Mathematical Sciences (B.S.)

Mathematics is both a profession and an indispensable tool for many types of work. As a tool, mathematics is a universal language which has been crucial in formulating and expressing ideas not only in science and engineering, but also in many other areas such as business and the social sciences. As probably the oldest and most basic science, it provides the key to understanding the major technological achievements of our time.

Of equal importance, a knowledge of mathematics may help provide a student with the type of uncompromising and clear-sighted thinking useful in considering the problems of many other disciplines. The Mathematical Sciences degree program encompasses mathematics, statistics, and applied mathematics.

Applied mathematics and statistics continue to enjoy a rapid growth. Students have the opportunity of applying their expertise to any of a number of fields of application. For the student to be more effective in such applications, Mathematical Sciences also offers degree programs allowing additional emphasis in the areas of actuarial science, computer science, electrical engineering, and management.

Those interested in obtaining both a B.S. in Mathematical Sciences and Teacher Certification in the state of Texas should consult the Office of Teacher Education for specific requirements as soon as possible after formal admission to the University. See the Teacher Education section of this catalog for additional information.

The Mathematical Sciences degree program also prepares students for graduate studies. An accelerated B.S./M.S. Fast-Track program is available which provides the opportunity for undergraduate students to satisfy some of the requirements of the master's degree while they are completing the bachelor's degree in Mathematical Sciences.

The Options

Students seeking a degree in the Mathematical Sciences may specialize in Mathematics, Statistics, or Applied Mathematics. Each option allows some flexibility in electives so that students can better adapt their degree plans to their educational goals.

Mathematics: For students interested in the intellectual satisfaction of mathematics per se and/or possibly continuing on to graduate work in mathematics, applied mathematics, math education, and related areas.

Statistics: For students interested in probability and statistical models and their use in data analysis and decision making and for students interested in continuing on to graduate work in statistics, biostatistics, actuarial science, and other statistics-related areas.

Applied Mathematics: For students interested in mathematics for the purpose of using it broadly in various areas of application and for students interested in continuing on to graduate work in applied mathematics and related areas.

Fast Track Baccalaureate/Master's Degrees

For students interested in pursuing graduate studies in mathematics, the Mathematics Department offers an accelerated B.S./M.S. Fast Track that involves taking graduate courses instead of several advanced undergraduate courses. Acceptance into the Fast Track is based on the student's attaining a GPA of at least 3.5 in all mathematics classes, being within 30 hours of graduation, and acceptance into a graduate program in Mathematics. Fast Track students may, during their senior year, take 15 graduate hours which may be used to complete the bachelor's degree and also satisfy requirements for the master's degree. Fast Track programs are offered in math, applied math, and statistics.

Bachelor of Science in Mathematical Sciences Degree Requirements (120 hours)
I. Core Curriculum Requirements\(^1\): 42 hours

A. Communication (6 hours)
   3 hours Communication (RHET 1302)
   3 hours Communication Elective (NATS 4310)\(^2\)
B. Social and Behavioral Sciences (15 hours)
   6 hours Government (GOVT 2305 and 2306)
   6 hours History (HST 1301 and 2301)
   3 hours Social and Behavioral Sciences Elective
C. Humanities and Fine Arts (6 hours)
   3 hours Fine Arts (AP 1301)
   3 hours Humanities (A&H 1301)
D. Mathematics and Quantitative Reasoning (6 hours)
   6 hours Calculus (MATH 2417 and 2419) \(^3\)
E. Science (9 hours)
   Math/Applied Math Options
      PHYS 2325/2125 Mechanics and Heat with lab
      PHYS 2326/2126 Electromagnetism and Waves with lab
      PHYS 1100 Fun of Physics (or any science course)
   Statistics Option
      PHYS 1100 Fun of Physics (or any science course)
      PHYS 2325/2125 Mechanics and Heat with lab and
      PHYS 2326/2126 Electromagnetism and Waves with lab
      or CHM 1311/1111 and 1312/1112 General Chemistry I and II with lab

\(^1\) Curriculum Requirements can be fulfilled by other approved courses from accredited institutions of higher education. The courses listed in parenthesis are recommended as the most efficient way to satisfy both Core Curriculum and Major Requirements at U.T. Dallas.

