Course Catalog

Mathematics

Faculty

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Requirements

The Major

The requirements for the degree of Bachelor of Arts with a major in mathematics are as follows:

I. Departmental requirements:

A. Mathematics core: MATH 1311, 1312, 2321, 3323, 3326, 3360, 3362.
B. Seminar/Writing: MATH 2094, 3194, 3195.
C. Mathematics electives: Eighteen (18) additional MATH credit hours numbered above 3320. At least three (3) of them must be numbered 4xxx.
D. Programming proficiency: CSCI 1320.
E. Completion of the capstone courses: MATH 4394, or MATH 4398 and 4399.

The appropriate choice of courses beyond those in the core depends on the student's interests and career plans and should be determined in consultation with the academic adviser. Further course suggestions and other information appear on the department's Web site.

II. University Requirements: completion of all other required elements of the Pathways curriculum and at least

120 credit hours.

Acceptance into Program

FULL ACCEPTANCE is granted if the following requirements are met at the time of application:

I. MATH 1311, 1312, 2321, 3323 with grades of C or better.
II. Grade point average of at least 2.0 in all mathematics courses.
III. Completion of at least one mathematics course required for the major while enrolled at Trinity University.
IV. CSCI 1320 with a grade of C or better.

PROVISIONAL ACCEPTANCE may be granted if the Department of Mathematics is convinced that the applicant has promise of graduating with a degree in mathematics. In cases of provisional acceptance, courses and performance standards will be specified so that the applicant may be granted full acceptance.

The Minor

A mathematics minor must complete MATH 1307 or 1311, 1308 or 1312, 2321, and nine (9) hours of upper division mathematics.

The Honors Program

Objectives

The Mathematics Department offers an Honors Program to provide students the opportunity to develop their capacity for mathematical skill and knowledge by completing a senior honors thesis. The thesis may be written in collaboration with any other university department that offers instruction. Specifics for interdisciplinary thesis must be worked out on an individual basis with the department. The Honors Program requires a minimum of nine credit hours arranged over two or three semesters. Six of these hours must be taken in the senior year and devoted to work on the thesis. The remaining three hours must be taken in an upper division course completed by the end of the junior year in the area in which the thesis is to be written. The specific upper division course will be chosen with the consent of the adviser.

Application and Procedures

Application for admission to the Honors Program is made through the department in the fall of the junior year. The University requires a 3.3 overall grade point average and two faculty letters of recommendation for admission to the program. In addition, the mathematics department requires at least 15 hours of work in mathematics courses

as well as a 3.2 average on all work attempted in the department.

Before an application is submitted, the candidate must obtain the consent of a full time department member to serve as the thesis adviser. The application is then submitted to the thesis adviser who determines if the documentation merits further consideration. Given the judgment by the thesis adviser that the student is a good candidate for the thesis, the student, in collaboration with the adviser, prepares a description of the work proposed along with a bibliography. These documents are forwarded to the department faculty for approval. Given a positive recommendation from the faculty, the student is then an official candidate for departmental honors. At this point the department, in collaboration with the thesis adviser, recommends a thesis committee to the Office of Academic Affairs. The committee will consist of the thesis adviser, another mathematics department faculty member who serves as reader, and a third member who may be from another department or an expert from outside the University.

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A final presentation of the completed thesis will be made to the department during the second semester of the student's senior year. After the presentation and a reading of the final thesis, the department will determine its acceptability for departmental honors. The accepted thesis will be sent to the Office of Academic Affairs for binding. The student will pay the cost of the binding. The completed thesis will be bound and placed in the Trinity University library.

For further information, contact the department at (210) 999-8205.

Courses

MATH-1190 Putnam Exam Seminar

This course involves preparation for the Putnam Exam. Topics include problem-solving applications of geometry, calculus, mathematical introduction, counting techniques, and more. The course may be repeated up to four times for credit. Fall. Prerequisite: MATH 1311 or consent of instructor.

MATH-1301 Pre-Calculus

Equations and inequalities; systems of linear equations. Polynomial and rational functions; trigonometric functions and identities; and transcendental functions. MATH 1301 provides a thorough preparation for Calculus 1.

MATH-1305 Mathematics for Business and Economics

The focus of the course will be to master mathematical principles such as derivatives and integrals and how these are related to applications for business and economics. Students will learn about mathematical rigor, basic algebraic properties of sets and functions. The course will also cover topics on optimization, the mathematics of

finance, and introduce students to basic ideas of operations research, such as systems of linear equations and linear programming. No student who has completed MATH 1312 may register for this course.

