Mathematics (MATH)

The department offers a major in Mathematics, a major in Mathematics with a Concentration in Applied Mathematics, a major in Mathematics with a Concentration in Pure Mathematics, and a minor in Mathematics. Students completing the major in Mathematics may qualify for the BA degree or the BS degree, depending upon how they meet the college’s general education requirement in the natural sciences. The department prepares students for mathematics related careers, including teacher education, and for graduate studies in mathematics.

Students majoring in Mathematics may obtain an Emphasis in Computational Science (http://catalog.wofford.edu/courses-programs-departments/computer-science/#emphasisrequirementstext). The interdisciplinary field of computational science applies computer science and mathematics to the sciences.

Students in the Teacher Education Program who are seeking to complete secondary education licensure requirements to teach mathematics should refer to the Teacher Education Handbook and consult with the chairs of the Departments of Mathematics and Education to develop a curricular plan that will meet the requirements for both fields of study.

Honors Courses and In-Course Honors

The Department of Mathematics encourages its students to undertake honors work. For further information, the student is referred to the sections on Honors Courses (http://catalog.wofford.edu/academics/academic-honors/honors-courses) and In-Course Honors (http://catalog.wofford.edu/academics/academic-honors/honors-courses) in the Catalog.

Chair
Joseph A. Spivey

Professors
Matthew E. Cathey
Anne J. Catllá
Charlotte A. Knotts-Zides
Brian J. Pigott
Thomas J. Wright

Requirements for the Major in Mathematics

Corequisite
COSC 235 Programming & Problem Solving

Core Requirements
MATH 181 Calculus I
MATH 182 Calculus II
MATH 210 Multivariable Calculus
MATH 220 Linear Algebra
MATH 260 Introduction to Mathematical Proof

Electives
Select six Math courses at the 200-level or higher, at least three of which must be at the 400-level.

Total Hours 33

Requirements for the Major in Mathematics with a Concentration in Applied Mathematics

Corequisite
COSC 235 Programming & Problem Solving

Core Requirements
MATH 181 Calculus I
MATH 182 Calculus II
MATH 201 Modeling & Simulation or MATH 320 Mathematical Modeling
MATH 210 Multivariable Calculus
MATH 220 Linear Algebra
MATH 240 Differential Equations
MATH 260 Introduction to Mathematical Proof

Upper Level Electives
Select three courses from the following (or other 400-level courses as approved by the Coordinator of Applied Math):
MATH 330 Numerical Methods
MATH 421 Probability and Statistics I
MATH 422 Probability and Statistics II
MATH 424 Advanced Game Theory
MATH 431 Abstract Algebra I
MATH 435 Cryptology
MATH 441 Mathematical Analysis I
MATH 445 Nonlinear Dynamics and Chaos Theory
MATH 446 Partial Differential Equations

Electives
Select two Math courses at the 200-level or higher.

Research (0-3 credit hours)
Each student must complete a summer research project, a semester of independent research, or an honors course. This requires the prior approval of the Applied Math Coordinator.

Area of Application (6-12 credit hours)
Each student must choose an area of application (Accounting, Finance, Biology, Chemistry, Computer Science, Economics, Environmental Studies, Philosophy, Physics or Psychology) and complete two or three courses as approved by the Applied Math Coordinator.

Total Hours 36

Requirements for the Major in Mathematics with a Concentration in Pure Mathematics

Corequisite
COSC 235 Programming & Problem Solving

Core Requirements
MATH 181 Calculus I
MATH 182 Calculus II

Total Hours 33

1 The total number of credit hours for the Major with the Applied Math Concentration is 36-39 depending on the the number of research hours earned; this does NOT include the hours associated with the Co-requisite or the Area of Application.

2
**Requirements for the Mathematics Major and Program in Teacher Education**

Students in the Teacher Education Program who are seeking to complete licensure requirements to teach mathematics at the secondary level should refer to the Teacher Education Handbook and consult with the chairs of the Departments of Mathematics and Education to develop a plan for meeting all requirements.