II. Major Requirements: 48 hours

Major Preparatory Courses (15 hours)
   CS 1315* Computer Science I
   MATH 2417 Calculus I\(^3\)
   MATH 2418* Linear Algebra
   MATH 2419 Calculus II\(^3\)
   MATH 2420* Differential Equations
   MATH 2421* Multivariable Calculus
Major Core Courses (21 hours)
   MATH 3310 Theoretical Concepts of Calculus
   MATH 3311 Abstract Algebra I
   MATH 3379 Complex Variables
   MATH 4301 Mathematical Analysis I
   MATH 4302 Mathematical Analysis II
   MATH 4334 Numerical Analysis
   NATS 4310 Advanced Writing in the Natural Sciences and Mathematics
   STAT 4351 Probability
Major Related Courses (12 hours)
   Applied Math Option
      MATH 4341 Topology
      MATH 4355 Methods of Applied Mathematics
MATH 4362 Partial Differential Equations  
STAT 4382 Stochastic Processes  
Mathematics Option  
MATH 3312 Abstract Algebra II  
MATH 3321 Geometry  
MATH 4341 Topology  
3 hours upper-division guided elective  
Statistics Option  
STAT 3355 Data Analysis for Statisticians and Actuaries  
STAT 4352 Mathematical Statistics  
STAT 4382 Stochastic Processes  
3 hour upper-division guided elective  

2 A Major course requirement that also fulfills a Core Curriculum requirement. If hours are counted in the Core Curriculum, students must complete additional coursework to meet the minimum requirements for graduation. Course selection assistance is available from the undergraduate advisor.  
3 Two hours of Calculus are counted as electives; six hours are counted in Core Curriculum.  
* Indicates a prerequisite class to be completed before enrolling in upper-division classes.  

III. Elective Requirements: 30 hours  

Advanced Electives (6 hours)  
All students are required to take at least six hours of advanced electives outside their major field of study. These must be either upper-division classes or lower-division classes that have prerequisites.  
Free Electives (24 hours)  
Both lower- and upper-division courses may count as electives, but the student must complete at least 51 hours of upper-division credit to qualify for graduation.  

Mathematical Sciences Options with Actuarial Science Emphasis  
Statistics Option together with following courses:  
ACCT 2301 Introductory Financial Accounting  
BA 3341 Business Finance  
BA 3351 Introduction to Management Information Systems  
BA 4345 Money and Capital Markets  
BA 4346 Investment Management  
STAT 4372 Actuarial Science  
And any two of the following courses:  
ACCT 2302 Introductory Cost Management  
ACCT 3331 Intermediate Financial Accounting I  
BA 4347 Applied Corporate Finance  
ECO 4330 Law and Economics  

Notes: ACCT 2301 must be taken before BA 3341, 4345, 4346 and 4397.  
MATH 1325 or MATH 2417 relates to Exam 100 of Society of Actuaries (SOA) and Exam 1A of the Casualty Actuarial Society (CAS) and MATH 4334 relates to Exam 135 of SOA.  
STAT 4351 and STAT 4352 relate to Exam 110 of SOA and Exam 1B of CAS. STAT 3355 and STAT 4382 relate to Exam 120 of SOA and Exams 3F, 3G, 4A, 4B, 4C of CAS. STAT 4372 relates to Exams 3E, 3H and the rest of Exam 4 of CAS and Exam 150 of SOA.  

Mathematical Sciences Options with Computer Science Emphasis  
Applied Mathematics Option or Statistics Option together with following courses:  
CS 2305 Discrete Mathematics for Computing I
CS 2315 Computer Science II
CS 2325 Computer Organization
CS 3335 C and C++
CS 3345 Algorithm Analysis and Data Structures
CS 4337 Organization of Programming Languages
CS 4340 Computer Architecture

Mathematical Sciences Options with Electrical Engineering Emphasis

Applied Mathematics Option or Statistics Option together with following courses:
EE 3201 Electrical Network Analysis Laboratory
EE 3301 Electrical Network Analysis
EE 3211 Electronic Circuits Laboratory
EE 3311 Electronic Circuits
EE 4220 Digital Circuits Laboratory
EE 4301 Electromagnetic Engineering I
EE 4320 Digital Circuits

Mathematical Sciences Options with Management Emphasis

Mathematics Option, Applied Mathematics Option or Statistics Option together with following courses:
ACCT 2301 Introductory Financial Accounting
ACCT 2302 Introductory Cost Management
BA 2301 Business and Public Law
BA 3341 Business Finance
BA 3351 Introduction to Management Information Systems
BA 3361 Organizational Behavior

NOTE: Students transferring into Mathematical Sciences at the upper-division level are expected to have completed all of the 1000- and 2000- level mathematics core course requirements.

