Mathematics

Tingxiu Wang (Department Head)
Location: Binnion Hall, 903-886-5157
Mathematics Web Site (http://www.tamuc.edu/academics/colleges/scienceEngineeringAgriculture/departments/mathematics/default.aspx)

The graduate program in mathematics provides thorough training to the student in one or more areas of mathematics to stimulate independent thinking, and to provide an apprenticeship for the development of creative research. The program prepares the student for employment in a high school, junior college, or four-year college, for continued study of mathematics at the doctoral level, or in one of the many nonacademic areas in which mathematicians work. For example, our graduates are employed as actuaries, software engineers, college faculty members, school administrators, and by companies such as L3, Texas Instruments, and General Dynamics.

Graduate students in mathematics have access to powerful software packages, and many courses include computer applications.

Programs of Graduate Work

Master of Science in Mathematics

Graduate work leading to a Master of Science degree is offered in pure and applied mathematics including analysis, biological mathematics, coding theory, combinatorics, complex analysis, differential equations, differential geometry, image analysis, and processing with learning, mathematics history and statistics (actuarial science). Students can choose a Thesis Option of 30 hours or a Non-Thesis Option of 36 hours. A Master of Science degree with a mathematics education (https://coursecatalog.tamuc.edu/grad/colleges-and-departments/science-engineering/mathematics/mathematics-ms/) concentration with 36 hours is offered. Emphases for secondary and middle school teachers are specially planned to meet their individual and particular objectives. For current undergraduate students, they can join the accelerated BS/MS program by taking graduate courses in their senior year.

Students may also select courses leading to a minor (https://coursecatalog.tamuc.edu/grad/colleges-and-departments/science-engineering/mathematics/applied-mathematics-minor/) in applied mathematics.

Admission

Admission to a graduate program is granted by the Dean of the Graduate School upon the recommendation of the department. Applicants must meet the following requirements for admission in addition to meeting the general university requirements in Mathematics.

Students entering the MS program for a career in higher education, professional work, or further advanced study in mathematics must meet the background requirements which include the calculus sequence, discrete mathematics, and at least two upper-level undergraduate mathematics courses from the areas of algebra, analysis, topology, statistics, and probability.

Secondary mathematics teachers and other students entering the master's degree program with goals other than work as a professional mathematician or advanced study in mathematics should have Calculus I, II, and at least two upper-level undergraduate mathematics courses from the areas of algebra, analysis, topology, statistics, and probability.

- Admission Requirements (https://www.tamuc.edu/programs/mathematics-ms/#Admission)

Successful completion of the Comprehensive Exam is required of all students.

Note: Individual departments may reserve the right to dismiss from their programs students who, in their judgment, would not meet the professional expectations of the field for which they are training.

Mathematics MS (https://coursecatalog.tamuc.edu/grad/colleges-and-departments/science-engineering/mathematics/mathematics-ms/)

Applied Mathematics Minor (https://coursecatalog.tamuc.edu/grad/colleges-and-departments/science-engineering/mathematics/applied-mathematics-minor/)

MATH 500 - Discrete Mathematics
Hours: 3
Study of formal logic; sets; functions and relations; principle of mathematical induction; recurrence relations; and introductions to elementary number theory and graph theory; counting (basic combinatorics); asymptotic complexity of algorithms; and NPcompleteness. This course is useful to those taking graduate classes in computer science. It also helpful to secondary teachers by giving them a better understanding of the terms and ideas used in modern mathematics. This is an elective course, eligible for the non-thesis option of the MS degree in math only. The maximum credit hours can be earned towards the MS degree in math among MATH 500, 550, 560 is six. Prerequisites: A grade of C or better on MATH 2414.

MATH 501 - Mathematical Statistics I
Hours: 3
A graduate level course in Probability Theory intended to provide the theoretical background for a course in statistical inference. Topics covered include: probability, random variables, distributions, moments, convergence of random variables, probability inequalities, random samples. Prerequisites: MATH 2415 with a minimum grade of C.