**Corequisite**

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<thead>
<tr>
<th>Course</th>
<th>Description</th>
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<tbody>
<tr>
<td>COSC 235</td>
<td>Programming &amp; Problem Solving</td>
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**Core Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
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<tbody>
<tr>
<td>MATH 140</td>
<td>Statistics</td>
</tr>
<tr>
<td>MATH 181</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MATH 182</td>
<td>Calculus II</td>
</tr>
<tr>
<td>MATH 220</td>
<td>Linear Algebra</td>
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<tr>
<td>MATH 235</td>
<td>Discrete Mathematical Models</td>
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<tr>
<td>MATH 260</td>
<td>Introduction to Mathematical Proof</td>
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<tr>
<td>MATH 310</td>
<td>History of Mathematics</td>
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<tr>
<td>MATH 410</td>
<td>Geometry</td>
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<tr>
<td>MATH 431</td>
<td>Abstract Algebra I</td>
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**Electives**

Select one course from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
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<tr>
<td>MATH 210</td>
<td>Multivariable Calculus</td>
</tr>
<tr>
<td>MATH 240</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>MATH 320</td>
<td>Mathematical Modeling</td>
</tr>
<tr>
<td>MATH 330</td>
<td>Numerical Methods</td>
</tr>
<tr>
<td>MATH 410</td>
<td>Geometry</td>
</tr>
<tr>
<td>MATH 432</td>
<td>Abstract Algebra II</td>
</tr>
</tbody>
</table>

**Electives (continued)**

Select one additional Math course at the 200-level or higher

**Total Hours**

33

**Requirements for the Minor in Mathematics**

<table>
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<tr>
<th>Course</th>
<th>Description</th>
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<tbody>
<tr>
<td>MATH 181</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MATH 182</td>
<td>Calculus II</td>
</tr>
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</table>

Select four additional Math courses at the 200-level or higher

**Total Hours**

18

### Notes

1. The total number of credit hours for the Major with the Pure Math Concentration is 36-39 depending on the number of research hours earned; this does NOT include the hours associated with the Co-requisite.

2. The total number of credit hours for the Minor in Mathematics is at least 18 hours including the core courses, electives, and additional courses.
MATH 181. Calculus I. 3 Hours.
A graphical, numerical, and symbolic study of the theory and applications of the derivative of algebraic, trigonometric, exponential, and logarithmic functions, and an introduction to the theory and applications of the integral. Suitable for students of both the natural and the social sciences.

MATH 182. Calculus II. 3 Hours.
A graphical, numerical, and symbolic study of the theory, techniques, and applications of integration, and an introduction to infinite series and/or differential equations.
Prerequisite: MATH 181 with a minimum grade of D.

MATH 201. Modeling & Simulation. 3 Hours.
A course in scientific programming, part of the inter-disciplinary field of computational science. Large, open-ended, scientific problems often require the algorithms and techniques of discrete and continuous computational modeling and Monte Carlo simulation. Students learn fundamental concepts and implementation of algorithms in various scientific programming environments. Throughout, applications in the sciences are emphasized. Cross-listed as Computer Science 201.
Prerequisite: MATH 181 with a minimum grade of D.

MATH 210. Multivariable Calculus. 3 Hours.
A study of the geometry of three-dimensional space and the calculus of functions of several variables.
Prerequisite: MATH 182 with a minimum grade of D.

MATH 212. Vector Calculus. 3 Hours.
A study of vectors and the calculus of vector fields, highlighting applications relevant to engineering such as fluid dynamics and electrostatics.
Prerequisite: MATH 182 with a minimum grade of D.

MATH 220. Linear Algebra. 3 Hours.
The theoretical and numerical aspects of finite dimensional vector spaces, linear transformations, and matrices, with applications to such problems as systems of linear equations, difference and differential equations, and linear regression.
Prerequisite: MATH 182 with a minimum grade of D.

MATH 235. Discrete Mathematical Models. 3 Hours.
An introduction to some of the important models, techniques, and modes of reasoning of non-calculus mathematics. Emphasis on graph theory and combinatorics. Applications to computing, statistics, operations research, and the physical and behavioral sciences.
Prerequisite: MATH 182 with a minimum grade of D.

MATH 240. Differential Equations. 3 Hours.
The theory and application of first- and second-order differential equations including both analytical and numerical techniques.
Prerequisite: MATH 182 with a minimum grade of D.

MATH 250. Introduction to Technical Writing. 1 Hour.
An introduction to technical writing in mathematics and the sciences with the markup language LaTeX, which is used to typeset mathematical and scientific papers, especially those with significant symbolic content.

MATH 260. Introduction to Mathematical Proof. 3 Hours.
An introduction to rigorous mathematical argument with an emphasis on the writing of clear, concise mathematical proofs. Topics will include logic, sets, relations, functions, and mathematical induction. Additional topics may be chosen by the instructor.
Prerequisite: MATH 182 with a minimum grade of D.

MATH 265. Scientific Writing. 1 Hour.
A course offered by the Department of Mathematics at the University of Illinois at Urbana-Champaign, focusing on the writing of scientific papers, especially those with significant symbolic content. The course covers the basics of technical writing, including the use of LaTeX for typesetting mathematical and scientific papers. The emphasis is on clarity, conciseness, and accuracy. Additional topics may be chosen by the instructor.

