

# Mathematical Sciences

---

258A Shelby Center

Telephone: 256.824.6470

Email: mathUG@uah.edu

The Mathematical Sciences department offers the following undergraduate degrees:

- Mathematical Sciences, Concentration I, BS (<http://catalog.uah.edu/undergrad/colleges-departments/science/mathematical-sciences/mathematics-bs-ba>)
- Mathematical Sciences, Concentration II, BS - Secondary Education (<http://catalog.uah.edu/undergrad/colleges-departments/science/mathematical-sciences/mathematics-bs-ba-concentration-ii>)
- Mathematical Sciences, Concentration III, BS - Double Major or Dual Degree. Double major-Math degree with another major in the College of Science. Dual Degree-Math degree with an additional degree in another college such as the College of Engineering. (<http://catalog.uah.edu/undergrad/colleges-departments/science/mathematical-sciences/mathematics-bs-ba-concentration-iii>)

## Program Objectives

Our objective is to provide excellent instruction and resources for the mathematics education through our courses and degree programs. Through our bachelor's, master's and doctoral degree programs, our goal is to help produce the new generations of well-educated mathematicians that are critical for the progress of mankind. Our second objective is to promote and communicate the importance of mathematics in society and to help maintain standards of excellence in mathematics through collaboration with other departments. Our third objective is to have graduates prepared for careers in government, industry, teaching at a secondary school level, or for graduate study in mathematics.

## Learning Outcomes

Graduates in Mathematics will:

- Demonstrate critical thinking skills to construct clear, valid and succinct proofs
- Effectively apply mathematics to solve problems in applied fields
- Exhibit quantitative reasoning and data analysis

## Majors in Mathematical Sciences

- Mathematical Sciences, Concentration I, BS (<http://catalog.uah.edu/undergrad/colleges-departments/science/mathematical-sciences/mathematics-bs-ba>)
- Mathematical Sciences, Concentration II, BS - Secondary Education (<http://catalog.uah.edu/undergrad/colleges-departments/science/mathematical-sciences/mathematics-bs-ba-concentration-ii>)
- Mathematical Sciences, Concentration III, BS - (<http://catalog.uah.edu/undergrad/colleges-departments/science/mathematical-sciences/mathematics-bs-ba-concentration-iii>) Double Major or Dual Degree (<http://catalog.uah.edu/undergrad/colleges-departments/science/mathematical-sciences/mathematics-bs-ba-concentration-iii>)

## Minor in Mathematical Sciences

- Mathematics (<http://catalog.uah.edu/undergrad/colleges-departments/science/mathematical-sciences/mathematics-minor>)

UAH's Joint Undergraduate Master's Program (JUMP) allows undergraduate students to study at the graduate level. By taking graduate courses in your senior year you could reduce the time taken to get a graduate (MS) degree. Please visit JUMP (<http://catalog.uah.edu/undergrad/academic-information/jump>) page for general information.

## Requirements For Admission

1. Cumulative overall 3.5 GPA
2. Major GPA of 3.5
3. MA 238, MA 244, MA 330, MA 442, and MA 452 must be taken Sophomore and Junior years

## Additional Information

1. Maximum of 12 credit hours count toward both degrees
2. With permission of JUMP advisor, a student may use any 500-level course or 500-600 level sequence of courses normally acceptable on Mathematics Master's POS for the 12 hours of double counted courses (Of these 12 hours, 9 credit hours replace undergraduate mathematics electives, and 3 credit hours replace a general undergraduate elective)

**Designated Faculty Contact/Advisor**

Dr. Guo-Hui Zhang zhangg@uah.edu 256.824.2228

MA 107 - ALGEBRA WITH APPLICATIONS

Semester Hours: 3

Algebra review, functions and graphs, linear models, exponential logarithmic functions, mathematics of finance, sets and probability. Prerequisites: Level 1 placement for MA 107 and Level 0 placement for MA 107L. No credit given to students who have received credit for another MA course.