MATH 502 - Mathematical Statistics II
Hours: 3
A graduate level course in statistical inference. Topics covered include: point estimation, interval estimation, hypothesis testing, Bayesian inference. Prerequisites: MATH 501 with a minimum grade of C.

MATH 503 - Actuarial Mathematics
Hours: 3
A course in business/financial mathematics designed as an introduction to actuarial science and as preparation for the Exam P/1 and Exam FM actuarial exams. Encounters appropriate topics from analysis, linear algebra, probability and statistics, and financial mathematics. Prerequisites: MATH 402 with a minimum grade of C or MATH 403 with a minimum grade of C.

MATH 511 - Real Analysis I
Hours: 3
Properties of real numbers, continuity, differentiation, integration, sequences and series of functions, differentiation and integration of functions of several variables. Prerequisites: MATH 2415, or Math 314, or Consent of Instructor.

MATH 511A - Real Analysis I
Hours: 3
(Same as MATH 511) Properties of real numbers, continuity, differentiation, integration, sequences and series of functions, differentiation and integration of functions of several variables. Prerequisites: MATH 2415, or Math 314, or Consent of Instructor. Crosslisted with: MATH 511.

MATH 512 - Real Analysis II
Hours: 3
Properties of real numbers, continuity, differentiation, integration, sequences and series of functions, differentiation and integration of functions of several variables. Prerequisites: MATH 511.

MATH 515 - Dynamical Systems
Hours: 3
Topics can be chosen from discrete or/and continuous dynamical systems such as linear systems and linear algebra, local theory for nonlinear systems, local existence-uniqueness theorem, the Hartman-Grobman theorem, Liapunov functions, the stable manifold theorem, limit sets of trajectories, the Poincare-Bendixson theorem, bifurcation theory, center manifold and normal form, chaotic dynamics, iteration of functions, graphical analysis, the linear, quadratic and logistic families, fixed points, symbolic dynamics, topological conjugacy, complex iteration, Julia and Mandelbrot sets. Prerequisites: MATH 2414 and MATH 2318.

MATH 517 - Calculus of Finite Differences
Hours: 3
Finite differences, integration, summation of series, Bernoulli and Euler Polynomials, interpolation, numerical integration, Beta and Gamma functions, difference equations. Prerequisites: MATH 2415 or Math 314 with a minimum grade of C.

MATH 518 - Thesis
Hours: 3-6
This course is required of all graduate students who have an Option I degree plan. Graded on a (S) satisfactory or (U) unsatisfactory basis. Prerequisite: Consent of the instructor.

MATH 522 - General Topology I
Hours: 3
Ordinals and cardinals, topology of the real line, metric spaces, topological spaces, sequences, continuity and homeomorphisms on topological spaces. Prerequisites: MATH 2414 with a minimum grade of C. Crosslisted with: MATH 440.

MATH 523 - General Topology II
Hours: 3
The course is a continuation of MATH 522. Compact spaces, connectedness and path connectedness, separation axioms, topological manifolds, further topics on metric spaces, product spaces. Prerequisites: MATH 522 with a minimum grade "C" or consent of the instructor.

MATH 529 - Workshop in School Mathematics
Hours: 3
This course may be taken twice for credit. A variety of topics, taken from various areas of mathematics, of particular interest to elementary and secondary school teachers will be covered. Consult with instructor for topics.

MATH 531 - Theory of Matrices
Hours: 3
Covers real and complex vector spaces, subspaces, linear operators, eigenvalues and eigenvectors, inner product spaces, orthogonality, operators on inner product spaces, singular value, LU and range-null-space decompositions, pseudo-inverse, canonical forms. Prerequisites: MATH 2305 and 2414 with minimum grades of C or MATH 2318 with a minimum grade of C. Crosslisted with: MATH 333.