Minor in Mathematical Sciences

Students not majoring in Mathematical Sciences may obtain a minor in Mathematics or Statistics by satisfying the following requirements:
18 credit hours of mathematics or statistics, 12 hours of which must be chosen from the following courses:
Mathematics Minor: MATH 3310, MATH 4334 and two more upper-division mathematics courses.
Statistics Minor: STAT 4351, STAT 4352 and two more upper-division statistics courses.

Specified Course Descriptions

A&H 1301 (HUMA 1301) Exploration of the Humanities (3 semester hours) An introduction to the concept of cultural tradition through the study of selected works of literature, philosophy, music, and visual art. Emphasis on the relations among various forms of cultural expression and developing students’ ability to interpret complex artistic works in their historical, cultural, and intellectual contexts. General education core course. (3-0) S
ACCT 2301 (ACCT 2301) **Introductory Financial Accounting** (3 semester hours) An introduction to business external financial reporting designed to create an awareness of the accounting concepts and principles used in preparing the three basic financial statements: the income statement, balance sheet, and statement of cash flows. The course is designed to benefit all business students, whether future users or preparers of accounting information. (3-0) S

ACCT 2302 (ACCT 2302) **Introductory Cost Management** (3 semester hours) An introduction to the determination, development, and uses of internal accounting information needed by business management to satisfy customers while continuously controlling and containing costs. The course is designed to benefit all business students, whether future users or preparers of accounting information. (3-0) Y

ACCT 3331 **Intermediate Financial Accounting I** (3 semester hours) A study of business external financial reporting, intended for students who desire further knowledge of concepts, principles and practice. Consideration of issues related to measurement and reporting of cash, receivables, inventories, property, plant and equipment, and intangibles. Current financial statement presentation issues are analyzed to gain an appreciation for the impact of generally accepted accounting principles on the business environment as a whole. Prerequisite: ACCT 2301. (3-0) S

AP 1301 (ARTS 1301) **Exploration of the Arts** (3 semester hours) This course introduces students to the physical and intellectual demands required of the author, the performer, and the visual artist. This introduction includes, but is not limited to, the student's production of a creative project as well as written assessments of art and performance. (3-0) Y

BA 2301 (BUSI 2301) **Business and Public Law** (3 semester hours) Commercial and administrative law, focusing on the law of contracts, agency, bailments, property, and laws of partnerships and corporations. (3-0) Y

BA 3341 **Business Finance** (3 semester hours) Theoretical and procedural considerations in the administration of finances in the firm: sources and uses of funds, working capital, capital budgeting, capital structure, and costs of capital. Corequisite: STAT 3360. (3-0) Y

BA 3351 **Introduction to Management Information Systems** (3 semester hours) Introduction to basic management information systems and computer concepts. Emphasis on the various facets of the computer, information processing including computer applications, processing data into information, computer hardware, file organization and databases, communications, and information system development. Use of word processing, spreadsheet, and database application software to develop PC skills. (3-0) S

BA 3361 **Organizational Behavior** (3 semester hours) An integrated social science approach to administrative problems using behavioral sciences. Behavior in organizations is examined with attention given to such topics as performance appraisal, selection, training, motivation, job satisfaction, communications, leadership, small group processes, decision making, power, conflict, organizational structure, and organizational change. (3-0) S

BA 4345 **Money and Capital Markets** (3 semester hours) Examines the management of the firm's short-term assets and liabilities. In addition to developing a framework for forecasting and planning for short-run financing needs, the topics covered include a detailed study of the banking system and the market for short-term securities. Prerequisite: STAT 3360, BA 3341, and BA 3351. (3-0) S

