MATHEMATICS, MINOR

Why Take This Minor?

Mathematics helps one to think logically, to formulate complex problems in a well-defined manner, to critically analyze data, and to determine optimal solutions to real-world problems. All of these skills are transferrable to a wide variety of careers that make mathematicians highly sought after in the work force. Mathematics majors often pursue careers as actuaries, statisticians, financial analysts, and teachers, but they are also well-prepared to enter the workforce in a much wider range of career fields.

The minor in mathematics introduces students to the foundational courses in the field usually encountered during the first two years of study.

Required for Graduation

- Courses
  - 6
- Credits
  - 21-23

Requirements

Code	Title	Credits
MTH 120	Calculus I	4
MTH 121	Calculus II	4
Select three of the following:		10-12
MTH 222	Calculus III	
MTH 240	Linear Algebra	
MTH 260	Discrete Structures I	
MTH 261	Discrete Structures II	
MTH 302	Foundations of Mathematics	
MTH 322	Differential Equations	
One additional Mathematics course at 300-level or greater		3
Total Credits		**21-23**

Choices for Mathematics

Code	Title	Credits
MTH 302	Foundations of Mathematics	3
MTH 321	Real Analysis	3
MTH 322	Differential Equations	4
MTH 330	Modern Geometries	3
MTH 335	Graph Theory	3
MTH 341	Abstract Algebra	3
MTH 345	Combinatorics	3
MTH 370	Selected Topics in Mathematics	3
MTH 405	History of Mathematics	3
MTH 410	Probability	3
MTH 411	Mathematical Statistics	3
MTH 415	Financial Mathematics	3
MTH 421	Numerical Analysis	3
MTH 424	Complex Variables	2-3
MTH 425	Mathematical Modeling	3
MTH 430	Topology	3
MTH 444	Research in MTH I	1-3
MTH 470	Selected Topics in Mathematics	3

Possible Course Sequence:

- FRESH or SOPH Fall: MTH 120 Calculus I
- FRESH or SOPH Spring: MTH 121 Calculus II
- SOPH or JUNIOR Fall: MTH 222 Calculus III
- SOPH or JUNIOR Spring: MTH 322 Differential Equations
- JUNIOR or SENIOR Fall: MTH 240 Linear Algebra
- JUNIOR or SENIOR Spring: MTH 300+ Elective

Course Descriptions

MTH 120 Calculus I
Topics in this course include functions of various types: rational, trigonometric, exponential, logarithmic; limits and continuity; the derivative of a function and its interpretation; applications of derivatives, including finding maxima and minima and curve sketching; antiderivatives, the definite integral and approximations; the fundamental theorem of calculus; and integration using substitution. A TI graphing calculator is required. Prerequisite(s): MTH 119 or its equivalent

MTH 121 Calculus II
This course addresses differentiation and integration of inverse trigonometric and hyperbolic functions; applications of integration, including area, volume, and arc length; techniques of integration, including integration by parts, partial fraction decomposition, and trigonometric substitution; L'Hopital's Rule; improper integrals; infinite series and convergence tests; Taylor series; parametric equations; polar coordinates; and conic sections. A TI graphing calculator is required. Prerequisite(s): MTH 120

MTH 222 Calculus III
This course addresses three-dimensional geometry, including equations of lines and planes in space, and vectors. It offers an introduction to multi-variable calculus including vector-valued functions, partial differentiation, optimization, and multiple integration. Applications of partial differentiation and multiple integration. A TI-89 graphing calculator is required. Prerequisite(s): MTH 121

MTH 240 Linear Algebra
This course includes vectors and matrices, systems of linear equations, determinants, real vector spaces, spanning and linear independence, basis and dimension, linear transformations, eigenvalues and eigenvectors, and orthogonality. Applications in mathematics, computer science, the natural sciences, and economics are included. Prerequisite(s): MTH 120

MTH 260 Discrete Structures I
This course is the first half of a two-semester course in discrete mathematics. Topics in the course include logic, sets, functions, numeric bases, matrix arithmetic, divisibility, modular arithmetic, elementary combinatorics, probability, graphs, and trees. There will be an emphasis on applications of mathematics. Prerequisite(s): MTH 101 or a Mathematics Placement of 102M

MTH 261 Discrete Structures II
This course is the second half of a two-semester course in discrete mathematics. Topics in the course include rules of inference, proof methods, sequences and summation, growth of functions, complexity of algorithms, prime numbers and their application to cryptography, proof by induction, recursion, recurrence relations, and properties of relations. There will be an emphasis on applications. Prerequisite(s): MTH 260

MTH 302 Foundations of Mathematics
Topics in this course include propositional logic, methods of proof, sets, fundamental properties of integers, elementary number theory, functions and relations, cardinality, and the structure of the real numbers. Prerequisite(s): MTH 120 Corequisite(s): MTH 121

MTH 321 Real Analysis
This is a course that emphasizes the theory behind calculus topics such as continuity, differentiation, integration, and sequences and series (both of numbers and of functions); basic topology, Fourier Series. Prerequisites: MTH 222 and either MTH 302 OR a B- or better in MTH 261

MTH 322 Differential Equations
This course focuses on analytical, graphical, and numerical techniques for first and higher order differential equations; Laplace transform methods; systems of coupled linear differential equations; phase portraits and stability; applications in the natural and social sciences. (offered in alternate years) Prerequisite(s): MTH 121

