometry; the golden ratio, tessellations, and spherical geometry. Emphasis will be on rich tasks using representational tools and models to explore mathematical relationships. Problem solving, reasoning and proof, and mathematical communication will also be emphasized. Does not count for the Master of Arts in Mathematics. Prerequisite: enrollment in the Master of Arts in Middle Grades Education program, or permission of the instructor.

**MAT 5973. Data Analysis and Probability for Middle Grades Teachers/(3).On Demand.** Designed primarily for teachers of mathematics at Grades 6-8, this course is a deep and connected study of data analysis and probability, including data collection, organization, and display; measures of spread and center; inferences and predictions based on data; and basic concepts of probability. Emphasis will be on rich tasks using representational tools and models to explore mathematical relationships. Problem solving, reasoning and proof, and mathematical communication will also be emphasized. Does not count for the Master of Arts in Mathematics. Prerequisite: enrollment in the Master of Arts in Middle Grades Education program, or permission of the instructor.