MATH-1311 Calculus I

A study of functions including transcendental and trigonometric: Limits and continuity; differential and integral calculus; and applications. Prerequisite: Successful completion of either MATH 1301 or the equivalent. Students who have completed the equivalent of MATH 1301, as opposed to taking MATH 1301 at Trinity, must take the Mathematics Placement Exam to determine readiness for this course.

MATH-1312 Calculus II

A study of methods of integration, series, and an introduction of differential equations. (Offered every semester). Prerequisite: MATH 1311 or the equivalent.

MATH-1320 Statistical Methods

Methods of analyzing data, statistical concepts and models, estimation, tests of significance, and regression. MATH 1320 and 3320 cannot both be taken for credit. Prerequisite: MATH 1311, or equivalent.

MATH-1330 Introduction to Modern Mathematics

A survey of modern mathematics. Topics to include infinity and infinities, the fourth dimension, fractional dimensions, fractals and chaos, pitfalls of statistics, and objects with fewer than the expected number of sides.

MATH-2117 Sports Analytics Seminar

This course introduces basic tools used by data scientists in the field of Sports Analytics. The course covers the principles of research methodology used to gather and clean databases. It also explores basic methods in the mathematical theory of sports analytics such as ranking methods and predictive analysis of outcomes. (Offered every semester). Prerequisites: MATH 1305 or MATH 1311 or Consent of instructor

MATH-2308 Mathematics for Data Science

An introduction to the formulation, interpretation, and predictive analyses of models arising in the life, physical, or social sciences. Mathematical topics will include differential equations modeling with continuous and discrete time models, linear algebra models, regression analysis, and introduction to standard models in Big Data such as ranking systems and recommendation systems. The necessary mathematical and scientific background will be developed as needed. (Offered every Spring) Prerequisites: MATH 1305 or MATH 1311

MATH-2321 Calculus III

The study of partial differentiation, multiple integrals, and vector calculus. Prerequisite: MATH 1312

MATH-2324 Numerical Calculus

Introduction to the numerical algorithms fundamental to scientific computer work. Elementary error analysis, interpolation, quadrature, linear systems of equations, and introduction to the numerical solution of ordinary differential equations. (Also listed as CSCI 2324.) Spring. Prerequisites: CSCI 1320 and MATH 1311

MATH-2094 Majors' Seminar

Attendance at the departmental seminar. Grade based on attendance. This course cannot be taken concurrently with MATH 3194, 3195, or 4394.

MATH-3310 The Mathematics Peer Educator

Peer tutoring or peer-led instruction in a mathematics course. Under the guidance and supervision of the course instructor, peer educators will assist students in learning mathematics concepts and in developing problem solving skills. Office hours and class attendance required. Course may be repeated for a maximum of 6 credit hours. Prerequisite: Consent of instructor

MATH-3316 Differential Equations and Linear Algebra

The theory and applications of first order equations, linear second order equations, linear systems of equations, Laplace transforms, the eigenvalue problem, matrix algebra, and vector spaces. MATH 3316 and MATH 3336 may not both be taken for credit. Prerequisite: MATH 1312

MATH-3320 Probability and Statistics for Engineers And Scientists

An introduction to statistics specifically for engineers and scientists. Topics include probability, random variables and their distributions, univariate and multivariate distributions, sampling distributions, estimation, hypothesis tests, confidence intervals, simple and multiple regression, analysis of variance, and reliability. Prerequisite: MATH 2321.

MATH-3323 Linear Algebra

A study of the theory and computations of linear algebra. Topics include matrix and vector operations, least squares, linear transformations, eigenvalues and eigenvectors. Prerequisite: MATH 1312 or consent of instructor.

MATH-3326 Introduction to Abstract Mathematics

This course begins with an elementary survey of logic and set theory. From there, the course introduces the concept of the mathematical proof, framed in introductions to the real line, point set topology, and modern algebra. This course is offered every semester. Prerequisite: Math 1312 or equivalent or consent of instructor.

MATH-3327 Probabilistic Models in Life Sciences

An introduction to probabilistic modeling with emphasis on its use in biology. Fundamental concepts such as conditional probability and conditional expectation are studied in depth in order to prepare for an introduction to the theory and applications of Markov chains. Applications in biology may include birth-and-death processes, branching processes, sequence alignment, population genetics, epidemic processes, molecular evolution, and phylogenetic tree construction. (This course or MATH 3328 will be offered every other year.) Prerequisite: MATH 1320 or MATH 3320 or MATH 3334.