MA 110 - FINITE MATHEMATICS

Semester Hours: 3

Algebra review, elementary functions, matrices, logic, sets, counting, and an introduction to probability and statistics. MA 110 is an AGSC core course. Prerequisites: Level 1 placement for MA 110 and Level 0 placement for MA 110L.

MA 112 - PRECALCULUS ALGEBRA

Semester Hours: 3

Real number systems, exponents, radicals, factoring, absolute value, inequalities, function notation, functions, inverse functions, graphing techniques, polynomial and rational functions, operations with complex numbers, conic sections, and theory of equations. Prerequisites: Level 1 placement for MA 112 and Level 0 placement for MA 112L.

MA 113 - PRECALCULUS TRIGONOMETRY

Semester Hours: 3

Exponential and logarithmic functions, trigonometric functions of angles and real numbers, graphing trigonometric functions, inverse trigonometric functions, solving trigonometric equations, verifying identities, laws of sines and cosines, vectors, trigonometric form of complex numbers, DeMoivre's theorem, summation notation, arithmetic and geometric sequences and series. Prerequisites: Level 2 placement or MA 112 with a grade of C or better. No credit given to students who have completed a MA course numbered above MA 113. MA 113 is an AGSC core course.

MA 115 - PRECALCULUS ALGEBRA & TRIG

Semester Hours: 4

The algebra of functions, including polynomial, rational, exponential, and logarithmic functions; systems of equations and inequalities; trigonometric and inverse trigonometric functions; trigonometric identities and equations; a brief introduction to DeMoivre's Theorem, vectors, polar coordinates, and the binomial theorem. This course is intended for students who plan to take at least MA 171 (Calculus A) but who do not need the full two-semester sequence in precalculus (MA 112, 113). MA 115 is an AGSC core course.

MA 120 - MATH PROFESSIONAL APPLICATIONS

Semester Hours: 3

Limits, continuity, differentiation, applications of the derivative, integration, the fundamental theorem of calculus, applications of the integral. Prerequisites: MA 107, MA 110, or MA 112 with a grade of C or better, or Level 2 placement. No credit given to students who have already received credit for a calculus course. MA 120 is an AGSC core course.

MA 171 - CALCULUS A

Semester Hours: 4

Limits, derivatives, applications of the derivative, definite and indefinite integrals, exponential and logarithmic functions, and inverse functions. Prerequisites: MA 113 or MA 115 with a grade of C or better, or Level 3 placement.

MA 171R - CALCULUS A RECITATION

Semester Hours: 0

Extension of MA 171. Review of previous math skills needed for success. Homework discussed; examination preparation, review of homework and examination tutoring and individual consultation.

MA 172 - CALCULUS B

Semester Hours: 4

Techniques of integration, applications of the integral, polar coordinates, sequences, series, and conic sections. Prerequisites: MA 171 with a grade of C or better.

MA 201 - CALCULUS C

Semester Hours: 4

Vectors, vector-valued functions, partial derivatives, multiple integrals, vector fields, line and surface integrals. Prerequisites: MA 172 with a grade of C or better.

**MA 230 - MATH FOR ELEMENTARY TEACHERS**

Semester Hours: 3

The course emphasizes the use of logical thinking in mathematics and the development of students' understandings of algorithm design. Directed at providing the elementary education student the mathematical background necessary for an understanding of the mathematical principles that are introduced to children in the elementary grades. Emphasis on sets, logic, an understanding of the number systems (integers, fractions, decimals, percents) and number theory. Prerequisites: Two MA courses at the 100 level or above, each with a grade of C or better. Open only to students majoring in elementary education.

**MA 231 - MATH FOR ELEM SCH TCHERS II**

Semester Hours: 3

Rational numbers, real numbers, algebra, statistics, probability, geometric shapes, measurement, and geometry (using triangle congruence and similarity, coordinates, and transformations). Prerequisites: MA 230 with a grade of C or better.

