MATHEMATICS

MTH 100 Math Skills Studio (4 Credits)
This course is for students who need additional preparation to succeed in courses containing quantitative material. It provides a supportive environment for learning or reviewing, as well as applying, arithmetic, algebra, and mathematical skills. Students develop their numerical and algebraic skills by working with numbers drawn from a variety of sources. This course does not carry a Latin Honors designation. Enrollment limited to 20. Instructor permission required.
Fall, Interterm

MTH 101 Quantitative Skills in Practice (4 Credits)
A course continuing the development of quantitative skills and quantitative literacy skills began in MTH 100. Students continue to exercise and review basic mathematical skills, to reason with quantitative information, to explore the use and power of quantitative reasoning in rhetorical argument, and to cultivate the habit of mind to use quantitative skills as part of critical thinking. Attention is given to visual literacy in reading graphs, tables, and other displays of quantitative information, and to cultural attitudes surrounding mathematics. Prerequisites: MTH 100. Enrollment limited to 20. {M}
Spring

MTH 102 Elementary Functions (4 Credits)
Linear, polynomial, exponential, logarithmic and trigonometric functions graphs, verbal descriptions, tables and mathematical formulae. For students who intend to take calculus or quantitative courses in scientific fields, economics, government and sociology. Also recommended for prospective teachers preparing for certification. Enrollment limited to 25. {M}
Fall

MTH 103 Precalculus and Calculus Bootcamp (2 Credits)
This course provides a fast-paced review of and intense practice of computational skills, graphing skills, algebra, trigonometry, elementary functions (pre-calculus), and computations used in calculus. Featuring a daily review followed by problem-solving drills and exercises stressing technique and application, this course provides concentrated practice in the skills needed to succeed in courses that apply elementary functions and calculus. Students gain credit by completing all course assignments. This course does not count towards the Mathematics or Mathematical Statistics majors. S/U only. Enrollment limited to 20. Instructor permission required.
Fall, Interterm, Spring, Variable

MTH 105ar Topics in Discovering Mathematics-MathStudio: Making, Art + Math (4 Credits)
The course has geometrical, mathematical and studio art components. Students draw and build 3D objects with simple tools and study their geometric and mathematical properties. Introduction to elements of geometry, algebra and symmetry in connection to what is built. Enrollment limited to 25. {M}
Fall, Spring, Variable

MTH 111 Calculus I (4 Credits)
Discussions include rates of change, differentiation, applications of derivatives including differential equations and the fundamental theorem of calculus. Written communication and applications to other sciences and social sciences motivate course content. Enrollment limited to 25. {M}
Fall, Spring

MTH 112 Calculus II (4 Credits)
Techniques of integration, geometric applications of the integral, differential equations and modeling, infinite series, and approximation of functions. Written communication and applications to other sciences and social sciences motivate course content. Prerequisite: MTH 111 or equivalent. Enrollment limited to 25. {M}
Fall, Spring

MTH 153 Introduction to Discrete Mathematics (4 Credits)
An introduction to discrete (finite) mathematics with emphasis on the study of algorithms and on applications to mathematical modeling and computer science. Topics include sets, logic, graph theory, induction, recursion, counting and combinatorics. Enrollment limited to 25. {M}
Fall, Spring

MTH 205/ CSC 205 Modeling in the Sciences (4 Credits)
Offered as CSC 205 and MTH 205. This course integrates the use of mathematics and computers for modeling various phenomena drawn from the natural and social sciences. Scientific case studies span a wide range of systems at all scales, with special emphasis on the life sciences. Mathematical tools include data analysis, discrete and continuous dynamical systems, and discrete geometry. This is a project-based course and provides elementary training in programming using Mathematica. Designations: Theory, Programming. Prerequisites: MTH 112. CSC 110 recommended. Enrollment limited to 20. {M}
Fall, Spring, Annually

MTH 211 Linear Algebra (4 Credits)
Systems of linear equations, matrices, linear transformations and vector spaces. Applications to be selected from differential equations, foundations of physics, geometry and other topics. Prerequisite: MTH 112 or equivalent, or MTH 111 and MTH 153; MTH 153 is suggested. Enrollment limited to 30. {M}
Fall, Spring

