COURSES FOR MATHEMATICS

Mathematics Courses

MATH005 Introductory Algebra
Hours 3

Brief review of arithmetic operations and basic algebraic concepts: factoring, operations with polynomials and rational expressions, linear equations and word problems, graphing linear equations, simplification of expressions involving radicals or negative exponents, and elementary work with quadratic equations. Grades are reported as pass/fail.

MATH100 Intermediate Algebra
Hours 3

Prerequisites: Placement and two units of college-preparatory mathematics; if a student has previously been placed in MATH 005, a passing grade in MATH 005 is required. Intermediate-level course including work on functions, graphs, linear equations and inequalities, quadratic equations, systems of equations, and operations with exponents and radicals. The solution of word problems is stressed. NOT APPLICABLE to UA Core Curriculum mathematics requirement. Grades are reported as A, B, C or NC (No Credit).

Prerequisite(s): UA Math Placement Test Score of 190-309 or ACT Math Subscore of 18 or old SAT Math Subscore of 440 or new SAT Math Subscore of 480 or MATH 005

MATH110 Finite Mathematics
MA

Hours 3

This course is intended to give an overview of topics in finite mathematics with applications. This course covers mathematics of finance, logic, set theory, elementary probability and statistics. This course does not provide sufficient background for students who will need to take Precalculus Algebra or Calculus. Prerequisites: Placement and two units of college-preparatory mathematics; if a student has previously been placed in MATH 005, a passing grade in MATH 005 is required.

Prerequisite(s): UA Math Placement Test Score of 190-600 or ACT Math Subscore of 18 or old SAT Math Subscore of 440 or new SAT Math Subscore of 480 or MATH 005

Mathematical Science

MATH111 Introduction to Data Science
MA

Hours 3

This course introduces data science as a means to explore and understand the world around us. Topics include experimental design and data preparation, exploratory analysis and visualization, introduction to statistical modeling, inference, and communicating findings. The course emphasizes conceptual understanding and applications to real data from a wide range of fields.

Prerequisite(s): (UA Math Placement Test Score of 310-600) OR (ACT Math Subscore of 24) OR (old SAT Math Subscore of 560) OR (new SAT Math Subscore of 580) OR (C- or higher in MATH 100) or MATH 110

Mathematical Science

MATH112 Precalculus Algebra
MA

Hours 3

A higher-level course emphasizing functions including polynomial functions, rational functions, and the exponential and logarithmic functions. Graphs of these functions are stressed. The course also includes work on equations, inequalities, systems of equations, the binomial theorem, and the complex and rational roots of polynomials. Applications are stressed. Grades are reported as A, B, C or NC (No Credit). Degree credit will not be granted for both MATH 115 and (MATH 112 or MATH 113).

Prerequisite(s): UA Math Placement Test Score of 310-439 or ACT Math Subscore of 24 or old SAT Math Subscore of 560 or new SAT Math Subscore of 580 or C- or higher in MATH 100

Mathematical Science

MATH113 Precalculus Trigonometry
MA

Hours 3

Continuation of MATH 112. The course includes study of trigonometric functions, inverse trigonometric functions, trigonometric identities and trigonometric equations. Complex numbers, De Moivre's Theorem, polar coordinates, vectors and other topics in algebra are also addressed, including conic sections, sequences and series. Grades are reported as A, B, C or NC (No Credit). Degree credit will not be granted for both MATH 115 and (MATH 112 or MATH 113).

Prerequisite(s): C- or higher in MATH 112

Mathematical Science

MATH115 Precalc Algebra & Trig
MA

Hours 3

Properties and graphs of exponential, logarithmic, and trigonometric functions are emphasized. Also includes trigonometric identities, polynomial and rational functions, inequalities, systems of equations, vectors, and polar coordinates. Grades are reported as A, B, C, or NC (No credit). Degree credit will not be granted for both MATH 115 and (MATH 112 or MATH 113).

Prerequisite(s): UA Math Placement Test Score of 370-439 or ACT Math Subscore of 28 or old SAT Math Subscore of 630 or new SAT Math Subscore of 650

Mathematical Science

MATH121 Calculus & Applications
MA

Hours 3

A brief overview of calculus primarily for students in the Culverhouse College of Commerce and Business Administration. This course does not provide sufficient background for students who will need higher levels of Calculus. Note: This course does not satisfy the requirement for MATH 125 or 126. Degree credit will not be granted for both MATH 121 and MATH 125 or MATH 145.

