MATHEMATICS

The Department of Mathematics offers programs leading to Bachelor of Science in Applied Mathematics, minors in Mathematics or Applied Mathematics, and a certificate in Technical Mathematics. The department also offers a Master's in Applied Mathematics with an accelerated pathway option.

- Applied Mathematics, BS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/mathematics/applied-mathematics-bs/)
- Applied Mathematics, Minor (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/mathematics/applied-mathematics-minor/)
- Mathematics, Minor (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/mathematics/mathematics-minor/)
- Technical Mathematics, Certificate (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/mathematics/technical-mathematics-certificate/)

Mathematics (MATH)

MATH 134 Mathematics for Everyday Life - Expanded (4 Units)
Contemporary applications of mathematics for the non-science major to develop skills in logical thinking and reading technical material. This course also provides study skills and just-in-time review to help students achieve the same learning outcomes as MATH 135. No credit earned for this course if a student already earned credit for MATH 134.

MATH 135 Mathematics for Everyday Life (3 Units)
Prerequisite: DEVP 50 with a grade of C- or better or placement test. Contemporary applications of mathematics for the non-science major to develop skills in logical thinking and reading technical material. No credit earned for this course if a student already earned credit for MATH 134. (Formerly 3450:135)
Ohio Transfer 36: Yes

MATH 137 Finite Math - Supported (5 Units)
Prerequisite: DEVP 50 with a grade of C- or better, MATH 134 with a grade of C- or greater, or placement. This course introduces students to essential mathematical tools for problem-solving and modeling real-world phenomena. Key topics include linear systems, matrices, linear programming, exponential and logarithmic functions, financial mathematics, probability, combinatorics, and data analysis. Students will learn to solve equations, optimize functions, analyze data, and apply mathematical concepts to various fields. Through practical exercises and applications, students will develop critical thinking and problem-solving skills. This course provides study skills and just-in-time review to help students achieve the same learning outcomes as MATH 139. No credit earned for this course if a student already earned credit for MATH 138 or MATH 139.

MATH 138 Finite Math - Expanded (4 Units)
Prerequisite: DEVP 52 with a grade of C- or better, or placement. This course introduces students to essential mathematical tools for problem-solving and modeling real-world phenomena. Key topics include linear systems, matrices, linear programming, exponential and logarithmic functions, financial mathematics, probability, combinatorics, and data analysis. Students will learn to solve equations, optimize functions, analyze data, and apply mathematical concepts to various fields. Through practical exercises and applications, students will develop critical thinking and problem-solving skills. This course provides just-in-time review to help students achieve the same learning outcomes as MATH 139. No credit earned for this course if a student already has credit for MATH 137 or MATH 139.

MATH 139 Finite Math (3 Units)
Prerequisite: Placement. This course introduces students to essential mathematical tools for problem-solving and modeling real-world phenomena. Key topics include linear systems, matrices, linear programming, exponential and logarithmic functions, financial mathematics, probability, combinatorics, and data analysis. Students will learn to solve equations, optimize functions, analyze data, and apply mathematical concepts to various fields. Through practical exercises and applications, students will develop critical thinking and problem-solving skills. No credit earned for this course if a student already has earned credit for MATH 137 or MATH 138.

MATH 140 Mathematics for Early/Middle Teachers 1 (3 Units)
Prerequisite: [MATH 134, MATH 135, MATH 143, MATH 144, MATH 152, STAT 250, or STAT 260] with a grade of C- or better, or placement test. Pre/Corequisite: EDFN 200. A problem-solving and inquiry-based approach to number systems; bases; operations, properties, relationships, algorithms of Real Numbers; patterns and algebra. (Formerly 3450:140)

MATH 143 Technical Algebra and Trigonometry 1 - Expanded (5 Units)
Prerequisite: DEVP 52 with a grade of C or better, or placement test. Functions; measurement systems; methods of factoring; graphs of polynomial, exponential and trigonometric functions; equations and inequalities; systems of equations; solving triangles using trigonometric and inverse trigonometric functions; vectors; complex numbers. This course also provides just-in-time review to help students achieve the same learning outcomes as MATH 144.