MTH 212 Multivariable Calculus (4 Credits)
Theory and applications of limits, derivatives and integrals of functions of one, two and three variables. Curves in two-and three-dimensional space, vector functions, double and triple integrals, polar, cylindrical and spherical coordinates. Path integration and Green's Theorem. Prerequisites: MTH 112. MTH 211 suggested (may be concurrent). Enrollment limited to 30. {M}
Fall, Spring

MTH 233 An Introduction to Abstract Algebra (4 Credits)
An introduction to the concepts of abstract algebra, including groups, quotient groups and, if time allows, rings and fields. Prerequisites: MTH 153 and MTH 211 or equivalent. {M}
Spring

MTH 238 Number Theory (4 Credits)
Topics to be covered include properties of the integers, prime numbers, congruences, various Diophantine problems, arithmetical functions and cryptography. Prerequisite: MTH 153 and MTH 211, or equivalent. {M}
Fall

MTH 246 Probability (4 Credits)
An introduction to probability, including combinatorial probability, random variables, discrete and continuous distributions. Prerequisites: MTH 153 and MTH 212 (may be taken concurrently), or equivalent. {M}
Fall

MTH 254 Combinatorics (4 Credits)
Enumeration, including recurrence relations and generating functions. Special attention paid to binomial coefficients, Fibonacci numbers, Catalan numbers and Stirling numbers. Combinatorial designs, including Latin squares, finite projective planes, Hadamard matrices and block designs. Necessary conditions and constructions. Error correcting codes. Applications. Prerequisites: MTH 153 and MTH 211 or equivalent. {M}
Spring, Alternate Years

MTH 255 Graph Theory (4 Credits)
The course begins with the basic structure of graphs including connectivity, paths, cycles and planarity and proceeds to independence, stability, matchings and colorings. Directed graphs and networks are considered. In particular, some optimization problems including maximum flow are covered. The material includes theory and mathematical proofs as well as algorithms and applications. Prerequisites: MTH 153 and MTH 211 or equivalent. {M}
Spring, Alternate Years

MTH 261 Computational Linear Algebra (4 Credits)
Linear algebra has become one of the most widely applied areas of mathematics. Fast matrix computation allows for the manipulation and analysis of large complex data sets which has enabled major advances in computation. Discussions include solving linear systems, matrices, determinants, matrix factorizations such as LU, and QR decompositions and singular value decomposition (SVD). Students will learn to use software to analyze large data sets, with applications in computer science, chemistry, engineering, and others. This course will be taught using the software MATLAB, but no knowledge of MATLAB is assumed. Prerequisite: MTH 211. Enrollment limited to 25. (E) {M}
Fall, Spring, Variable

MTH 264de Topics in Applied Math-Differential Equations (4 Credits)
This course gives an introduction to the theory and applications of ordinary differential equations. The course explores different applications in physics, chemistry, biology, engineering and social sciences. Students learn to predict the behavior of a particular system described by differential equations by finding exact solutions, making numerical approximations, and performing qualitative and geometric analysis. Specific topics include solutions to first order equations and linear systems, existence and uniqueness of solutions, nonlinear systems and linear stability analysis, forcing and resonance, Laplace transforms. Prerequisites: MTH 112, MTH 212 and MTH 211 (recommended) or PHY 210, or equivalent. {M}
Fall, Spring

MTH 270ss Topics in Geometry-The Shape of Space (4 Credits)
This is a course in intuitive geometry and topology, with an emphasis on hands-on exploration and developing the visual imagination. Discussions may include knots, geometry and topology of surfaces and the Gauss-Bonnet Theorem, symmetries, wallpaper patterns in Euclidean, spherical and hyperbolic geometries, and an introduction to 3-dimensional manifolds. Prerequisites: MTH 211 and MTH 212 or equivalent. {M}
Fall, Spring, Variable

MTH 280 Advanced Calculus (4 Credits)
Functions of several variables, vector fields, divergence and curl, critical point theory, transformations and their Jacobians, implicit functions, manifolds, theory and applications of multiple integration, and the theorems of Green, Gauss and Stokes. Prerequisites: MTH 211 and MTH 212, or equivalent. MTH 153 is encouraged. {M}
Spring