Prerequisite(s): UA Math Placement Test Score of 440-600 or ACT Math Subscore of 30 or old SAT Math Subscore of 680 or new SAT Math Subscore of 710 or a C- or higher in MATH 112 or MATH 115.

Mathematical Science

MATH125 Calculus I
MA

Hours 4

This is the first of three courses in the basic calculus sequence. Topics include the limit of a function; the derivative of algebraic, trigonometric, exponential, and logarithmic functions; and the definite integral. Applications of the derivative are covered in detail, including approximations of error using differentials, maxima and minima problems, and curve sketching using calculus. There is also a brief review of selected precalculus topics at the beginning of the course. Degree credit will not be granted for both MATH 121 and MATH 125 or MATH 145.

Prerequisite(s): C- or higher in MATH 113 and C- or higher in MATH 112; or C- or higher in MATH 115

Mathematical Science

MATH126 Calculus II
MA

Hours 4

This is the second of three courses in the basic calculus sequence. Topics include vectors and the geometry of space, applications of integration, integration techniques, L'Hopital's Rule, improper integrals, parametric equations, polar coordinates, conic sections and infinite series.

Prerequisite(s): C- or higher in MATH 125 or C- or higher in MATH 145

Mathematical Science

MATH145 Honors Calculus I
MA, UH

Hours 4

This course covers the same material as MATH 125 but in a depth appropriate for honors students. It is the first course in the three part honors calculus sequence for students majoring in mathematics, science or engineering. Topics include limits, continuity, differentiation, applications of differentiation, and integration. Applications of the derivative are covered in detail, including approximation of errors using differentials, maxima and minima problems, curve sketching, optimization problems, and Newton's method. Topics on integration include Riemann sums, properties of definite integrals, integration by substitution and integrals involving logarithmic exponential and trigonometric functions.

Prerequisite(s): ACT Math Subscore of 32 or old SAT Math Subscore of 730 or new SAT Math Subscore of 760 or a B- or higher in (MATH 112 and MATH 113) or MATH 115

Mathematical Science, University Honors

MATH146 Honors Calculus II
MA, UH

Hours 4

This course covers the same material as MATH 126 but in a depth appropriate for honors students. It is the second course in the three part honors calculus sequence for students majoring in mathematics, science or engineering. Topics include vectors and the geometry of space, L'Hospital's Rule, applications of integration, integration techniques, improper integrals, infinite series, conic sections, plane curves, parametric equations, and polar coordinates.

Prerequisite(s): A grade of B- or higher in MATH 125 or MATH 145 or a score of 4 or 5 on AP Calculus AB or a score of 4 or 5 on AP Calculus BC: AB Subscore.

Mathematical Science, University Honors

MATH208 Number And Operations
Hours 3

This course is designed to develop deeper understanding of elementary school mathematics content needed for teaching. The course topics include whole numbers and integers, fractions, ratio, percent, decimals and arithmetic operations within these systems. The goal of the course is to develop conceptual understanding (instead of just procedural understanding) of the number systems and operations by focusing on basic concepts and principles, exploring multiple representations and strategies, and illuminating connections among concepts and procedures. The content knowledge needed for teaching will be reinforced by engaging in inquiry-based activities, analyzing children's ways of thinking, focusing on explanation and communication of underlying mathematical principles when solving problems, and using appropriate manipulative and technology.

Prerequisite(s): C- or higher in MATH 110 or C- or higher in MATH 111 or C- or higher in MATH 112 or C- or higher in MATH 113 or C- or higher in MATH 115 or C- or higher in MATH 121 or C- or higher in MATH 125 or ACT Math Subscore of 22 or new SAT Math Subscore of 540

MATH209 Geometry, Measurement, and Data Analysis
Hours 3

This course focuses on properties of two- and three-dimensional shapes, spatial reasoning, and the process and techniques of measurement and basic data analysis. Class activities initiate investigations of underlying mathematical structure in the exploration of shape, space and data. Emphasis is on the explanation of the mathematical thought process. Technology specifically designed to facilitate geometric explorations and data analysis is integrated throughout the course.

Prerequisite(s): C- or higher in MATH 208

MATH210 Data Analysis for Elementary Teachers
Hours 3

Data analysis, statistics, and probability, including collecting, displaying/representing, exploring, and interpreting data, probability models, and applications. Focus is on statistics for problem-solving and decision making, rather than calculation. Class activities deepen the understanding of fundamental issues in learning to work with data. Technology specifically designed for data-driven investigations and statistical analysis related to elementary school teaching is integrated throughout the course.

