Mathematics (MATH)

The department offers a BS with majors in Mathematics, Mathematics with a Concentration in Applied Mathematics, and Mathematics with a Concentration in Pure Mathematics. A minor in Mathematics is also available. The Applied Concentration requires an additional focus area like Accounting, Biology, Economics, etc. while the Pure Concentration emphasizes the theoretical aspects of the field. Additionally, students majoring in Mathematics may obtain an Emphasis in Computational Science (http://catalog.wofford.edu/courses-programs-departments/computer-science/#emphasisrequirementstext). This interdisciplinary field applies computer science and mathematics to the sciences.

Honors Courses

The Department of Mathematics encourages its students to undertake honors work. For further information, students should review the section on Honors Courses (http://catalog.wofford.edu/academics/academic-honors/honors-courses/)in this *Catalog*.

Chair

Brian J. Pigott

Professors

Matthew E. Cathey
Anne J. Catllá
Deidra A. Coleman
Rachel E. Grotheer
Charlotte A. Knotts-Zides
Ali Pirhadi
Joseph A. Spivey
Thomas J. Wright

Requirements for the Major in Mathematics

Course	Title	Hours
Required Major Courses		**18**
COSC 235	Programming & Problem Solving	
MATH 181	Calculus I	
MATH 182	Calculus II	
MATH 210	Multivariable Calculus	
MATH 220	Linear Algebra	
MATH 260	Introduction to Mathematical Proof	
Pure Mathematics Elective		**3**
Select one course from the following:		
MATH 415	Topology	
MATH 431	Abstract Algebra I	
MATH 439	Elementary Number Theory	
MATH 441	Mathematical Analysis I	
MATH 448	Functions of a Complex Variable	
400-Level Electives		**6**
Select 6 credit hours in MATH at 400-level		
Electives		**9**
Select 9 credit hours in MATH at the 200-level or above		
Total Hours		**36**

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

Course	Title	Hours
Required Major Courses		**18**
COSC 235	Programming & Problem Solving	
MATH 181	Calculus I	
MATH 182	Calculus II	
MATH 210	Multivariable Calculus	
MATH 220	Linear Algebra	
MATH 260	Introduction to Mathematical Proof	
Modeling & Methods		**3**
Select one course from the following:		
MATH 221	Statistical Methods I	
MATH 320	Mathematical Modeling	
MATH 330	Numerical Methods	
Differential Equations		**3**
MATH 240	Ordinary Differential Equations	
Applied Mathematics Electives		**6**
Select two courses from the following:		
MATH 421	Probability and Statistics I	
MATH 422	Probability and Statistics II	
MATH 445	Nonlinear Dynamics and Chaos Theory	
MATH 446	Partial Differential Equations	
Pure Mathematics Elective		**3**
Select one course from the following:		
MATH 431	Abstract Algebra I	
MATH 441	Mathematical Analysis I	
MATH 448	Functions of a Complex Variable	
Electives		**6**
Select 6 credit hours in MATH at 200-level or higher		
Research		
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		
Each student must choose an area of application (Accounting, Finance, Biology, Chemistry, Computer Science, Economics, Environmental Studies, Philosophy, Physics or Psychology). See Applied Math Coordinator for specific course options.		
Total Hours		**39**

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

Course	Title	Hours
Required Major Courses		**18**
COSC 235	Programming & Problem Solving	
MATH 181	Calculus I	
MATH 182	Calculus II	
MATH 210	Multivariable Calculus	
MATH 220	Linear Algebra	
MATH 260	Introduction to Mathematical Proof	
Required Pure Mathematics Courses		**15**
MATH 415	Topology	
MATH 431	Abstract Algebra I	
MATH 439	Elementary Number Theory	
MATH 441	Mathematical Analysis I	
MATH 448	Functions of a Complex Variable	
Applied Mathematics Electives		**6**
Select two courses from the following:		
MATH 201	Modeling & Simulation	
MATH 212	Vector Calculus	
MATH 240	Ordinary Differential Equations	
MATH 320	Mathematical Modeling	
MATH 330	Numerical Methods	
MATH 421	Probability and Statistics I	
MATH 422	Probability and Statistics II	
MATH 445	Nonlinear Dynamics and Chaos Theory	
MATH 446	Partial Differential Equations	
Research		
Each student must complete a summer research project, a semester of independent research, or an honors course. This requires the prior approval of the Pure Math Coordinator.		
Total Hours		**39**

Requirements for the Minor in Mathematics

Course	Title	Hours
Required Courses		**6**
MATH 181	Calculus I	
MATH 182	Calculus II	
Electives		**12**
Select four Math (MATH) courses at the 200-level or higher		
Total Hours		**18**

MATH 120. Appreciation of Mathematics. 3 Hours.
An exploration of topics which illustrate the power and beauty of mathematics, with a focus on the role mathematics has played in the development of Western culture. This course is designed for students who are not required to take statistics or calculus as part of their studies. Students who previously earned credit for a math course at the 200-level or higher are not permitted to enroll or earn credit for this course.

MATH 140. Introduction to Statistics. 3 Hours.
An introduction to statistical thinking and the analysis of data using such methods as graphical descriptions, correlation and regression, estimation, hypothesis testing, and statistical models.

MATH 170. Functions Modeling Change: A Preparation for Calculus. 3 Hours.
A study of the mathematical building blocks used to describe behavior seen in natural and social sciences as presented in Calculus I. Topics include: forms and graphs of polynomial, trigonometric, exponential, and logarithmic functions. Additionally, it focuses on the relationship between scientific problems and mathematical expressions. As this course is intended specifically to prepare students for MATH 181, a special emphasis will be placed on using functions to model change. Students who previously earned a grade of 'C' or higher in MATH 160 or MATH 181 are not permitted to enroll or earn credit for this course.

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. Students may not earn credit for both MATH 160 and MATH 181.

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 221. Statistical Methods I. 3 Hours.
A study of statistical methods including sampling and experimental design, graphical and numerical summaries, sampling distributions, parametric and non-parametric tests, with applications across disciplines. An emphasis will be placed on choosing appropriate techniques, analyzing data with the openly accessible statistical software R, interpreting analyses, and communicating results to both technical and non-technical audiences.
Prerequisite: COSC 235 with a minimum grade of D.

MATH 240. Ordinary 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 255. Colloquia!. 1 Hour.
Students will be exposed to the mathematics colloquium. The colloquia selected will cover a variety of subject areas.
Prerequisite: MATH 210 with a minimum grade of C or MATH 212 with a minimum grade of C or MATH 220 with a minimum grade of C or MATH 240 with a minimum grade of C or MATH 250 with a minimum grade of C or MATH 260 with a minimum grade of C or MATH 270 with a minimum grade of C.

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 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 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 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. 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 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 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-dimentional 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.