MATH-3328 Mathematical Models in Life Sciences

The course is designed to introduce advanced tools to study discrete mathematical models in the life sciences including their practical applications. The focus will be on understanding the processes, implications, and results

of modeling phenomena in life sciences in the laboratory setting or field. The course investigates exponential growth and logistic models, competitive and predatory-prey models, age structured models, harvesting models, and epidemiological models. The integrated laboratory experience consists of several experiments on model organisms such as bacteria and protists. In addition, human epidemiological data will also be utilized. (This course or MATH 3327 will be offered every other year) Prerequisite: MATH 1311 and 1312.

MATH-3334 Probability

This course covers the basic concepts of probability, including counting methods, events, conditional probability, discrete and continuous random variables and their distributions, multivariate distributions, commonly used discrete and continuous distributions, functions of random variables, expectation, variance, and correlation. Fall. Prerequisite: MATH 2321

MATH-3335 Mathematical Statistics

This course covers the basic concepts of statistics, including samples, statistics, estimation, sampling distribution of estimators, confidence intervals, tests of hypotheses, significance, power, and simple linear regression. Additional topics may include Bayesian statistics, analysis of variance, and nonparametric methods. Spring. Prerequisite: MATH 3334

MATH-3336 Differential Equations

Introduction to the basic quantitative and qualitative concepts of differential equations. Topics include first order differential equations, second order differential equations and applications, Laplace transforms, and systems of differential equations. MATH 3316 and MATH 3336 may not both be taken for credit. Offered occasionally. Prerequisite: MATH 3323

MATH-3338 Mathematical Modeling

Formulation, analysis, and interpretation of models arising in the life, physical, or social sciences. The actual source for the models will depend upon the interests of the instructor. Mathematical topics will include one or more of the following areas: linear algebra, differential equations, difference equations, numerical analysis, statistics, stochastic processes, and optimization. (Offered every Fall.) Prerequisites: MATH 2321; CSCI 1320 or knowledge of computer programing; or consent of instructor.

MATH-3341 Number Theory I

A study of the arithmetic properties of the ring integers. Topics may include factorization, modular arithmetic, solution of polynomial congruences, the law of quadratic reciprocity, Diophantine equations, and applications to cryptography. Prerequisite: MATH 3326 or consent of instructor.

MATH-3343 Combinatorics I

A study of the theory and problem-solving techniques of algebraic and enumerative combinatorics. Topics include basic enumeration and the combinatorial proofs, the binomial theorem, recurrence relations, generating functions, and inclusion-exclusion. Fall, alternate years. Prerequisite: MATH 3326 or consent of instructor.

MATH-3351 Numerical Analysis I

Methods of solution of algebraic and transcendental equations, simultaneous linear algebraic equations, numerical integration and differentiation, initial and boundary value problems of ordinary differential equations. (Also listed as CSCI 3351.) Spring. Prerequisite: CSCI 1321, MATH 3316

MATH-3352 Numerical Analysis II

Direct and iterative solution of linear systems of equations, approximation theory, eigenvalues and eigenvectors, solution of non-linear systems of equations, boundary value problems for ordinary differential equations, numerical solutions of partial differential equations. Irregular. Prerequisite: MATH 3351.

MATH-3355 Non-Euclidean Geometry

Topics include the fifth postulate of Euclid, hyperbolic geometry of Lobachevsky, elliptic geometry of Riemann. Spring, alternate years. Prerequisite: MATH 3326 or Consent of Instructor.

MATH-3357 Partial Differential Equations

The heat, wave and Laplace equations and boundary value problems, the method of separation of variables, special functions, orthogonal expansion, Sturm-Liouvulle theory, the Fourier and Laplace transform methods. Additional topics may include Green's functions, Poisson's integral formula for the disk and variational calculus if time permits. Prerequisites: MATH 2321 and 3316 or 3336.

MATH-3359 Difference Equations

Dynamics of first order difference equations, difference equations of higher order, stability analysis, methods of Z-transform. Offered infrequently. Prerequisites: MATH 3316 or 3323

MATH-3360 Real Analysis I

An introduction to the real number system, elementary topology of Euclidean spaces, calculus of real-valued functions of one and several variables including a rigorous development of limits, continuity, differentiation and integration. Fall. Prerequisite: MATH 3326.

MATH-3362 Modern Algebra I

A study of the theory of groups, rings, and fields. Fall. Prerequisites: MATH 3326.

MATH-3370 Financial Mathematics

Problems that arise in the area of finance and the mathematics of their solutions. Examples include portfolio selection, option pricing, arbitrage, single-agent optimization, the Fundamental Theorem of Asset Pricing, and the Black-Scholes formula. Prerequisites: MATH 1320 or 3320 or 3334 and MATH 3316 or 3323

MATH-3-90 Reading and Conference

Course will vary in credit according to scope of work included. Prerequisite: Consent of instructor.