Prerequisite(s): C- or higher in MATH 208

MATH227 Calculus III
MA

Hours 4

This is the third of three courses in the basic calculus sequence. Topics include: vector functions and motion in space; functions of two or more variables and their partial derivatives; and applications of partial derivatives (including Lagrange multipliers), quadric surfaces, multiple integration (including Jacobian), line integrals, Green's Theorem, vector analysis, surface integrals and Stokes' Theorem.

Prerequisite(s): C- or higher in MATH 146 or C- or higher in MATH 126

Mathematical Science

MATH237 Introduction to Linear Algebra
C

Hours 3

Fundamentals of linear algebra and matrix theory are covered. Topics include vectors in Euclidean spaces, solving systems of linear equations, matrix algebra, inverses, determinants, eigenvalues, and eigenvectors. Also vector spaces and the basic notions of span, subspace, linear independence, basis, dimension, linear transformation, kernel and range are considered. Computing proficiency is required for a passing grade in this course.

Prerequisite(s): C- or higher in MATH 126 or C- or higher in MATH 146

Computer Science

MATH238 Appld Diff Equations I
C, MA

Hours 3

Introduction to analytic and numerical methods for solving differential equations. Topics include numerical methods and qualitative behavior of first order equations, analytic techniques for separable and linear equations, applications to population models and motion problems; techniques for solving higher order linear differential equations with constant coefficients (including undetermined coefficients, reduction of order, and variation of parameters), applications to physical models; the Laplace transform (including intial value problems with discontinuous forcing functions). Use of mathematics software is an integral part of the course. Computing proficiency is required for a passing grade in this course.

Prerequisite(s): C- or higher in MATH 126 or C- or higher in MATH 146

Computer Science, Mathematical Science

MATH247 Honors Calculus III
MA, UH

Hours 4

This course covers the same material as MATH 227 but in a depth appropriate for honors students. It is the third course in the three part honors calculus sequence for students majoring in mathematics, science or engineering. Topics include analytic geometry in space, vector-valued functions and motion in space, functions of two or more variables and their partial derivatives, applications of partial differentiation (including Lagrangian multipliers), quadric and cylindrical surfaces, and multiple integration (including Jacobian) and applications, line integrals, Green's Theorem, curl and divergence, surface integrals, and Stokes' Theorem.

Prerequisite(s): A grade of B- or higher in MATH 126 or MATH 146 or a score of 4 or 5 on AP Calculus BC exam.

Mathematical Science, University Honors

MATH301 Discrete Mathematics
W

Hours 3

An introduction to mathematical logic and proof within the context of discrete structures. Topics include basic mathematical logic, elementary number theory, basic set theory, functions, and relations. Writing proficiency is required for a passing grade in this course. A student who does not write with the skill normally required of an upper-division student will not earn a passing grade, no matter how well the student performs in other areas of the course.

Prerequisite(s): MATH 125 or MATH 145

Writing

MATH311 Introduction to Scientific Computing and Problem Solving
Hours 3

An introduction to using computer algorithms to solve mathematical problems, such as data analysis, visualization, numerical approximation and simulation. Basic programming concepts, such as variables, statements, loops, branches, functions, data structures, and debugging will be introduced in Python. A brief introduction to MATLAB tools for handling vectors, matrices, and vectorizing codes for performance, will be discussed as well in the later portion of the course. Some advanced mathematical and computational topics may be offered at the discretion of instructor.

Prerequisite(s): C- or higher in MATH 237 AND C- or higher in (CS 100 OR CS 110 OR CS 223 OR AEM 249 or MIS 221 OR RRS 101)

MATH343 Appl Diff Equations II
Hours 3

Continuation of Appl Diff Equations I (Math 238) and is designed to equip students with further methods of solving differential equations. Topics include initial value problems with variable coefficients, methods of infinite series, two-point boundary value problems, wave and heat equations, Fourier series, Sturm-Liouville theory, phase plane analysis, and Liapunov's second method.

Prerequisite(s): C- or higher in MATH 238

MATH355 Theory Of Probability
Hours 3

The foundations of the theory of probability, laws governing random phenomena and their practical applications in other fields. Topics include: probability spaces; properties of probability set functions; conditional probability; and an introduction to combinatorics, discrete random variables, expectation of discrete random variables, Chebyshev's Inequality, continuous variables and their distribution functions, and special densities.

