M.S. – Mathematics

The Master of Science in Mathematics has two tracks, Pure Mathematics and Industrial Mathematics. In each case, the student has the thesis and non-thesis option.

Mathematicians with a strong background in Pure Mathematics are surprisingly attractive to many professional branches in our society, particularly Intelligence Technology, Finance, Security, Engineering, and Physics. Industrial Mathematics is a growing branch in Mathematics which provides trained personnel for key positions in modern industries.

Admission Requirements

Evidence of academic achievement and potential for advanced study and research is required for graduate admission. Specific criteria for Unconditional Admission for Master's degree seeking students in Math are:

- Undergraduate GPA of 3.0
- GRE Verbal score of 400
- GRE Quantitative score of 600
- Two letters of recommendation from college or university professors indicating the applicant's potential in Mathematics
- A letter from the applicant indicating reasons for wanting to pursue graduate studies in Mathematics including professional and personal goals; in this letter, the applicant should indicate his/her field of interest in Mathematics as well as his/her preference for an advisor
- Undergraduate transcript including completion of a set of Mathematics courses determined by the departmental graduate committee (an applicant lacking some of these courses may be accepted to the program but will be required to complete them during the first academic year in order to continue in the program. An undergraduate course may be taken concurrently with graduate course work.)

Applicants with an undergraduate GPA of at least 2.5 and/or GRE scores lower than those specified are also encouraged to apply.

Notification of decisions on graduate admission is made by the office of Graduate Studies based on the admission criteria and recommendation of the academic department. Information related to application procedures and deadlines is available through the Office of Graduate Studies.

Degree Requirements

The M.S. program requires 36 semester credit hours (SCH). Graduate students may be required to take undergraduate courses in Mathematics to make up for deficiencies in preparation as determined by their temporary Admission and/or Advising Committee. These courses will not be applied to the degree program.

M.S. in Pure Mathematics: 36 SCH

Required Courses: 18 SCH

MATH 5321 Higher Algebra	3 SCH
MATH 5323 Group Theory	3 SCH
MATH 5331 Higher Geometry	3 SCH
MATH 5339 Topology	3 SCH
MATH 5341 Higher Analysis	3 SCH
MATH 5367 Numerical Analysis	3 SCH

Also, the student is required to take three courses out of the following collection: 9 SCH

MATH 5304 Foundations of Mathematics	3 SCH
MATH 5327 Lie Algebras	3 SCH
MATH 5329 Number Theory	3 SCH
MATH 5342 Measure and Integral Theory	3 SCH
MATH 5346 Functional Analysis	3 SCH
MATH 5348 Differential Equations	3 SCH
MATH 5362 Graph Theory	3 SCH
MATH 5375 Measure and Probability	3 SCH
MATH 5391 Special Topics in Mathematics (Pure)	3 SCH

Thesis Option:

MATH 5397 Thesis	6 SCH

Non-Thesis Option:

MATH 5395 Research Seminar	6 SCH

The two seminars must be in two different areas in Mathematics. In addition, the student must take a free elective course. 3SCH

M.S. in Industrial Mathematics: 36 SCH

Required Courses: 18 SCH

MATH 5321 Higher Algebra	3 SCH
MATH 5323 Group Theory	3 SCH
MATH 5331 Higher Geometry	3 SCH
MATH 5341 Higher Analysis	3 SCH
MATH 5367 Numerical Analysis	3 SCH
MATH 5379 Stochastic Analysis	3 SCH

Advisors

Dr. Jerzy Mogilski • SETB 1.510 • 882-6628 • jerzy.mogilsky@utb.edu
Dr. Jorge Navarro • SETB 2.326 • 882-6629 • jorge.navarro@utb.edu
Dr. Taeil Yi • M 1.128 • 882-6621 • taeil.yi@utb.edu
Dr. Paul-Hermann Zieschang • M 1.124 • 882-6620 • paul-hermann.zieschang@utb.edu