MATH-3391 Special Topics

Special topics not covered by courses described in the Course of Study Bulletin. Announcements of this course will be made by special prospectus. The course may be repeated for credit on different topics.

MATH-3194 Junior Writing Workshop

Students work to improve their mathematical skills as well as their writing and presentation skills. They will be required to submit computer solutions to several math problems. They will attempt to solve a mathematical problem and will present their findings in both written and oral form. Attendance at the Major's Seminar (MATH 2094) is required.

MATH-3195 Junior Technology Workshop

Students work to improve their mathematical software skills as well as their writing and presentation skills. They will be required to submit computer solutions to several mathematical problems. They will also be required to read a referred mathematics journal article and present their findings in both written and oral form. Attendance at the majors seminar (MATH 2094) is required. Prerequisite: MATH 3194

MATH-4324 Linear Algebra II

Topics beyond MATH 3323, which may include canonical forms, spectral decompositions, analysis of linear systems, and matrix norms, Fall, alternate years. Prerequisite: MATH 3323 or consent of instructor

MATH-4336 Stochastic Processes

An Introduction to the theory and applications of stochastic processes. Topics may include processes, random walks, Markov chains in discrete and continuous time, branching processes, queuing systems. and Brownian motion. Spring, alternate years. Prerequisite: Math 3320 or 3334 or consent of instructor.

MATH-4342 Number Theory II

Topics beyond MATH 3341, which may include the theory of fractional ideals in number fields, arithmetic functions and Dirichlet series, distribution of primes, and the prime number theorem. Spring, alternate years. Prerequisite: MATH 3341 and MATH 3360 or 3362, or consent of instructor.

MATH-4344 Combinatorics II

Topics beyond MATH 3343, which may include Polya counting, partition theory, special functions, the R-S-K algorithm, combinatorial species, and other advanced topics in algebraic and enumerative combinatorics. Spring, alternate years. Prerequisite: Math 3343 or Consent of Instructor.

MATH-4361 Real Analysis II

Topics beyond MATH 3360, which may include measure, Lebesgue theory, Banach and Hilbert spaces, manifolds, and differential forms. Prerequisite: MATH 3360.

MATH-4363 Modern Algebra II

Topics beyond MATH 3362, which may include field and ring theory, representation theory, Galois theory, additional

algebraic structures, and applications to other branches of mathematics. Fall, alternate years. Prerequisite: MATH 3362 and 3323.

MATH-4364 Theory of Complex Variables

A study of functions of a single complex variable including properties of complex numbers, analytic functions, contour integration and Cauchy's theorem, Taylor and Laurent series, the calculus of residues and applications. Additional topics may include conformal mappings, analytic continuation, Rouche's theorem, and infinite products. Fall, alternate years. Prerequisites: MATH 3360 or Consent of Instructor.

MATH-4365 Topology

Introduction to the study of basic topological concepts including topological spaces, continuous functions, homeomorphisms, separation properties, connectedness, and compactness. Additional topics may be chosen from algebraic or geometric topology. Fall, alternate years. Prerequisite: MATH 3360 or 3362, or consent of instructor.

MATH-4367 Dynamical Systems

Topics beyond MATH 3336, which may include chaos theory, bifurcation, and discrete continuous systems. Offered occasionally Prerequisites: MATH 3360 and 3336, or consent of instructor.

MATH-4391 Special Topics

This course will treat special topics not covered by courses described in the Courses of Study Bulletin. Announcements of such courses will be by special prospectus. This course may be repeated for credit on different topics.

MATH-4194 Majors' Seminar II

Seminar for senior majors. Seniors write reports on lectures and present senior projects. May be repeated for a maximum of two credit hours.

MATH-4394 Senior Project

Independent project under faculty supervision. Oral and written presentation of results and attendance at the majors' seminar (MATH 2094) are required. Prerequisite: MATH 3195 and senior standing

MATH-4398 Honors Thesis

Individual research and scholarly investigation under faculty supervision leading to the preparation of an Honors Thesis. To be taken only by Senior Honors students in both semesters of their Senior year. Prerequisite: Senior Standing.

MATH-4399 Honors Thesis

Individual research and scholarly investigation under faculty supervision leading to the preparation of an Honors Thesis. To be taken only by Senior Honors students in both semesters of their Senior year. Prerequisite: Senior Standing.

MATH-4-90 Research and Conference

Course will vary in credit according to scope of work included. This course cannot be used to satisfy the 4000-level Mathematics major elective requirement. May be repeated when topics vary. One to three credit hours. (Offered Occasionally). Prerequisite: Consent of the Instructor