MTH 330 Modern Geometries
Topics from Euclidean geometry including: planar and spatial motions and similarities, collinearity and concurrence theorems for triangles, the nine-point circle and Euler line of a triangle, cyclic quadrilaterals, compass and straightedge constructions. In addition, finite geometries and the classical non-Euclidean geometries are introduced. (offered in alternate years) Prerequisite(s): MTH 240 or MTH 302 or a B- or better in MTH 261

MTH 335 Graph Theory
This course introduces students to the field of graph theory and leads them through an exploration of the major branches of this subject, incorporating both theoretical results and current applications for each area studied. From a theoretical perspective, students re-derive well-known existing results and construct proofs related to new topics which have been introduced. From an applied standpoint, members of the class learn to formulate graph models to solve problems in computer science, the natural sciences, engineering, psychology, sociology, and other fields. We also consider some open problems and pose new questions of our own. In addition to fundamental definitions and concepts in graph theory, some specific topics that will be introduced are the following: Eulerian, Hamiltonian, planar, and directed graphs; trees, connectivity, matching, decomposition, coloring, covering, and independent sets and cliques; techniques and algorithms on graphs; and optimization problems and network flows. Prerequisite(s): Junior/senior mathematics standing or permission of the department chair

MTH 341 Abstract Algebra
Sets and mappings; groups, rings, fields, and integral domains; substructures and quotient structures; homomorphisms and isomorphisms; abelian and cyclic groups; symmetric and alternating groups; polynomial rings are topics of discussion in this course. (offered in alternate years) Prerequisite(s): MTH 302 or a B- or better in MTH 261

MTH 345 Combinatorics
This course addresses permutations and combinations, generating functions, recurrence relations and difference equations, inclusion/exclusion principle, derangements, and other counting techniques, including cycle indexing and Polya's method of enumeration. Prerequisite(s): MTH 120

MTH 370 Selected Topics in Mathematics
This is an introductory course to specialized areas of mathematics. The subject matter will vary from term to term. Restriction(s): junior or senior standing

MTH 405 History of Mathematics
This course is an in-depth historical study of the development of arithmetic, algebra, geometry, trigonometry, and calculus in Western mathematics (Europe and the Near East) from ancient times up through the 19th century, including highlights from the mathematical works of such figures as Euclid, Archimedes, Diophantus, Fibonacci, Cardano, Napier, Descartes, Fermat, Pascal, Newton, Leibniz, Euler, and Gauss. A term paper on some aspect of the history of mathematics is required. (offered in alternate years) Prerequisite(s): MTH 302 or a B- or better in MTH 261

MTH 410 Probability
Topics in this course include sample spaces and probability measures, descriptive statistics, combinatorics, conditional probability, independence, random variables, joint densities and distributions, conditional distributions, functions of a random variable, expected value, variance, various continuous and discrete distribution functions, and the Central Limit Theorem. (offered in alternate years) Prerequisite(s): MTH 222

MTH 411 Mathematical Statistics
Topics in this course include measures of central tendency and variability, random sampling from normal and non-normal populations, estimation of parameters, properties of estimators, maximum likelihood and method of moments estimators, confidence intervals, hypothesis testing, a variety of standard statistical distributions (normal, chi-square, Student's t, and F), analysis of variance, randomized block design, correlation, regression, goodness of fit, and contingency tables. (offered in alternate years) Prerequisite(s): MTH 410

MTH 415 Financial Mathematics
This course introduces students to the fundamental concepts of financial mathematics and provides opportunities to apply those concepts to real-world problems. Students will gain an understanding of concepts behind present and future values for various streams of cash flows and will work with reserving, valuation, pricing, asset and liability management, investment income, budgeting, and contingencies. Pre-requisite(s): Math 120 or permission of Chair.

MTH 421 Numerical Analysis
A survey of numerical methods commonly used in algebra and calculus with emphasis on both algorithms and error analysis. Topics include round-off error, numerical methods for solving equations in one variable, interpolation and polynomial approximation, and numerical differentiation and integration. Methods and techniques studied include Bisection, Fixed-Point Iteration, Newton's Method, Müller's Method, Lagrange Polynomials, Neville's Method, Divided Differences, Cubic Splines, Three-point and Five-point Numerical Differentiation Formulas, Newton-Cotes Formulas, Composite Numerical Integration, Adaptive Quadrature, Gaussian Quadrature. Prerequisite(s): MTH 121

MTH 424 Complex Variables
This course examines analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem; power series; infinite series; calculus of residues; contour integration; conformal mapping. Prerequisite(s): MTH 222

MTH 425 Mathematical Modeling
This course addresses the uses of mathematical methods to model real-world situations, including energy management, assembly-line control, inventory problems, population growth, predator-prey models. Other topics include: least squares, optimization methods interpolation, interactive dynamic systems, and simulation modeling. Prerequisite(s): MTH 120

MTH 444 Research in MTH I
This course provides the student with an opportunity to do research with a faculty member. The student and the faculty member agree on the research project before the student registers for the course.

MTH 470 Selected Topics in Mathematics
This course is an introduction to specialized research, concentrating on one particular aspect of mathematics. The subject matter will vary from term to term. Restriction(s): junior or senior standing