**MA 238 - APPL DIFFERENTIAL EQUATIONS**

Semester Hours: 3

This course provides an elementary introduction to the techniques and necessary theory for solving the basic differential equations usually encountered by beginning science and engineering students. General topics include analytical and graphical methods for solving and analyzing firstorder differential equations; Euler's numerical method; the basic theory of higher-order, linear differential equations, with major emphasis on equations with constant coefficients; variation of parameters; the Laplace transform as a tool for solving differential equations. MA 238 is an AGSC core course. Prerequisites: MA 172 & MA 201 with concurrency.

**MA 244 - INTRO TO LINEAR ALGEBRA**

Semester Hours: 3

Systems of linear equations, matrices, matrix operations, determinants, vector spaces, bases, dimension of a vector space, inner product, Gram-Schmidt process, linear transformations, change of basis, similar matrices, eigenvalues and eigenvectors, diagonalization, symmetric matrices, and applications. Prerequisites: MA 120 or MA 172.

**MA 281 - ELEMENTS OF STATISTICAL ANALYS**

Semester Hours: 3

Descriptive statistics, fundamentals of probability theory, fundamentals of statistical inference, including estimation and hypothesis testing, and use of a typical statistical package such as MINITAB. Prerequisites: MA 113, or MA 115, or Level 2 Placement.

**MA 299 - MATHEMATICS PROJECT**

Semester Hour: 1

Individualized special projects in mathematics and its applications for inquisitive and well prepared sophomore-level undergraduate students. No credit allowed toward major or minor in mathematics. S/U grading. Approval of department chair and instructor required.

**MA 301 - INTRO ELEMENTARY NUMBER THEORY**

Semester Hours: 3

Fundamental properties of integers, divisibility, linear Diophantine equations, congruency, Euler function, Chinese Remainder Theorem, Fermat Theorems, Wilson Theorem, and applications to Cryptography. Prerequisite: MA 244.

**MA 330 - FOUNDATIONS OF MATH**

Semester Hours: 3

Symbolic logic and methods of proof, set theory, combinations and permutations, equivalence relations and functions, mathematical induction and recurrence relations, cardinality (finite, countably infinite, and uncountable sets), and decimal representation of the rational and real numbers. Prerequisites: MA 172 and (MA 201 or MA 244).

**MA 385 - INTRO TO PROBABILITY & STATIST**

Semester Hours: 3

This course is a calculus-based introduction to probability with special emphasis on the interplay between probability and statistics. Topics include descriptive statistics; probability spaces; discrete distributions (including the binomial, geometric, hypergeometric, and Poisson); continuous distributions (including the uniform, exponential, and normal); joint distributions; mean, variance, and general expected value; independence and correlation; the law of large numbers; and the central limit theorem. Prerequisites: MA 120 or MA 172 with a grade of C or better and 1 MA course at 200 level or above.

**MA 399 - MATHEMATICS PROJECT**

Semester Hour: 1

Individualized special projects in mathematics and its applications for inquisitive and well prepared junior-level undergraduate students. No credit allowed toward a major or minor in mathematics. S/U grading. Approval of department chair and instructor required.

## MA 415 - INTRO NUMERICAL METHODS

Semester Hours: 3

Derivation and analysis of approximate methods for the solution of nonlinear equations, interpolation and integration of functions, and techniques for the solution of systems of linear equations and for approximating solutions of elementary differential equations. Emphasis is placed on obtaining an intuitive understanding of both the problem at hand and the numerical method used to solve it. Prerequisites: MA 201, MA 244, and CS 121.

## MA 420 - INTERM DIFFERENTIAL EQUATIONS

Semester Hours: 3

This is a second course in differential equations. Course topics include series solutions for second order differential equations and the method of Frobenius; eigenvalue and eigenvector methods for solving systems of linear first order equations; the qualitative theory of nonlinear equations; boundary value problems and the Sturm-Liouville theory. Prerequisites: MA 201, MA 244 and MA 238.

## MA 433 - INTRODUCTION TO GEOMETRY

Semester Hours: 3

Axiomatic development of geometry, introduction to non-Euclidean geometries with emphasis in elliptic and hyperbolic geometries, selected topics in Euclidean geometry. Prerequisites: MA 244 and MA 330.