MTH 281 Introduction to Analysis (4 Credits)
The topological structure of the real line, compactness, connectedness, functions, continuity, uniform continuity, differentiability, sequences and series of functions, uniform convergence, introduction to Lebesgue measure and integration. Prerequisites: MTH 211 and MTH 212, or equivalent. MTH 153 is strongly encouraged. Enrollment limited to 20. {M}
Fall, Spring, Variable

MTH 300 Dialogues in Mathematics and Statistics (1 Credit)
In this class students don't do math as much as they talk about doing math and the culture of mathematics. The class includes lectures by students, faculty and visitors on a wide variety of topics, and opportunities to talk with mathematicians about their lives. This course is especially helpful for those considering graduate school in the mathematical sciences. Prerequisites: MTH 211, MTH 212 and two additional mathematics courses at the 200-level, or equivalent. May be repeated once for credit. S/U only. {M}
Fall, Spring

MTH 301rs Topics in Advanced Mathematics-Research (3 Credits)
In this course students work in small groups on original research projects. Students are expected to attend a brief presentation of projects at the start of the semester. Recent topics include interactions between algebra and graph theory, plant patterns, knot theory and mathematical modeling. This course is open to all students interested in gaining research experience in mathematics. Prerequisites vary depending on the project, but normally MTH 153 and MTH 211 are required. Restrictions: MTH 301rs may be repeated once. {M}
Fall, Spring, Variable

MTH 320/ SDS 320 Mathematical Statistics (4 Credits)
Offered as MTH 320 and SDS 320. An introduction to the mathematical theory of statistics and to the application of that theory to the real world. Discussions include functions of random variables, estimation, likelihood and Bayesian methods, hypothesis testing and linear models. Prerequisites: a course in introductory statistics, MTH 212 and MTH 246, or equivalent. Enrollment limited to 20. {M}
Spring

MTH 333ct Topics in Abstract Algebra-Coding Theory (4 Credits)
An overview of noiseless and noisy coding. Covers both theory and applications of coding theory. Topics include linear codes, Hamming codes, Reed-Muller codes, cyclic redundancy checks, entropy, and other topics as time permits. Prerequisites: MTH 153 and MTH 211. One of MTH 233 or MTH 238 is highly recommended. {M}
Fall, Spring, Variable

MTH 333la Topics in Abstract Algebra-Advanced Linear Algebra (4 Credits)
This is a second course in linear algebra that explores the structure of matrices. Topics may include characteristic and minimal polynomials, diagonalization and canonical forms of matrices, the spectral theorem, the singular value decomposition theorem, an introduction to modules, and applications to problems in optimization, Markov chains, and others. {M}
Fall, Spring, Variable

MTH 333rt Topics in Abstract Algebra-Representation Theory (4 Credits)
Representation theory is used everywhere, from number theory, combinatorics, and topology, to chemistry, physics, coding theory, and computer graphics. The core question of representation theory is: what are the fundamentally different ways to describe symmetries as groups of matrices acting on an underlying vector space? This course explains each part of that question and key approaches to answering it. Discussions may include irreducible representations, Schur's Lemma, Maschke's Theorem, character tables, orthogonality of characters, and representations of specific finite groups. MTH 233 is recommended but not required. Prerequisite: MTH 211. {M}
Fall, Spring, Variable

MTH 353ac Seminar: Advanced Topics in Discrete Applied Mathematics-Calderwood Seminar on Applied Algebraic Combinatorics and Mathematical Biology (4 Credits)
Calderwood Seminar. Combinatorial ideas permeate biology at all scales, from the combinatorial properties of the sequences of letters (nucleotides) representing DNA and RNA, to the symmetries often observed in cell divisions, to the graphs that can be used to represent evolutionary trees. This course focuses on key combinatorial ideas that arise on multiple scales in biology, including molecular, cellular and organism, especially: counting and classification, symmetries and combinatorial graphs. The class interviews mathematicians and biologists about their current research and prepares multiple reports and presentations for different kinds of popular audiences (for example: kids, biologists and newspapers). No particular biological background is expected. MTH 153 and an additional proof-based course are required, or equivalent. MTH 233 and MTH 254 or their equivalents are useful but not required. Restrictions: Juniors and seniors only. Enrollment limited to 12. Instructor permission required. {M}
Fall, Spring, Variable