MATH 144 Technical Algebra and Trigonometry 1 (4 Units)
Prerequisite: Placement. Functions; measurement systems; graphs of polynomial, exponential and trigonometric functions; equations and inequalities; systems of equations; solving triangles using trigonometric and inverse trigonometric functions; vectors; complex numbers.

MATH 145 Algebra for Calculus (4 Units)
Prerequisite: DEVP 85 with a grade of C- or better or MATH 152 with a grade of C- or placement test. Real numbers, equations and inequalities, linear and quadratic functions. Exponential and logarithmic functions. Systems of equations, matrices, determinants. Permutations and combinations. (Formerly 3450:145)
Ohio Transfer 36: Yes

MATH 149 Precalculus Mathematics (4 Units)
Prerequisite: [MATH 145 or MATH 153] with a grade of C- or better or placement test. Functions, polynomial functions, complex numbers, exponential and logarithmic functions, systems of equations, trigonometric functions, mathematical inductions, sequences, and binomial theorem. (Formerly 3450:149)
Ohio Transfer 36: Yes

MATH 151 Technical Mathematics I (2 Units)
Prerequisite: placement test, DEVP 52, DEVP 54, DEVP 57, or DEVP 84 with a grade of C or better. Fundamental concepts and operations, functions, graphs, factoring and algebraic fractions, and quadratic equations. (Formerly 2030:151)

MATH 152 Technical Mathematics II (2 Units)
Prerequisite: MATH 151 with a grade of C- or better or placement test. Variation, equations of lines, Cramer's rule, right triangle trigonometry, oblique triangles, radian measure, and complex numbers. (Formerly 2030:152)
Ohio Transfer 36: Yes

MATH 153 Technical Mathematics III (2 Units)
Prerequisite: MATH 152 with a grade of C- or better or placement test. Factoring, algebraic fractions, exponents and radicals, equations with radicals, equations in quadratic form, functions, their properties and graphs, exponential and logarithmic functions. (Formerly 2030:153)
Ohio Transfer 36: Yes

MATH 154 Technical Algebra and Trigonometry 2 (3 Units)
Prerequisite: [MATH 143, MATH 144, or MATH 145] with a grade of C- or better or placement test. Functions and their graphs; polynomial, rational, trigonometric, exponential and logarithmic functions; polynomial equations; graphs of trigonometric functions; trigonometric identities and equations; analytic geometry; rates and rates of change. (Formerly 2030:154)

MATH 200 Introduction to Data Science (3 Units)
Prerequisite: MATH 145 with a grade of C- or better or placement test. This course provides students a practical introduction to the field of Data Science and familiarizes them with the essential facets of the data scientist profession. This includes a grounding on data-based reasoning, problem formulation, data collection, data pre-processing, data analytics, visualization, and use of data analysis for decision-making.

MATH 208 Introduction to Discrete Mathematics (4 Units)
Prerequisite: [MATH 143, MATH 144, MATH 145, or MATH 149] with a grade of C- or better, or placement. A foundation course in discrete mathematics with applications. Topics include sets, number systems, Boolean Algebra, logic, relations, functions, recursion, matrices, induction, graphs, and trees. (Formerly 3450:208)

MATH 210 Calculus with Business Applications (3 Units)
Prerequisite: [MATH 137, MATH 138, MATH 139, MATH 145 or MATH 153] with a grade of C- or better, or placement. Review of functions, derivatives of functions, extrema and concavity, optimization, logarithmic and exponential functions, extrema for multivariate functions. Graphing calculator required. For business or economics majors only. (Formerly 3450:210)
Ohio Transfer 36: Yes

MATH 221 Analytic Geometry-Calculus I (4 Units)
Prerequisite: [MATH 154 or MATH 255 or MATH 149] with a grade of C- or better or placement test. Limits; continuity; rates of change; derivatives and applications algebraic, trigonometric, transcendental functions; curve sketching, antiderivatives and integration, areas. (Formerly 3450:221)
Ohio Transfer 36: Yes

MATH 222 Analytic Geometry-Calculus II (4 Units)
Prerequisite: MATH 221 with a grade of C- or better or MATH 356 with a grade of C- or better. Methods and applications of integration; sequences, series and power series; Taylor polynomials and Taylor series; parametric and polar coordinates. (Formerly 3450:222)
Ohio Transfer 36: Yes