MATH 532 - Fourier Analysis and Wavelets
Hours: 3
Inner Product Spaces; Fourier Series; Fourier Transform; Discrete Fourier Analysis; Haar Wavelet Analysis; Multiresolution Analysis; The Daubechies Wavelets; Applications to Signal Processing; Advanced Topics. Prerequisites: MATH 2414 with a minimum grade of C.

MATH 533 - Linear and Nonlinear Optimization
Hours: 3
Graphical optimization, linear programming, simplex method, interior point methods, nonlinear programming, optimality conditions, constrained and unconstrained problems, combinatorial and numerical optimization, applications. Prerequisites: MATH 333 with a minimum grade of C.

MATH 536 - Cryptography
Hours: 3
The course begins with some classical cryptanalysis (Vigenere ciphers, etc). The remainder of the course deals primarily with number-theoretic and/or algebraic public and private key cryptosystems and authentication, including RSA, DES, AES and other block ciphers. Some cryptographic protocols are described as well. Prerequisites: MATH 437, or MATH 537, or consent of the instructor.

MATH 537 - Theory of Numbers
Hours: 3
Factorization and divisibility, diophantive equations, congruences, quadratic reciprocity, arithmetic functions, asymptotic density, Riemann's zeta function, prime number theory, Fermat's Last Theorem. Prerequisites: MATH 437 or Consent of instructor.

MATH 538 - Functions of Complex Variables I
Hours: 3
Geometry of complex numbers, mapping, analytic functions, Cauchy-Riemann conditions, complex integration. Taylor and Laurent series, residues. Prerequisites: MATH 436, or MATH 438, Consent of Instructor.

MATH 538A - Functions of Complex Variables I
Hours: 3
(Same as 538) This course covers the elements of one-dimensional complex analysis. The complex numbers (their algebra, geometry, and topology); Analytic functions of a complex variable (definition, examples, properties); complex functions (complex exponential and trigonometric functions, complex logarithm and power functions), Mobius transformations, stereographic projection; Integration in the complex plane, particularly Cauchy's integral formula and its consequences; infinite series of complex numbers and complex variables, including Taylor series and Laurent series; the residue theorem and the computation of real integrals by complex methods; and conformal mapping. Prerequisites: MATH 2415 Calculus III (Min Grade C) or MATH 314 (Min Grade C). Crosslisted with: MATH 438, MATH 538.

MATH 539 - Functions of Complex Variables II
Hours: 3
Geometry of complex numbers, mapping, analytic functions, Cauchy-Riemann conditions, complex integration. Taylor and Laurent series, residues. Prerequisites: MATH 538.

MATH 543 - Abstract Algebra I
Hours: 3
Groups, isomorphism theorems, permutation groups, Sylow Theorems, rings, ideals, fields, Galois Theory. Prerequisites: MATH 334 or MATH 550, or Consent of Instructor.

MATH 544 - Abstract Algebra II
Hours: 3
Groups, isomorphism theorems, permutation groups, Sylow Theorems, rings, ideals, fields, Galois Theory. Prerequisites: MATH 543.

MATH 546 - Numerical Analysis and Elements of Machine Learning
Hours: 3
The course will include numerical methods for derivatives approximation; will teach data approximation and interpolation by Fourier series; Euler's and Runge-Kutta's methods for solving ordinary differential equations (ODE) and systems of ODE. Also, the students will study methods to approximate solutions of partial differential equations (PDE) and will learn the basics of optimization (minimization of functions) for machine learning (ML). The students will develop the important skills of knowledge and methods generalization for their computer implementation and will program the basic methods in MatLab. Some programming skills would be of help. Prerequisites: MATH 2414. Crosslisted with: CSCI 546.

MATH 550 - Foundations of Abstract Algebra
Hours: 3
This course will cover the fundamental properties of algebraic structures such as properties of the real numbers, mapping, groups, rings, and fields. The emphasis will be on how these concepts can be related to the teaching of high school algebra. Note: This course will be helpful to secondary teachers by giving them a better understanding of the terms and ideas used in modern mathematics. This is an elective course, eligible for the non-thesis option only. The maximum credit hours can be earned towards the MS degree in math among MATH 500, 550, 560 is six. Pre-requisites: MATH 2305 with a minimum grade of C or MATH 500 with a minimum grade of C. Crosslisted with: MATH 334.