BA 4346 **Investment Management** (3 semester hours) Examines a wide range of issues concerning the management risk and the measurement of investment performance. The objective of the course is to provide an understanding of the role of modern financial theory in portfolio management and to present a framework for addressing a wide range of issues in the management of financial assets. The topics covered include valuation, the measurement of risk and portfolio performance, the management of portfolios of fixed income securities, and derivative securities. Prerequisites: STAT 3360, BA 3341, and BA 3351. (3-0) S

BA 4347 **Applied Corporate Finance** (3 semester hours) Integrates a variety of advanced topics in corporate financial decision making in examining the development of the financial strategy of the firm. Emphasis will be placed on the valuation of the firm and the impact of financial markets on corporate investment and financing decisions. Prerequisites: BA 4345 and BA 4346. (3-0) Y

CHM 1111 (CHEM 1111) **General Chemistry Laboratory I** (1 semester hour) Introduction to the chemistry laboratory. Experiments are designed to demonstrate concepts covered in CHM 1311; including properties and reactions of inorganic substances, and elementary qualitative and quantitative analysis. (0-3) S

CHM 1112 **General Chemistry Laboratory II** (1 semester hour) A continuation of CHM 1111 demonstrating the concepts covered in CHM 1312, including acid-base chemistry, reaction kinetics, electrochemistry, polymers, and organic synthesis. Prerequisite: CHM 1111 or 1215. (0-3) S
CHM 1311 (CHEM 1311) General Chemistry I (3 semester hours) Introduction to elementary concepts of chemistry theory. The course emphasizes chemical reactions, the mole concept and its applications, and molecular structure and bonding. (3-0) S

CHM 1312 (CHEM 1312) General Chemistry II (3 semester hours) A continuation of CHM 1311 treating metals; solids, liquids, and intermolecular forces; chemical equilibrium; electrochemistry; organic chemistry; rates of reactions; and environmental, polymer, nuclear, and biochemistry. Prerequisite: CHM 1311 or 1315. (3-0) S

CS 1315 (COSC 1315) Computer Science I (3 semester hours) Computer programming in a high-level, block structured language. Algorithmic thinking and the history and utility of machines which automate it. Basic data types and variables, memory usage, control structures (sequential, selection, repetition), functions and parameter passing, recursion, console and file input/output. Prerequisite: Basic computer literacy/programming skills (see CS 1115 description) or concurrent enrollment in CS 1115. (3-0) S

CS 2305 (MATH 2305) Discrete Mathematics for Computing I (3 semester hours) Principles of counting. Boolean operations. Propositional calculus. Sets, relations, functions, strings, languages, partial orders, and lattices. Prerequisite: MATH 1326 or MATH 2419 or consent of the instructor. (3-0) S

CS 2315 (COSC 2315) Computer Science II (3 semester hours) Advanced programming techniques, including an introduction to object-oriented programming. Classes, inheritance, dynamic function binding, strings, stacks, queues, lists, and trees. Dynamic memory allocation/management. Prerequisite: CS 1315. (3-0) S

CS 2325 (COSC 2325) Computer Organization (3 semester hours) The composition of central processing units and its impact on low-level programming. The study of computers as symbolic processors; the nature and manipulation of the symbols. Assembly language programming. Prerequisite: CS 2315. (3-0) S

CS 3335 C and C++ (3 semester hours) Numerous programming projects in both C and C++. All fundamentals of C, with special emphasis on use of pointers. Use of C++ extensions to create and extend (by inheritance) abstract data types. The use/advantages of virtual functions (dynamic polymorphism). This course may not be taken for degree credit by students who have completed CS 2315 (C/C++) or CS 3333. Prerequisite: CS 2315 (in a language other than C/C++) or equivalent programming experience. (3-0) S

CS 3345 Algorithm Analysis and Data Structures (3 semester hours) Metrics for performance evaluation of algorithms. Formal treatment of basic data structures such as arrays, stacks, queues, lists, trees. Various sorting and searching techniques. Fundamental graph algorithms. Prerequisites: CS 2315 and CS 3305. (3-0) S