MATH 223 Analytic Geometry-Calculus III (4 Units)
Prerequisite: MATH 222 with a grade of C- or better. Vector algebra, cylindrical, spherical coordinates, vector-valued functions, curvature; functions of several variables, limit, continuity, partial derivatives, differentials, directional derivatives, maxima and minima, multiple integrals, Divergence Theorem. (Formerly 3450:223)
Ohio Transfer 36: Yes

MATH 240 Mathematics for Early/Middle Teachers 2 (3 Units)
Prerequisite: MATH 140 with a grade of C- or better. A problem-solving and inquiry-based approach to functions and algebra, coordinate and Euclidean geometry, and elementary data analysis. (Formerly 3450:240)

MATH 255 Technical Calculus I (3 Units)
Prerequisite: [MATH 154 or MATH 149] with a grade of C- or better, or placement test. The derivative, applications of the derivative, derivatives of the trigonometric, logarithmic and exponential functions. Integration by antidifferentiation. (Formerly 2030:255)

MATH 260 Mathematics for Surveyors (2 Units)
Prerequisite: MATH 143, MATH 144, MATH 149 or equivalent with a grade of C- or better, or placement test. Horizontal circular curves, vertical curves, and spherical triangles. (Formerly 2030:260)

MATH 261 Applied Finite Mathematics (3 Units)
Prerequisite: [MATH 143, MATH 144, MATH 145, or MATH 153] with a C- or higher, or placement test. Number systems, integer rings, finite fields, number theory algorithms, prime numbers and primality tests, factoring, and random numbers. (Formerly 2030:216)

MATH 289 Selected Topics in Mathematics (1-3 Units)
Prerequisite: Permission. Selected topics of interest in mathematics. (Formerly 3450:289)

MATH 290 Special Topics: Associate Studies Mathematics (1-4 Units)
(May be repeated with a change in topic) Prerequisite: Permission. Selected topics on subject areas of interest in associate studies. (Formerly 2030:290)

MATH 300 Tools for Data Science (3 Units)
Prerequisites: MATH 200 and [CPSC 209 or CPSC 200] with a grade of C- or better. This course offers students a practical introduction to the field of "Data Science," and common methods for quantitative and computational analytics, through which they can have an overview of key concepts, skills, and technologies used by data scientists. While the course covers several programming languages and tools, the focus is on solving problems. The students will be introduced to several real-life problems that involve collecting and analyzing data.

MATH 307 Fundamentals of Advanced Mathematics (3 Units)
Prerequisite: MATH 222 with a grade of C- or better. Logic, solving problems, and doing proofs in mathematics. Sets, extended set operations, and indexed family sets, induction. Binary relations. Functions, cardinality. Introductory concepts of algebra and analysis. (Formerly 3450:307)

MATH 312 Linear Algebra (3 Units)
Prerequisite: MATH 222 with a grade of C- or better. Study of vector spaces, linear transformations, matrices, determinants, inner products, the eigenvalue problem, quadratic forms and canonical forms. (Formerly 3450:312)
Ohio Transfer 36: Yes

MATH 335 Introduction to Ordinary Differential Equations (3 Units)
Prerequisite: MATH 223 with a grade of C- or better or permission of instructor. Basic techniques for solving ODEs and systems of ODEs. Analysis of models involving differential equations of first order and simple equations of second order. (Formerly 3450:335)
Ohio Transfer 36: Yes

MATH 345 Technical Data Analysis (2 Units)
Prerequisite: [MATH 154 or MATH 261] with a grade of C- or better. Data summarization including graphic representation, numerical measures, introduction to probability, confidence intervals and hypothesis testing. (Formerly 2030:345)

MATH 356 Technical Calculus II (3 Units)
Prerequisite: MATH 255 or equivalent with a grade of C- or better, or placement test. Methods and applications of integration, first and second order differential equations and applications, series expansion, Laplace transform, partial derivatives, and double integrals. (Formerly 2030:356)

MATH 360 Advanced Mathematics for Surveyors (2 Units)
Pre/Corequisite: MATH 255 or MATH 221. This course is designed to prepare surveying majors for the math portion of their professional exam. Topics include matrices, introduction to series, partial derivatives, least squares adjustments, topics in astronomy, and coordinate systems. (Formerly 2030:480)