MATH 560 - Euclidean and NonEuclidean Geometry
Hours: 3
The National Council of Teachers of Mathematics (NCTM) in its Principles and Standards states the geometric skills that students should be able to use when they finish high school. This course trains students, particularly, middle and high-school teachers for understanding and mastering these geometric skills. This is an elective course, eligible for the non-thesis option of the MS degree in math only. The maximum credit hours can be earned towards the MS degree in math among MATH 500, 550, 560 is six. Prerequisites: MATH 2305 or MATH 500 with a minimum grade of C.

MATH 561 - Regression Analysis
Hours: 3
A computer oriented statistical methods course which involves concepts and techniques appropriate to design experimental research and the application of the following methods and techniques: methods of estimating parameters and testing hypotheses about them; analysis of variance, multiple regression methods, orthogonal comparisons, experimental designs with applications. Prerequisites: Math 401 or 502, or 402 and 403.

MATH 563 - Image Processing with Elements of Learning
Hours: 3
This class will provide the students with an introduction to image processing, with applications to science, medicine, and industry. Students will learn methods for 2D image enhancement, sharpening, blurring, noise detection, modeling, and cleaning, as well as edge detection in gray-level images. The students will learn and will be able to implement methods like local statistics, convolution, Laplacian and Gradient operators, Fourier transforms, and the Fast Fourier Transform. Further, the teacher will introduce basic elements of neural networks (NN) and machine learning(ML). At the end of the class, the students will know which gray-level image methods apply to color images. The students will develop skills in independent study, program, experiment, report, and present advanced methods from the field. Some programming skills would be of help. Prerequisites: MATH 2414. Crosslisted with: CSCI 567.

MATH 569 - Image Analysis and Recognition with Learning
Hours: 3
This class will start with a study of the basic color image models. Next, the students will learn about scaling functions and calculus with them. Further will study the basics of wavelets and how to decompose a function to wavelets. Next, the students will learn about convolution-correlation, convolutional neural networks (CNN), and the fundamentals of machine learning (ML) and deep ML(DML). In the following stage, the students will learn basic image segmentation methods based on active contours (In case of time permission deep active contours). Further, they will learn about image and object representation and description, mainly boundary and region description. The following methods will be taught from the field of Recognition: Decision making; feature extraction. The students will develop skills in independent study, program, experiment, report, and present advanced methods from the field. Some programming skills would be of help. Prerequisites: MATH 2414. Crosslisted with: CSCI 569.

MATH 572 - Modern Applications of Mathematics
Hours: 3
This course, specifically designed for teachers, covers a range of applications of mathematics. Topics may include classical encryption, data compression ideas, coding theory, private and public key cryptography, data compression including wavelets, difference equations, GPS systems, computer tomography, polynomial interpolation/Belier curves, construction and use of mathematical models, probability theory, Markov chains, network analysis, linear programming, differentiation and integration, linear algebra, complex variables, Fourier-series, Fourier and Laplace transforms and their applications, differential equations, integral equations, calculus of variations, and topics from student presentations. Prerequisites: MATH 2414 or MATH 192 with a minimum grade of C.

MATH 580 - Topics in the History of Mathematics
Hours: 3
A chronological presentation of historical mathematics. The course presents historically important problems and procedures. Prerequisites: MATH 2305 or MATH 500 with a minimum grade of C.

MATH 589 - Independent Study
Hours: 1-4
Individualized instruction/research at an advanced level in a specialized content area under the direction of a faculty member. Note: May be repeated when the topic varies. Prerequisites: Consent of department head.

MATH 595 - Research Literature & Techniques
Hours: 3
This course provides a review of the research literature pertinent to the field of mathematics. The student is required to demonstrate competence in research techniques through literature investigation and formal reporting of a problem. Graded on a (S) satisfactory or (U) unsatisfactory basis. Prerequisites: Consent of instructor.