Also, the student is required to take three courses out of the following collection: 9 SCH

MATH 5309 Integrating Technology into Mathematics	3 SCH
MATH 5337 Dynamical Systems	3 SCH
MATH 5348 Differential Equations	3 SCH
MATH 5361 Mathematical Modeling	3 SCH
MATH 5362 Graph Theory	3 SCH
MATH 5363 Operations Research	3 SCH
MATH 5365 Discrete Mathematics	3 SCH
MATH 5368 Codes, Cyphers, and Security in Communications	3 SCH
MATH 5381 Mathematical Statistics	3 SCH
MATH 5385. Time Series and Engineering Systems	3 SCH
MATH 5391 Special Topics in Pure Mathematics (Industrial)	3 SCH

Thesis-Option:

MATH 5397 Thesis	6 SCH

Non-Thesis Option:

MATH 5395 Research Seminar	6 SCH

The two seminars must be in two different areas in Mathematics In addition, the student must take a free elective course. 3 SCH

Special Requirements

Satisfactory completion of a comprehensive examination is required. The examination will be scheduled during the last semester of course work upon recommendation of the Graduate Advisor. The form of the examination will be specified in the student's program of study and may include one of the following:

-An examination prepared by the Departmental Graduate Committee and scheduled by the Graduate Office. The examination will be evaluated by two Graduate Faculty members and the student's advisor.
-Thesis defense and evaluation by the student's Advising Committee.

M.S. in Mathematics with Emphasis in Distance Learning

This M.S. program requires 36 semester credit hours (SCH) including 24 sch in Mathematics and 12 sch in Educational Technology. Students also need to take and pass the comprehensive exam.

Required Mathematic Courses

MATH 5321 Higher Algebra	3 SCH
MATH 5323 Group Theory	3 SCH
MATH 5331 Higher Geometry	3 SCH
MATH 5339 Topology	3 SCH
MATH 5341 Higher Analysis	3 SCH
MATH 5381 Mathematical Statistics	3 SCH

Mathematics Elective Course
Once course selected from the Graduate Mathematics Inventory

Mathematics Technology Course

MATH 5309 Integrating Technology into Mathematics	3 SCH

Required Educational Technology Courses

EDTC 6355 Designing Instruction for the Online Course	3 SCH
EDTC 6356 Media Enhacement for the Online Course	3 SCH
EDTC 6357 Using Open Source Courseware for Online Course Development	3 SCH
EDTC 6332 Practicum	3 SCH

M.S. in Mathematics with Emphasis in Teaching Mathematics

This M.S. program requires 36 semester credit hours (SCH) including 24 sch in Mathematics and 12 sch in Education/ Mathematics Education.

Required Mathematic Courses

MATH 5321 Higher Algebra	3 SCH
MATH 5323 Group Theory	3 SCH
MATH 5331 Higher Geometry	3 SCH
MATH 5339 Topology	3 SCH
MATH 5341 Higher Analysis	3 SCH
MATH 5381 Mathematical Statistics	3 SCH

Mathematics Elective Course
Two courses selected from the Graduate Mathematics Inventory. It may also include graduate level Mathematics courses designed for teachers (6 sch)

Required Education/Mathematics Education Courses
Four courses in Education/Mathematics Education from the list below, approved by the student's graduate advisor in consultation with the school of Education
.

EDCI 6341 Teaching Algebraic Concepts	3 SCH
EDCI 6343 Teaching Geometric Concepts	3 SCH
EDCI 6349 Current Issues and Research in Mathematics Education	3 SCH
EDCI 6302 Field-research Methodology	3 SCH

Transfer Students

Graduate students transferring from another university may be admitted to the program. A maximum of nine graduate credit hours from an accredited university with grades B or better may be applied to the total semester credit hours required for the degree, if approved by the Departmental Graduate Committee.