Prerequisite(s): C- or higher in MATH 227 or C- or higher in MATH 247

MATH359 Mathematical Theory of Data Science
Hours 3

An introduction to the mathematical foundations of data science and machine learning. The fundamental roles of linear algebra and probability theory in data science will be explored. Heuristics for a variety of learning tasks, such as methods for clustering, classification, regression, or deep learning will be discussed in tandem with mathematical justifications for their use and effectiveness, as well as exercises illustrating their practical use in data analysis. Theoretical models for the feasibility of machine learning and for different types of learning problems will be introduced.

Prerequisite(s): (C- or higher in MATH 237) AND (C- or higher in MATH 301) AND (C- or higher in MATH 355) AND (C- or higher in CS 101 or MATH 311)

MATH371 Advanced Linear Algebra
Hours 3

Topics include inner product spaces, norms, self adjoint and normal operators, orthogonal and unitary operators, orthogonal projections and the spectral theorem, bilinear and quadratic forms, generalized eigenvectors, and Jordan canonical form.

Prerequisite(s): C- or higher in MATH 237 and C- or higher in MATH 301

MATH403 Algebraic Structures for Secondary Teachers
Hours 3

Explore the interconnections between the algebraic, analytic, and geometric areas of mathematics with a focus on properties of various number systems, importance of functions, and the relationship of algebraic structures to solving analytic equations. This exploration will also include the development and sequential nature of each of these branches of mathematics and how it relates to the various levels within the algebra mathematics curriculum.

Prerequisite(s): C- or higher in MATH 237 and C- or higher in MATH 301

MATH405 Geometry for Secondary Teachers
Hours 3

This course will give an overview of geometry from a modern point of view. Axiomatic, analytic, transformational, and algebraic approaches to geometry will be used. The relationship between Euclidean geometry, the geometry of complex numbers, and trigonometry will be emphasized.

Prerequisite(s): C- or higher in MATH 403

MATH409 Data Analysis for Secondary Teachers
Hours 3

Concepts and techniques of posing questions and collecting, analyzing, and interpreting data. Topics include: univariate and bivariate statistics, probability, simulation, confidence intervals and hypothesis testing.

Prerequisite(s): C- or higher in MATH 125 and C- or higher in MATH 355

MATH410 Numerical Linear Algebra
Hours 3

Further study of matrix theory, emphasizing computational aspects. Topics include direct solution of linear systems, analysis of errors in numerical methods for solving linear systems, least-squares problems, orthogonal and unitary transformations, eigenvalues and eigenvectors, and singular value decomposition.

Prerequisite(s): (C- or higher in MATH 311) OR ((C- or higher in CS 101) AND (C- or higher in MATH 237))

MATH411 Numerical Analysis I
Hours 3

Credit will not be granted for both MATH 411 and MATH 300. An introduction to numerical methods. Topics include numerical methods for solving nonlinear equations; iterative methods for solving systems of equations; approximations and interpolations; numerical differentiation and integration; and numerical methods for solving initial value problems for ordinary differential equations.

Prerequisite(s): (C- or higher in MATH 238) AND (C- or higher in MATH 237) AND ((C- or higher in MATH 311) OR (C- or higher in CS 101))

MATH420 Linear Optimization Theory
Hours 3

This course is an introduction to theory of linear programming (focused on development of theory and algorithms with only a limited coverage of examples and applications), a basic component of optimization theory. Topics include: basic theory (fundamental theorem of LP, equivalence of basic feasible solutions and extreme points, duality and sensitivity results), simplex algorithm and its variations, and special applications to transportation and network problems. Non-simplex methods are also briefly introduced.

Prerequisite(s): C- or higher in (MATH 227 or MATH 247) AND (C- or higher in MATH 237) AND ((C- or higher in MATH 311) OR (C- or higher in CS 101))

MATH421 Non-Linear Optimization Theory
Hours 3

This course is an introduction to nonlinear programming. Topics will include necessary and sufficient conditions for optimality, as well as basic theory and numerical algorithms for several traditional optimization methods, e.g., basic descent methods, conjugate direction methods, quasi-Newton methods, penalty and barrier methods, Lagrange multiplier methods. A brief introduction to selected modern topics may be added if time permits.