CS 4337 Organization of Programming Languages (3 semester hours) Language definition structure, data types and structures, control structures and data flow, run-time considerations. Interpretive languages; functional programming. Prerequisites: CS 2315 or CS 3333, and CS 2305. (3-0) S

CS 4340 Computer Architecture (3 semester hours) Boolean algebra and logic circuits; register transfer operations; design of a small computer; input, output, and interrupt organization; powerful addressing modes, instruction formats, and their hardware structures; microprogram control. Must be taken concurrently with CS 4140. Prerequisites: CS 2305 and CS 2325. (3-0) S

ECO 4330 Law and Economics (3 semester hours) Contracts, torts, and property rights, integrating economic theory concerning efficiency and equity with actual legal cases. Topics include medical malpractice, habitability laws, zoning, crime deterrence, environmental laws, and discrimination. This course is also recommended for students who are not economics majors. (3-0) T

EE 3201 Electrical Network Analysis Laboratory (2 semester hours) Laboratory to accompany EE 3301. Design, assembly and testing of linear electrical networks and systems. Use of computers to control electrical equipment and acquire data. Corequisite: EE 3301. (0-3) S

EE 3211 Electronic Circuits Laboratory (2 semester hours) Laboratory to accompany EE 3311. Design, assembly and testing of electronic circuits that use diodes, transistors and operational amplifiers in configurations typically encountered in practical applications. Prerequisite: EE 3201. Corequisite: EE 3311. (0-3) S

EE 3301 Electrical Network Analysis (3 semester hours) Analysis and design of RC, RL, and RLC electrical networks. Sinusoidal steady state analysis of passive networks using phasor representation; mesh and nodal analyses. Introduction to the concept of impulse response and frequency analysis using the Laplace transform. Prerequisites: EE 2305, MATH 2420. Corequisite: EE 3201. (3-0) S

EE 3311 Electronic Circuits (3 semester hours) Analysis and design of electronic circuits using diodes, transistors and
operational amplifiers with feedback. Gain and stability of basic amplifier circuits using BJT's, JFET's and MOSFET's; classes of amplifiers; performance of ideal and non-ideal operational amplifiers. Prerequisites: EE 3301, EE 3310. Corequisite: EE 3211. (3-0) S

EE 4220 Digital Circuits Laboratory (2 semester hours) Laboratory to accompany EE 4320. Design, assembly, and testing of logic circuits. Corequisite: EE 4320. (0-3) S

EE 4301 Electromagnetic Engineering I (3 semester hours) Introduction to the general characteristics of wave propagation. Physical interpretation of Maxwell’s equations. Propagation of plane electromagnetic waves and energy. Transmission lines. Antenna fundamentals. Prerequisites: PHYS 2326, EE 4300. (3-0) S

EE 4320 Digital Circuits (3 semester hours) Boolean logic. Design and analysis of combinational logic circuits using SSI and MSI. Design and analysis of synchronous state machines. Use of programmable logic devices and simple CAD tools. Prerequisite: CS 2325 or EE 2310. Corequisite: EE 4220. (3-0) S

GOVT 2305 (GOVT 2305) Constitutional Foundations and Political Behavior in the U.S. and Texas (3 semester hours) This course examines the evolution and current state of political behavior and public policy making in the U.S. and Texas. Topics discussed will include the constitutions, federalism, intergovernmental relations, voting, elections, political parties, public opinion, and interest groups. (Fulfills one-half of the legislative requirement of 6 hours of American government.) (3-0) S

GOVT 2306 (GOVT 2306) Political Institutions in the U.S. and Texas (3 semester hours) This course explores the primary institutions of U.S. and Texas government. It examines the bureaucracy as well as the executive, legislative, and judicial branches of government at the state and federal level. (Fulfills one-half of the legislative requirement of 6 hours of American government.) (3-0) S

HST 1301 Themes and Ideas in American History (3 semester hours) An introduction to the methods of historical inquiry through the study of selected main themes in American history. A course designed to offer students an understanding of the historical and cultural context of America in the contemporary world. Fulfills one-half of the Texas legislative requirement for six hours in American history. (3-0) S

HST 2301 Issues in American History (3 semester hours) Readings, commentary, and discussion aimed at varying aspects of history and culture. Fulfills one-half of the Texas legislative requirement for six hours in American history. (3-0) Y