MATH 270. Independent Study in Mathematics. 1 to 3 Hours.
Independent study of selected topics in Mathematics at an intermediate level. Specific topics vary from semester to semester. Permission of the instructor required.

MATH 280. Selected Topics in Mathematics. 1 to 4 Hours.
Selected topics in mathematics at the introductory or intermediate level.

MATH 310. History of Mathematics. 3 Hours.
A survey of the history and development of mathematics from antiquity to the twentieth century.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 320. Mathematical Modeling. 3 Hours.
The study of problem-solving strategies to solve open-ended, real-world problems.
Prerequisite: MATH 210 with a minimum grade of D or MATH 220 with a minimum grade of D or MATH 240 with a minimum grade of D.

MATH 330. Numerical Methods. 3 Hours.
A study of the theory and computer implementation of numerical methods. Topics include error analysis, zeros of polynomials, numerical differentiation and integration, and systems of linear equations.
Prerequisite: MATH 220 with a minimum grade of D.

MATH 410. Geometry. 3 Hours.
A study of the foundations of Euclidean geometry with emphasis on the role of the parallel postulate. An introduction to non-Euclidean (hyperbolic) geometry and its intellectual implications.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 415. Topology. 3 Hours.
An introduction to topological spaces. Topics will include examples of topological spaces, standard constructions of topological spaces, continuous maps, topological properties, homotopies, homeomorphisms, and simplicial complexes.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 421. Probability and Statistics I. 3 Hours.
A study of probability models, random variables, estimation, hypothesis testing, and linear models, with applications to problems in the physical and social sciences.
Prerequisite: MATH 210 with a minimum grade of D and MATH 260 with a minimum grade of D.

MATH 422. Probability and Statistics II. 3 Hours.
A study of probability models, random variables, estimation, hypothesis testing, and linear models, with applications to problems in the physical and social sciences.
Prerequisite: MATH 421 with a minimum grade of D.

MATH 424. Probability and Statistics III. 3 Hours.
A study of the theory and computer implementation of numerical methods. Topics include error analysis, zeros of polynomials, numerical differentiation and integration, and systems of linear equations.
Prerequisite: MATH 220 with a minimum grade of D.

MATH 430. History of Mathematics. 3 Hours.
A survey of the history and development of mathematics from antiquity to the twentieth century.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 440. Geometry. 3 Hours.
A study of the foundations of Euclidean geometry with emphasis on the role of the parallel postulate. An introduction to non-Euclidean (hyperbolic) geometry and its intellectual implications.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 445. Topology. 3 Hours.
An introduction to topological spaces. Topics will include examples of topological spaces, standard constructions of topological spaces, continuous maps, topological properties, homotopies, homeomorphisms, and simplicial complexes.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 451. Probability and Statistics I. 3 Hours.
A study of probability models, random variables, estimation, hypothesis testing, and linear models, with applications to problems in the physical and social sciences.
Prerequisite: MATH 210 with a minimum grade of D and MATH 260 with a minimum grade of D.

MATH 452. Probability and Statistics II. 3 Hours.
A study of probability models, random variables, estimation, hypothesis testing, and linear models, with applications to problems in the physical and social sciences.
Prerequisite: MATH 451 with a minimum grade of D.

MATH 460. History of Mathematics. 3 Hours.
A survey of the history and development of mathematics from antiquity to the twentieth century.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 465. Geometry. 3 Hours.
A study of the foundations of Euclidean geometry with emphasis on the role of the parallel postulate. An introduction to non-Euclidean (hyperbolic) geometry and its intellectual implications.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 470. Topology. 3 Hours.
An introduction to topological spaces. Topics will include examples of topological spaces, standard constructions of topological spaces, continuous maps, topological properties, homotopies, homeomorphisms, and simplicial complexes.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 480. Probability and Statistics I. 3 Hours.
A study of probability models, random variables, estimation, hypothesis testing, and linear models, with applications to problems in the physical and social sciences.
Prerequisite: MATH 210 with a minimum grade of D and MATH 260 with a minimum grade of D.

MATH 482. Probability and Statistics II. 3 Hours.
A study of probability models, random variables, estimation, hypothesis testing, and linear models, with applications to problems in the physical and social sciences.
Prerequisite: MATH 480 with a minimum grade of D.