MATH 361 Applied Cryptography (3 Units)
Prerequisite: A grade of C or better in MATH 261. Symmetric cryptography, modular arithmetic, stream and block ciphers, random numbers, Advanced Encryption Standard, public-key cryptography, key exchange, digital signatures, hash functions, message authentication. (Formerly 2030:361)

MATH 362 Applied Cryptology (3 Units)
Prerequisite: MATH 208. Concepts of cryptography and cryptanalysis, public-key and private-key cryptosystems, cryptography for a network, digital signatures, modular arithmetic, integer factorization methods, encryption and decryption algorithms, stream and block ciphers, RSA cryptosystem, key exchange, cryptanalytic attacks.

MATH 401 History of Mathematics (3 Units)
Prerequisite: [MATH 307 or MATH 208] with a grade of C- or better. Origin and development of mathematical ideas. (Formerly 3450:401)

MATH 410 Advanced Linear Algebra (3 Units)
Prerequisite: MATH 312 with a grade of C- or better. Study of vector spaces, linear transformation, canonical and quadratic forms, inner product spaces. (Formerly 3450:410)

MATH 411 Abstract Algebra I (3 Units)
Prerequisite: MATH 307 or [MATH 208 and MATH 222] with a grade of C- or better or permission of instructor. Study of groups, rings, fields, integral domains. (Formerly 3450:411)

MATH 412 Abstract Algebra II (3 Units)
Prerequisite: MATH 411 with a grade of C- or better or permission of instructor. Study of groups, rings, fields, integral domains, vector spaces, field extensions, Galois theory. (Formerly 3450:412)

MATH 413 Theory of Numbers (3 Units)
Prerequisite: MATH 222 with a grade of C- or better or permission. Euclidean algorithm, unique factorization theorem, congruences, primitive roots, indices, quadratic residues, number-theoretic functions, Gaussian integers and continued fractions. (Formerly 3450:413)

MATH 415 Combinatorics & Graph Theory (3 Units)
Prerequisite: MATH 222 with a grade of C- or better or permission. Introduction to basic ideas and techniques of mathematical counting; properties of structure of systems. (Formerly 3450:415)

MATH 421 Advanced Calculus I (3 Units)
Sequential. Prerequisites: MATH 223 with a grade of C- or better and [MATH 307 or MATH 208 with a grade of C- or better]. Real number system, sequences, series, set theory, continuity, differentiation, integration, partial derivatives, multiple integration, maxima and minima, convergence and uniform convergence, power series, improper integrals, transformations, line and surface integrals. (Formerly 3450:421)

MATH 422 Advanced Calculus II (3 Units)
Sequential. Prerequisite: MATH 421 with a grade of C- or better or permission of instructor. Real number system, sequences, series, set theory, continuity, differentiation, integration, partial derivatives, multiple integration, maxima and minima, convergence and uniform convergence, power series, improper integrals, transformations, line and surface integrals. (Formerly 3450:422)

MATH 425 Complex Variables (3 Units)
Prerequisite: MATH 223 with a grade of C- or better. Complex variables; elementary functions, differentiation and analytic functions; integration and Cauchy's theorem; power series and Laurent series; residue theorem; applications such as conformal mappings, inversion of integral transform. (Formerly 3450:425)

MATH 427 Numerical Methods I (3 Units)
Prerequisites: MATH 222 and CPSC 209 with grades of C- or better or permission. Numerical methods in polynomial interpolation, rootfinding, numerical integration, and numerical linear algebra. (Formerly 3450:427)

MATH 428 Numerical Methods II (3 Units)
Prerequisites: MATH 335 and MATH 427 with grades of C- or better or permission. Numerical methods in the solution of ordinary and partial differential equations. Numerical differentiation, Runge-Kutta methods, and iterative methods for ODEs, finite differences for PDEs. (Formerly 3450:428)

MATH 430 Numerical Solutions for Partial Differential Equations (3 Units)
Prerequisite: MATH 428 with a grade of C- or better or equivalent. For advanced undergraduate and graduate students. The study of finite difference and finite element methods for partial differential equations consistency, stability, convergence and computer implementation. (Formerly 3450:430)