Prerequisite(s): C- or higher in (MATH 227 or MATH 247) AND (C- or higher in MATH 237) AND ((C- or higher in MATH 311) OR (C- or higher in CS 101))

MATH441 Boundary Value Problems
Hours 3

Methods of solving the classical second-order linear partial differential equations: Laplace's equation, the heat equation, and the wave equation, together with appropriate boundary or initial conditions. Usually offered in the fall semester.

Prerequisite(s): C- or higher in MATH 343

MATH451 Math Stats W/Applictn I
Hours 3

Introduction to mathematical statistics. Topics include bivariate and multivariate probability distributions, functions of random variables, sampling distributions and the central limit theorem, concepts and properties of point estimators, various methods of point estimation, interval estimation, tests of hypotheses and Neyman-Pearson lemma with some applications.

Prerequisite(s): C- or higher in MATH 237 and C- or higher in MATH 355

MATH452 Math Stats W/Applictn II
Hours 3

Further applications of the Neyman-Pearson Lemma, Likelihood Ratio tests, Chi-square test for goodness of fit, estimation and test of hypotheses for linear statistical models, analysis of variance, analysis of enumerative data, and some topics in nonparametric statistics.

Prerequisite(s): C- or higher in MATH 451

MATH457 Stochastic Processes I
Hours 3

Introduction to the basic concepts and applications of stochastic processes. Markov chains, continuous-time Markov processes, Poisson and renewal processes, and Brownian motion. Applications of stochastic processes including queueing theory and probabilistic analysis of computational algorithms.

Prerequisite(s): C- or higher in MATH 355

MATH460 Intro Differential Geom
Hours 3

Introduction to basic classical notions in differential geometry: curvature, torsion, geodesic curves, geodesic parallelism, differential manifold, tangent space, vector field, Lie derivative, Lie algebra, Lie group, exponential map, and representation of a Lie group. Usually offered in the spring semester.

Prerequisite(s): C- or higher in (MATH 227 or MATH 247), and C- or higher in MATH 371

MATH465 Intro General Topology
Hours 3

Basic notions in topology that can be used in other disciplines in mathematics. Topics include topological spaces, open sets, basis for a topology, continuous functions, seperation axioms, compactness, connectedness, product spaces, quotient spaces.

Prerequisite(s): MATH 486

MATH466 Intro Algebraic Topology
Hours 3

Homotopy, fundamental groups, covering spaces, covering maps, and basic homology theory, including the Eilenberg Steenrod axioms.

Prerequisite(s): MATH 465

MATH470 Prin Modern Algebra I
Hours 3

A first course in abstract algebra. Topics include groups, cyclic groups, non-abelian groups, Lagrange's theorem, subgroups, cosets, homomorphisms, isomorphisms, rings.

Prerequisite(s): C- or higher in MATH 237 and C- or higher in MATH 301

MATH471 Prin Modern Algebra II
Hours 3

An introduction to ring theory. Topics include rings, polynomial rings, matrix rings, modules, fields and semi-simple rings. Usually offered in the fall semester.

Prerequisite(s): C- or higher in MATH 470

MATH485 Intro Complex Variables
Hours 3

Some basic notions in complex analysis. Topics include analytic functions, complex integration, infinite series, contour integration, and conformal mappings.

Prerequisite(s): C- or higher in MATH 227 or C- or higher in MATH 247

MATH486 Introduction to Real Analysis I
Hours 3

Rigorous development of the calculus of real variables. Topics include the topology of the real line, sequences and series, limits, limit suprema and infima, continuity, and differentiation.

Prerequisite(s): C- or higher in MATH 301

MATH487 Introduction to Real Analysis II
Hours 3

A continuation of Math 486. Topics include Riemann integration, sequences and series of functions, uniform convergence, power series, Taylor series. Optional topics may include the Reimann-Stieltjes integration, Weierstrass Approximation Theorem and the Arzela-Ascoli Theorem, metric spaces, multi-variable calculus.

Prerequisite(s): C- or higher in MATH 486

MATH493 Capstone in Data Science
EXP

Hours 3

A project-based course that integrates the skills and abilities developed throughout the curriculum for the Data Science major. The course will require the analysis of a real world data set, a plan for conducting that analysis, a report on the analysis, and an oral presentation of the results and reasoning behind them.

Prerequisite(s): (C- or higher in MATH 359) AND (C- or higher in CS 451)

Experiential Learning

MATH495 Seminar Directed Reading
SP

Hours 1-3

Offered as needed.

Special Topics Course

MATH499 Undergrad Research Exp
Hours 1-3

Independent or collaborative research experience in mathematics.