Careers:

- Intelligence
- Technology
- Finance
- Security
- Engineering
- Physics
- Community College Instructors, K-12 Math Teachers

Graduate Courses in Mathematics

Code	Title	Pure, Thesis	Pure, Nonthesis	Industrial, Thesis	Industrial, Nonthesis
MATH 5321	Higher Algebra	R	R	R	R
MATH 5323	Group Theory	R	R	R	R
MATH 5331	Higher Geometry	R	R	R	R
MATH 5339	Topology	R	R		
MATH 5341	Higher Analysis	R	R	R	R
MATH 5367	Numerical Analysis	R	R	R	R
MATH 5379	Stochastic Analysis			R	R
MATH 5304	Foundations of Mathematics	P	P		
MATH 5309	Integrating Technology into Math			P	P
MATH 5327	Lie Algebras	P	P		
MATH 5329	Number Theory	P	P		
MATH 5337	Dynamical Systems			P	P
MATH 5342	Measure and Integration	P	P		
MATH 5346	Functional Analysis	P	P		
MATH 5348	Differential Equations	P	P	P	P
MATH 5361	Mathematical Modeling			P	P
MATH 5362	Graph Theory	P	P	P	P
MATH 5363	Operations Research			P	P
MATH 5365	Discrete Mathematics			P	P
MATH 5368	Security in Communications			P	P
MATH 5375	Measure and Probability	P	P		
MATH 5381	Mathematical Statistics			P	P
MATH 5385	Time Series and Engineering Systems			P	P
MATH 5391	Special Topics in Mathematics (Pure)	P	P		
MATH 5391	Special Topics in Mathematics (Ind)			P	P
MATH 5395	Research Seminar		2		2
MATH 5397	Thesis	2		2	

R = required course, P = prescribed elective, 2 = counts twice

MATH 5304 Foundations of Mathematics
This course presents elements of mathematical logic, set theory, number theory and selected topics from Discrete Mathematics such as Combinatorial Analysis and Graph Theory. Mathematics proofs are emphasized. Prerequisite: 6 SCH of MATH 4000-courses.

MATH 5309 Integrating Technology Into Mathematics
This is an introductory course related to the latest technological computer programs, especially in Mathematics. The students become familiar with a representative sample of the technology currently available for industry, and will be able to publish mathematical articles both on-line and off-line. They will also be enabled to decide how to use technology in industry. Prerequisite: 6 SCH of MATH 4000-courses

MATH 5363 Operations Research
This course emphasizes fundamental concepts and principles as well as algorithms in Operations Research. The topics are Linear Programming (simplex and its variations), integral programming (cutting plane method, 0-1 style and assignment problems), non-linear programming (gradient, conjugate gradient, penalty functions, patterns), dynamic programming, networks, queuing theory, inventory theory, decision theory, game theory. In this course, students will be required to participate in projects. Prerequisite: 6 SCH of MATH 4000-courses.

MATH 5365 Discrete Mathematics
This course is on the borderline between Mathematics and Computer Science. It contains basic graph theory (flows, minmax, Ford-Fulkerson), generating functions, (convolutions, Dirichlet's generating function, Riemann's zeta function), design theory, basic facts on coding theory (minimal distance, Reed-Solomon Codes), combinatorial optimization, elements of asymptotics (O-notation, O-manipulation), and complexity of algorithms. Prerequisite: 6 SCH of MATH 4000-courses.

MATH 5367 Numerical Analysis
This course deals with solutions of equations, interpolation and approximation, numerical differentiation and integration, numerical aspects of linear algebra, and with solutions of ordinary differential equations. Prerequisite: MATH 5341 or consent of instructor.

MATH 5368 Codes, Cyphers, and Security in Communications
This course addresses two related problems in communications theory. The first deals with errors that occur in the transmission of information; how they can be detected and corrected. The second is concerned with the security of transmitted information. Prerequisite: 6 SCH of MATH 4000-courses.