MATH 2417 (MATH 2417) Calculus I (4 semester hours) Functions, limits, continuity, differentiation; integration of function of one variable; logarithmic, exponential, and inverse trigonometric functions; techniques of integration, and applications. Three lecture hours and two discussion hours a week. Prerequisite: MATH 2312 or equivalent. (4-0) S

MATH 2418 Linear Algebra (4 semester hours) Systems of linear equations, determinants, vectors and vector spaces, linear transformations, eigenvalues and eigenvectors, quadratic forms. Three lecture hours and two discussion hours per week. Credit given for only one of MATH 2333 or 2418. Prerequisite: MATH 2419 or consent of instructor. (4-0) S

MATH 2419 Calculus II (MATH 2419) (4 semester hours) Continuation of MATH 2417. Improper integrals, sequences, infinite series, power series, parametric equations and polar coordinates, vectors, vector-valued functions, functions of several variables, partial derivatives and applications, multiple integration. Three lecture hours and two discussion hours a week. Prerequisite: MATH 2417. (4-0) S

MATH 2420 (MATH 2420) Differential Equations with Applications (4 semester hours) Topics covered will be drawn from the following list: First order differential equations, ordinary differential equations, system of linear differential equations, stability, series solutions, special functions, Sturm-Liouville problem, Laplace transforms and linear differential equations, numerical solutions and applications in physical sciences and engineering using computers. Three lecture hours and two discussion hours per week. Prerequisite: MATH 2419. (4-0) S

MATH 2421 Multivariable Calculus with Applications (4 semester hours) Vectors, matrices, vector functions, partial derivatives, divergence, curl, Laplacian, multiple integrals, line and surface integrals, Green's, Stoke's, and Gauss's theorems, and applications in physical sciences and engineering. Three lecture hours and two discussion hours per week. Prerequisite: MATH 2419. (4-0) S

MATH 3310 Theoretical Concepts of Calculus (3 semester hours) Mathematical theory of calculus. Limits, types of convergence, power series, differentiation, and Riemann integration. Prerequisite: MATH 2419. (3-0) Y

MATH 3311 Abstract Algebra I (3 semester hours) Groups, rings, fields, vector spaces modules, linear transformations, and Galois theory. Prerequisite: MATH 2419. (3-0) Y
problems and trajectories; rotating coordinate systems; Lagrangian formulation; rotational dynamics and the inertia tensor; gravitation. Prerequisite: PHYS 3311 or equivalent. (3-0) Y

**RHET 1302 (ENGL 1302) Rhetoric** (3 semester hours) The course presents an integrated approach to writing, reading, and critical thinking by developing the grammatical, logical, and rhetorical skills necessary for university writing. All classes work in a computerized learning environment. Students are taught basic computer literacy and submit all work electronically and on paper. (3-0) S

**STAT 3355 Data Analysis for Statisticians and Actuaries** (3 semester hours) Methods of data analysis used in different areas of Statistics and Actuarial Science. Sampling, fitting and testing models, regression, and comparison of populations. A statistical computer package will be used. Prerequisite: MATH 2419. (3-0) T

**STAT 4351 Probability** (3 semester hours) Probability models, random variables, expectation, special distributions, and the central limit theorem. The theory is illustrated by numerous examples. Prerequisite: MATH 2421. (3-0) T

**STAT 4352 Mathematical Statistics** (3 semester hours) Theory and methods of statistical inference. Sampling, estimation, hypothesis testing, analysis of variance, and regression with examples from the physical, social, and management sciences. Prerequisite: STAT 4351 or equivalent. (3-0) T

**STAT 4372 Actuarial Science** (3 semester hours) Probability models and statistical methods used in insurance business. Typical loss distributions including Pareto, Weibull, lognormal, loggamma, discrete and continuous mixtures. Effect of coverage modifications, and clustering in modeling. Estimation by simulation. Prerequisite: STAT 4351. (3-0) T

**STAT 4382 Stochastic Processes** (3 semester hours) Stochastic models including Markov chains, random walks, Poisson processes, renewal processes, and an introduction to time series and forecasting. Prerequisite: STAT 4351 or equivalent. (3-0) T