MATH 432 Partial Differential Equations (3 Units)
Prerequisite: MATH 335 with a grade of C- or better. The classical initial value and boundary value problems of mathematical physics developed and solved using Fourier series and integral transforms. (Formerly 3450:432)

MATH 435 Systems of Ordinary Differential Equations (3 Units)
Prerequisites: MATH 335 and [MATH 312 or MATH 428 with grades of C- or better] or permission. Analysis, solution of systems of equations, linear, nonlinear. Topics: stability theory, perturbation methods, asymptotic methods, applications from physical, social sciences. (Formerly 3450:435)

MATH 436 Mathematical Models (3 Units)
Prerequisite: MATH 335 with a grade of C- or better, and a six-hour sequence in an approved applied area, or permission. Formulation and analysis of mathematical models in social and physical sciences. Analysis of deterministic and stochastic models. Topics may include stochastic processes, linear programming, graph theory, theory of measurement. (Formerly 3450:436)

MATH 438 Advanced Engineering Mathematics (3 Units)
Prerequisites: MATH 335 and MATH 312 with grades of C- or better or permission. Matrices, eigenvalue problems, systems of ODEs, vector analysis, complex variables. (Formerly 3450:438)

MATH 439 Applied Analysis and PDEs (3 Units)
Prerequisites: MATH 335 and MATH 312 with grades of C- or better or permission. Special functions, Fourier series and transforms, PDEs. (Formerly 3450:439)

MATH 441 Concepts in Geometry (4 Units)
Prerequisite: [MATH 208 or MATH 307] with a grade of C- or better, or permission of instructor. This course includes the study of axiomatic, modern, and transformational geometry. In particular: the foundations of geometry (points, lines, segments, angles, polygons, and circles), Euclidean and non-Euclidean geometry. (Formerly 3450:441)

MATH 445 Introduction to Topology (3 Units)
Prerequisite: MATH 307 with a grade of C- or better or permission of instructor. Introduction to topological spaces and topologies, mappings, cardinality, homeomorphisms, connected spaces, metric spaces. (Formerly 3450:445)

MATH 450 Optimization (3 Units)
Prerequisites: [MATH 223, MATH 312, and STAT 461] with grades of C- or better. Topics include convexity, convex optimization problems, Lagrangian duality, optimality conditions and optimization in machine learning. Algorithmic topics will include the gradient descent and its variants, Newton's and quasi-Newton methods. Applications will emphasize topics in data science.

MATH 455 Deep Learning (3 Units)
Prerequisites: MATH 223 and MATH 312 with grades of C- or better. Introduction to the basic concepts, theories, and practices of traditional and modern neural networks in the area of deep learning. Materials are grouped in the following categories (i) machine learning basics, (ii) multilayer perceptrons and modern neural networks, (iii) applications and advanced techniques. Students will gain experiences in implementing the concepts and methods for applications.

MATH 461 Applied Cryptanalysis (3 Units)
Prerequisite: MATH 361 with a grade of C or better. Cryptanalysis concepts; cryptanalysis of symmetric and public key cryptosystems, key exchange systems, and digital signatures; hash function collision resistance; cryptanalysis with quantum computer. (Formerly 2030:461)

MATH 489 Topics in Mathematics (1-4 Units)
(May be repeated for a total of 12 credits) Prerequisite: Permission of instructor. Selected topics in mathematics and applied mathematics at an advanced level. (Formerly 3450:489)

MATH 491 Workshop in Mathematics (1-4 Units)
(May be repeated) Group studies of special topics in mathematics and applied mathematics. May not be used to meet undergraduate or graduate major requirements. May be used for elective credit. (Formerly 3450:491)

MATH 497 Individual Reading: Mathematics (1-2 Units)
Prerequisites: senior standing and permission. Mathematics or applied mathematics majors only. Directed studies designed as an introduction to research problems, under guidance of selected faculty member. (Formerly 3450:497)

MATH 498 Senior Honors Project: Mathematics (1-3 Units)
Prerequisite: Senior standing or higher in the Honors program and permission of instructor. Directed study for senior student in the Honors Program. An introduction to research problems in mathematics and applied mathematics under the guidance of selected faculty. May be repeated for up to six credits. (Formerly 3450:498)