MATH 5375 Measure and Probability
This course is an introduction to measure-theoretic probability theory. Topics covered include sets and events, monotone sequences, algebras, sigma-algebras, probability spaces, Borel sets and Lebesgue measure; measurable functions and random variables, independence, Borel-Cantelli lemma, Kolmogorov's zero-one law; Lebesgue integral and expectation; different types of convergence, laws of large numbers, characteristic functions and the central limit theorem. Prerequisite: MATH 5341.

MATH 5379 Stochastic Analysis
The main objective of this course is to study discrete stochastic processes and their applications. The principal topics discussed include Markov process and Markov chains; transient and persistent states, irreducible, aperiodic chains, stationary distributions, convergence theorems, random walks on a lattice, stopping times, Ehrenfest chain, birth and death chains, Bernoulli-Laplace model of diffusion. Martingales, super and submartingales, reversed martingales, connection between martingales and Markov process, gambling systems, fundamental theorems of mathematical finance, trading strategies, viable markets, and market models. Prerequisite: MATH 4374 or consent of instructor.

MATH 5381 Mathematical Statistics
This is a course in inferential statistics. Topics include random sampling, distribution of means and the central limit theorem, estimation problems, tests of hypotheses, linear regression, correlation, analysis of variance. Prerequisite: MATH 4374 or consent of instructor.

MATH 5385 Time Series and Engineering Systems
The contents of this course include the treatment of normal sequences and white noise, stationary time series, characteristic analysis of time series, the analysis of stationary time series in the time domain, linear modeling of dynamic data, linear prediction of time series, multivariate dynamic data models. Prerequisite: 6 SCH of MATH 4000-courses.

MATH 5391 Special Topics in Mathematics
The topic of this course may come from different areas of Pure and Industrial Mathematics not available in other courses. For instance, the course could be an introduction to the foundations of system engineering. This would enable the student to treat complex systems from the point of view of entire, multiple aspects, and evolution. Topics would include open and closed systems (ordered and unordered), bifurcation and catastrophe, attractors and chaos, self-organization of systems, stochastic systems. Other topics of this course could be linear optimization or non-linear optimization. The course may be repeated for credit. Prerequisite: 6 SCH of MATH 4000-courses.

MATH 5395 Research Seminar
This course is an introduction to the methods of mathematical research. The participants will study (under the guidance of an instructor) a chapter of a textbook or an original research paper, and they will have to present the contents to their classmates and to faculty.

MATH 5397 Thesis
Supervised research. This will include the treatment of an original research problem with a written thesis, if needed with a collection and the analysis of original data, and written in a scientific style in an acceptable publication format. Prerequisite: Consent of advisor.MATH 5321 Higher Algebra
The purpose of this course is to provide the necessary algebraic background for all branches of modern Mathematics that use algebraic language and methods (in particular Number Theory and Algebraic Geometry). Topics include basic ring theory (primes and irreducible ring elements, prime ideals and maximal ideals, integral ring extensions, Noetherian and Dedekind rings, polynomial rings over Noetherian rings (Hilbert's Basissatz)), field extensions, and basic Galois theory with the usual applications to classical problems in geometry. Prerequisite: 6 SCH of MATH 4000 courses.

MATH 5323 Group Theory
The purpose of this course is to provide students with a concept, which arises naturally in almost every mathematical area, but also in Physics and Chemistry, the notion of a group. The course will cover at least one of the essential aspects of modern group theory, finite group theory, algebraic group theory, or combinatorial group theory. In the first case, the course will include the theorems of Jordan-Hölder, Sylow, and Schur-

Zassenhaus, the treatment of the generalized Fitting subgroup, a first approach to solvable as well as simple groups (including theorems of Ph. Hall and Burnside). Prerequisite: Math 5321 or consent of instructor.

MATH 5327 Lie Algebras
This course is an introduction to the classical theory of Lie algebras. Topics include root systems, the Weyl group, nilpotent and solvable Lie algebras, the theorems of Lie and Engel, Cartan subalgebras, Cartan's criterion for semisimplicity, Chevalley groups and groups of Lie type. Prerequisite: MATH 5321 or consent of instructor.