MATH 490. History of Mathematics. 3 Hours.
A survey of the history and development of mathematics from antiquity to the twentieth century.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 495. Geometry. 3 Hours.
A study of the foundations of Euclidean geometry with emphasis on the role of the parallel postulate. An introduction to non-Euclidean (hyperbolic) geometry and its intellectual implications.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 499. Topology. 3 Hours.
An introduction to topological spaces. Topics will include examples of topological spaces, standard constructions of topological spaces, continuous maps, topological properties, homotopies, homeomorphisms, and simplicial complexes.
Prerequisite: MATH 260 with a minimum grade of D.
MATH 424. Advanced Game Theory. 3 Hours.
Game Theory is an analytical tool that models strategic interactions. It is widely used in economics, political science, biology, sociology, and psychology. This advanced class is intended to provide a more rigorous introduction to the main concepts and techniques of the field. These techniques will be used to investigate relevant social phenomena, such as evolutionary games, auction theory, the “prisoner’s dilemma,” the “tragedy of the commons,” tacit collusion, competition among firms, and strategic interactions in labor, credit, and product markets. The most important classes of games will be analyzed (zero-sum games, cooperation problems, coordination games, bayesian games, signaling games, etc.), as well as the most important solution concepts (rationalizability, nash equilibrium in pure and mixed strategies, bayesian nash equilibrium, and evolutionarily stable strategies). This course will also introduce students to the main techniques of game-theoretic mathematical modelling.
Prerequisite: MATH 210 with a minimum grade of D.

MATH 431. Abstract Algebra I. 3 Hours.
The axiomatic development of abstract algebraic systems, including groups, rings, integral domains, fields, and vector spaces.
Prerequisite: MATH 220 with a minimum grade of D and MATH 260 with a minimum grade of D.

MATH 432. Abstract Algebra II. 3 Hours.
The axiomatic development of abstract algebraic systems, including groups, rings, integral domains, fields, and vector spaces.
Prerequisite: MATH 431 with a minimum grade of D.

MATH 435. Cryptology. 3 Hours.
An introduction to cryptology and modern applications. Students will study various historical and modern ciphers and implement select schemes using mathematical software. Cross-listed with COSC 435.
Prerequisite: MATH 220 with a minimum grade of D and (MATH 235 with a minimum grade of D or MATH 260 with a minimum grade of D).

MATH 439. Elementary Number Theory. 3 Hours.
A study of the oldest branch of mathematics, this course focuses on mathematical properties of the integers and prime numbers. Topics include divisibility, congruences, diophantine equations, arithmetic functions, primitive roots, and quadratic residues.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 441. Mathematical Analysis I. 3 Hours.
A rigorous study of the fundamental concepts of analysis, including limits, continuity, the derivative, the Riemann integral, and sequences and series.
Prerequisite: MATH 210 with a minimum grade of D and MATH 260 with a minimum grade of D.

MATH 442. Mathematical Analysis II. 3 Hours.
A rigorous study of the fundamental concepts of analysis, including limits, continuity, the derivative, the Riemann integral, and sequences and series.
Prerequisite: MATH 441 with a minimum grade of D.

MATH 445. Nonlinear Dynamics and Chaos Theory. 3 Hours.
The study of differential equations from a geometric perspective that allows for exploration of two and three-dimensional systems. Topics will include linear systems of equations, linear stability analysis, and bifurcations of nonlinear systems, and chaos theory.
Prerequisite: MATH 220 with a minimum grade of D and MATH 240 with a minimum grade of D.

MATH 446. Partial Differential Equations. 3 Hours.
A detailed introduction to partial differential equations. Students will develop familiarity with the derivation and solution techniques for various equations including transport equations, the heat equation, wave equation, and Laplace equation.
Prerequisite: (MATH 210 with a minimum grade of D or MATH 212 with a minimum grade of D) and MATH 240 with a minimum grade of D.

MATH 448. Functions of a Complex Variable. 3 Hours.
An introduction to the analysis of functions of a complex variable. Topics will include differentiation, contour integration, power series, Laurent series, and applications.
Prerequisite: MATH 260 with a minimum grade of D.

MATH 470. Independent Study in Math. 1 to 3 Hours.
Independent study of selected topics in Mathematics at an advanced level. Specific topics vary from semester to semester.

MATH 480. Advanced Topics in Mathematics. 1 to 4 Hours.
Advanced topics in undergraduate mathematics offered occasionally to meet special needs. Typical topics include number theory, foundations of mathematics, topology, and complex variables.

MATH 500. Honors Course. 3 Hours.
At the discretion of the faculty, students may undertake a six-hour independent course of study in the senior year in order to broaden their educational experience within their major area of study. Students must meet specific GPA standards and arrange a faculty sponsor. The honors course criteria are outlined in the Academic Honors portion of the catalog.