MTH 354 Mathematics of Deep Learning (4 Credits)
The developments of Artificial Intelligence (AI) are tied to an unprecedented reshaping of the human experience throughout society, impacting the arts, literature, science, politics, commerce, law, education, etc. Despite these consequential effects, understanding of AI is mostly empirical. The state of knowledge of deep learning has been recently likened to a pseudo-science like alchemy. Progress in this direction rests on truly interdisciplinary approaches that are equally informed from mathematics, computer science, statistics and data science. The course goals are: (1) Understand the mathematical foundations of deep learning, (2) Develop proficiency in using mathematical tools to analyze deep learning algorithms, (3) Apply mathematical concepts to implement real-world applications of deep learning. Not recommended for first-years. Prerequisites: MTH 211 and MTH 212. Enrollment limited to 12. {M}
Fall, Spring, Variable

MTH 364ds Advanced Topics in Continuous Applied Mathematics-Dynamical Systems, Chaos and Applications (4 Credits)
An introduction to the theory of Dynamical Systems with applications. A dynamical system is a system that evolves with time under certain rules. The class looks at both continuous and discrete dynamical systems when the rules are given by differential equations or iteration of transformations. Students study the stability of equilibria or periodic orbits, bifurcations, chaos and strange attractors. Applications are often biological, but the final project is on a scientific application of the student's choice. Prerequisites: MTH 211 and MTH 212 or equivalent. {M}
Fall, Spring, Variable

MTH 364pd Advanced Topics in Continuous Applied Mathematics-Partial Differential Equations (4 Credits)
Partial differential equations allow the ability to track how quantities change when they depend on multiple variables, e.g. space and time. This course provides an introduction to techniques for analyzing and solving partial differential equations and surveys applications from the sciences and engineering. Specific topics include Fourier series; separation of variables; heat, wave and Laplace's equations; finite difference numerical methods; and introduction to pattern formations. Prerequisite: MTH 211 and MTH 212, or MTH 280/MTH 281, or equivalent. MTH 264 is strongly recommended. Prior exposure to computing (using Matlab, Mathematica, Python, etc.) is helpful. {M}
Fall, Spring, Variable

MTH 370tp Topics in Topology and Geometry-Topology (4 Credits)
Topology is a kind of geometry in which important properties of a shape are preserved under continuous motions (homeomorphisms)—for instance, properties like whether one object can be transformed into another by stretching and squishing but not tearing. This course gives students an introduction to some of the classical topics in the area: the basic notions of point set topology (including connectedness and compactness) and the definition and use of the fundamental group. Prerequisites: MTH 280 or MTH 281, or equivalent. {M}
Fall, Spring, Variable

MTH 381fw Topics in Mathematical Analysis- Fourier Analysis and Wavelets (4 Credits)
The mathematics of how it is possible to simultaneously stream videos while using the same cable to call on the phone. Hilbert spaces, Fourier series, Fourier transform, discrete Fourier transforms, wavelets, multiresolution analysis, applications. Prerequisite: MTH 280 or MTH 281. {M}
Fall, Spring, Variable

MTH 381gm Topics in Mathematical Analysis-Geometry and Mechanics (4 Credits)
Introduction to modern geometric approaches to classical physics. The essential idea is that the notion of symmetry can be used to simplify the analysis of physical systems. Topics may include Lagrangian and Hamiltonian mechanics, Noether's Theorem and conservation laws, quantization, and special relativity. MTH 233 is suggested (possibly concurrently). No prior exposure to physics is necessary. Prerequisite: MTH 280 or MTH 281. {M}
Fall, Spring, Variable

MTH 382 Complex Analysis (4 Credits)
Complex numbers, functions of a complex variable, algebra and geometry of the complex plane. Differentiation, integration, Cauchy integral formula, calculus of residues, applications. Prerequisite: MTH 211 and MTH 212, or equivalent.
Fall, Spring, Variable

MTH 400 Special Studies (1-4 Credits)
Normally for majors who have had at least four semester courses at the intermediate level. Instructor permission required.
Fall, Spring

MTH 430D Honors Project (4 Credits)
Department permission required.
Fall, Spring

MTH 431 Honors Project (8 Credits)
Department permission required.
Fall, Spring

MTH 432D Honors Project (6 Credits)
Department permission required.
Fall, Spring

MTH 580 Graduate Special Studies (4 Credits)
Instructor permission required.
Fall, Spring