## MA 442 - ALGEBRAIC STRUCTURES W/APPLIC

Semester Hours: 3

Mappings, binary operations, equivalence relations, groups and subgroups, Lagrange's theorem, homomorphisms and isomorphisms, normal subgroups and quotient groups, rings, fields, ordered integral domains, fields of quotients, error correcting codes, linear codes, and decoding. Prerequisites: MA 244 and either MA 330 or 385.

## MA 450 - COMBINATORIAL ENUMERATION

Semester Hours: 3

Counting, pigeonhole principle, permutations and combinations, generating functions, principle of inclusion and exclusion, Polya's theory of counting. Prerequisite: MA 385 or MA 442 (with concurrency).

## MA 452 - INTRO TO REAL ANALYSIS

Semester Hours: 3

Sequences, limits, continuity, differentiation of functions of one real variable, Riemann integration, uniform convergence, sequences and series of functions, power series, and Taylor series. Prerequisites: MA 330.

## MA 453 - INTRO TO COMPLEX ANALYSIS

Semester Hours: 3

Complex algebra, analytic functions, Cauchy-Riemann equations, exponential, trigonometric, and logarithmic functions, integration, Cauchy integral theorem, Morera's theorem, Liouville's theorem, maximum modulus theorem, residue theory, Taylor and Laurent series, and applications. Prerequisites: MA 201 and one MA course at 300 level or above.

## MA 456 - METHODS OF PARTIAL DIFF EQUA

Semester Hours: 3

Survey of theory and methods for solving elementary partial differential equations. Topics include first-order equations and the method of characteristics, second-order equations, reduction to canonical form, the wave equation, the heat equation, Laplace's equation, separation of variables, and Fourier series. Prerequisites: MA 238 and MA 244.

## MA 458 - APPLIED LINEAR ALGEBRA

Semester Hours: 3

Fundamental concepts of linear algebra are developed with emphasis on real and complex vector spaces, linear transformations, and matrices. Systems of equations, inverses of matrices, determinants, vector spaces, linear transformations, eigenvalues and eigenvectors, normal matrices, canonical forms of matrices, applications of systems of linear differential equations, and use of computer software such as MATLAB. Prerequisites: MA 238 and MA 244.

## MA 460 - INTRO FOURIER ANALYSIS

Semester Hours: 3

Brief development of trigonometric and exponential Fourier series, derivation of the classical Fourier transform from series, classical properties of Fourier transforms, transforms of functions, convolution, elementary development of the delta function, transforms of periodic functions, use of transforms to solve systems, introduction to the discrete transform and/or multidimensional transforms, as time permits. Prerequisites: MA 238 and MA 244.

**MA 465 - INTRO TO MATH MODELING**

Semester Hours: 3

Applying mathematics by formulating, analyzing, and criticizing mathematical models of various phenomena. Examples will be chosen from the physical, biological, and social sciences. Emphasizes development and use of simple mathematical models by having student study general modeling principles and case studies (some open-ended) drawn from various sources. Prerequisites: MA 201, MA 238, and MA 244.

**MA 487 - INTRO TO MATH STATISTICS**

Semester Hours: 3

This is an introductory, calculus-based course in mathematical statistics. Topics include a review of basic probability, including probability spaces, independence, distributions and expected value; the fundamental theorems of probability, including the law of large numbers and the central limit theorem; estimation, including point estimation and interval estimates for means, variances, and proportions; hypothesis testing, including tests for means, variance, and goodness of fit; an introduction to correlation and regression; theory of inference, including sufficiency and power. Prerequisites: MA 201 and either MA 385 or ISE 390.

**MA 490 - SEL TOP UNDERGRAD MATH**

Semester Hours: 1-3

Requested undergraduate topics. Approval of instructor required.

**MA 499 - MATHEMATICS PROJECT**

Semester Hour: 1

Individualized special projects in mathematics and its applications for superior undergraduate students. No credit is allowed toward a major or minor in mathematics. S/U grading. Approval of department chair and instructor required.