MATH 597 - Special Topics
Hours: 3
Organized class. May be repeated when topics vary. Prerequisites: Consent of instructor.

MTE 551 - Fundamental Mathematics for Teachers
Hours: 3
This course is designed to prepare the teachers to create learning environments conducive to meeting the national and state standards regarding teaching and learning problem solving through number and operations, algebraic reasoning, geometry, and other techniques.

MTE 552 - Mathematical Modeling for Teachers
Hours: 3
The National Council of Teachers of Mathematics (NCTM) explains in its Principles and Standards (2000) that all mathematical learning should be grounded in problem solving and mathematical reasoning. This course is designed to prepare the teachers to create learning environments conducive to meeting the national and state standards regarding problem solving, mathematical modeling, and the judicious use of technology.

MTE 553 - Geometric Structures for Teachers
Hours: 3
The National Council of Teachers of Mathematics (NCTM) explains in its Principles and Standards (2000) that “geometry and spatial sense are fundamental components of mathematics learning.” This course is designed to prepare the teachers to create learning environments conducive to meeting the national and state standards regarding geometry. Topics include characteristics of 2 and 3 dimensional shapes, mathematical proofs, spatial relationships, transformations and symmetry.

MTE 554 - Algebraic Structures for Teachers
Hours: 3
The National Council of Teachers of Mathematics (NCTM) explains in its Principles and Standards (2000) that algebraic reasoning is a important part of mathematical study. This course is designed to prepare the teachers to create learning environments conducive to meeting the national and state standards regarding algebraic reasoning. Topics include understanding patterns, relations, functions; representing and analyzing mathematical situations and structures using algebraic symbols; using mathematical models to represent and understand quantitative relationships; and analyzing change in various contexts.

MTE 555 - Research Techniques for STEM and Education
Hours: 3
This course, Research Techniques for STEM and Education, will focus on Math and Education research topics that are necessary for the person who is pursuing a graduate degree and/or who wishes to work in higher education. Students will explore concepts that are integral to the research process at this level in higher education. Particular areas of study include: Institutional Review Boards (IRBs); topics of Research Conduct (Responsibility and Ethics that are related to research); grant writing for STEM areas; preparation for a MATH 595, thesis, or even a dissertation; writing research articles; and other research areas. This course is a Special Topics course and will offer students a unique opportunity to experience some areas of research, such as IRB proceedings. Prerequisites: Graduate student status.

MTE 556 - Stat Reasoning for Teachers
Hours: 3
National Council of Teachers of Mathematics (NCTM) explains in its Principles and Standards (2000) that statistical reasoning is essential to being an informed citizen, employee, and consumer; thus it is essential for all students. This course is designed to prepare the teachers to create learning environments conducive to meeting the national and state standards regarding statistical reasoning. Topics include formulating questions that can be addressed with data; collecting, organizing, and displaying relevant data to answer questions; selecting and using appropriate statistical methods to analyze data; developing and evaluating inferences and predictions based on data; understanding and applying basic concepts of probability. Topics on statistics and assessment may also be covered.

MTE 557 - Problem Based Learning in Mathematics and Science
Hours: 3
This course is specifically designed for teachers 7-12. The National Council of Teachers of Mathematics (NCTM) explains in its Principles and Standards (2000) that all mathematical learning should be grounded in problem solving and mathematical reasoning. This course focuses on project-based and problem-based learning (PBL); conducting PBL and its applications in the classroom.

MTE 589 - Independent Study
Hours: 1-6
Independent Study - Hours: One to Six Individualized instruction/research at an advanced level in a specialized content area under the direction of a faculty member. Prerequisites Consent of department head. Note May be repeated when the topic varies.

MTE 597 - Special Topics
Hours: 1-4
Hours: One to four - Organized class Note May be graded on a satisfactory (S) or unsatisfactory (U) basis. May be repeated when topics vary