MATH 5329 Number Theory
This course focuses on analytical or algebraic number theory. In the first case, the course covers arithmetic functions (Moebius, Euler, Dirichlet), Dirichlet series (convergence, uniqueness, multiplicative property) distribution of primes (Dirichlet, Tchebycheff, Hadamrd resp. de la Vallee-Poussin), Riemann's zeta function. In the second case, the course focuses on algebraic number fields, Dedekind domains, and the class group. Prerequisite: MATH 5321 or consent of instructor.

MATH 5331 Higher Geometry
This course will be on Projective, Algebraic or Convex Geometry. Projective Geometry includes basic incidence geometry, group actions on geometries, ternary rings and coordinates in projective and affine geometries, and the Fundamental Theorem on Projective Geometry. Algebraic Geometry includes basic facts on algebraic curves, the relationship between algebraic sets and radical ideals, Hilbert's Nullstellensatz. Prerequisite: 6 SCH of MATH 4000-courses.

MATH 5337 Dynamical Systems
The main goal of this course is to understand the long term behavior of states in a system for which there is a deterministic rule for how a state evolves. The evolution of the state of the system may be very different, such as stability and instability/ bifurcation/catastrophe; controllability and stabilizability; observability and detectability; isolations and attractors; oscillations and chaos. In this course we will focus on the linear control systems and preliminary nonlinear control systems.

MATH 5339 Topology
The course treats both the general and the algebraic aspects of topology. It covers topological spaces, continuous mappings, connectedness and compactness, the fundamental group, covering spaces, the Jordan Curve Theorem and a classification of surfaces. Prerequisite: MATH 5341 or consent of instructor.

MATH 5341 Higher Analysis
This course presents the system of the real numbers and the system of the complex numbers, sequences and series of real numbers, continuity and differentiability of real functions, convergence of sequences and series of functions, aspects of functions in several variables, the Riemann-Stieltjes integral and an introduction to Lebesgue Theory. Prerequisite: 6 SCH of MATH 4000-courses.

MATH 5342 Measure and Integral Theory
The course presents the Lebesgue Theory, abstract integration, Borel measures, Lebesgue spaces, integration of differential forms. Prerequisite: MATH 5341.

MATH 5346 Functional Analysis
This course introduces to topological vector spaces. It presents the theory of Hilbert spaces, Banach space techniques and their applications, and basic facts on operator theory and spectral theory. Prerequisite: MATH 5342 or consent of instructor.

MATH 5348 Differential Equations
This course covers first order and higher order differential equations, systems of solutions of linear differential equations, the Laplace transform, and several basic concepts of partial differential equations. Prerequisite: 6 SCH of MATH 4000-courses or 3 SCH of MATH 5000-courses.

MATH 5361 Mathematical Modeling
In this course, we shall not deal with a specified mathematical theory. Instead, the students will learn how to develop mathematical models which reflect the real world problems. It may include modeling with difference and differential equations or with stochastic processes. The course may be project-oriented. Prerequisite: 6 SCH of MATH 4000-courses.

MATH 5362 Graph Theory
This course provides the student with the basic ideas of graph theory as it is used in many branches of Industrial Mathematics. It contains Ramsey Theory, spanning trees, decision trees, matching theory, graph coloring, traveling salesman problems, networks, min-max theorems, flows, Ford-Fulkerson. Prerequisite: 6 SCH of MATH 4000-courses.

"Thanks to the efforts of the universities' faculty, staff and administrators, the Masters in Mathematics Program at the University of Texas at Brownsville and Texas Southmost College has given me the opportunity to continue my studies without having to transfer to another university. The faculty is dedicated and motivates their students to excel in their studies. I have no doubt that this program will have an impact on current and future educators in the mathematics field and in the community."

- Luis Sanchez, Graduate Student