MATHMATICS (MST)

MST 105. Fundamentals of Algebra and Trigonometry. (1-3 h)
A review of the essentials of algebra and trigonometry. Admission by
permission only (generally, a student must have taken fewer than three
years of high school mathematics to be eligible for admission). Not to be
counted towards any major or minor offered by the department.

MST 105L. Fundamentals of Algebra and Trigonometry Lab. (1-2 h)
A review of the essentials of algebra and trigonometry in a guided
laboratory setting. Admission by permission only. Not to be counted
towards any major or minor offered by the department. Pass/Fail only.

MST 107. Explorations in Mathematics. (4 h)
An introduction to mathematical reasoning and problem solving. Topics
vary by instructor and may include one or more of the following: knot
theory, Euclidean and non-Euclidean geometry, set theory, cryptography,
discrete models, number theory, discrete mathematics, chaos theory,
probability, and MAPLE programming. Lab. (D, QR)

MST 111. Calculus with Analytic Geometry I. (4 h)
Functions, trigonometric functions, limits, continuity, differentiation,
applications of derivatives, introduction to integration, the fundamental
theorem of calculus. Lab. (D, QR)

MST 112. Calculus with Analytic Geometry II. (4 h)
Techniques of integration, indeterminate forms, improper integrals,
transcendental functions, sequences, Taylor's formula, and infinite series,
including power series. Lab. (D, QR)

MST 113. Multivariable Calculus. (4 h)
The calculus of vector functions, including geometry of Euclidean space,
differentiation, extrema, line integrals, multiple integrals, and Green's,
Stokes', and divergence theorems.9 Lab. (D, QR)

MST 117. Discrete Mathematics. (4 h)
Introduction to various topics in discrete mathematics applicable to
computer science including sets, relations, Boolean algebra, propositional
logic, functions, computability, proof techniques, graph theory, and
elementary combinatorics. Lab. (D, QR)

MST 121. Linear Algebra I. (4 h)
Vectors and vector spaces, linear transformations and matrices,
determinants, eigenvalues, and eigenvectors. Credit not allowed for both
MST 121 and 205. Credit not allowed for both MST 121 and 206. Lab. (D, QR)

MST 165. Problem-Solving Seminar. (1 h)
Weekly seminar designed for students who wish to participate in
mathematical competition such as the annual Putnam examination. Not
to be counted toward any major or minor offered by the department. May
be repeated for credit. Pass/Fail only.

MST 205. Introduction to Linear Algebra and Differential Equations. (4 h)
Specific topics covered include: vector algebra, solving linear systems
of equations, rank, vector spaces, determinants, eigenvalues, linear
transformations, first order differential equations, second order linear
ordinary differential equations, and power series solutions to differential
equations. Credit not allowed for both MST 205 and MST 251 or for both
MST 205 and MST 121 or for both MST 205 and MST 206. P-MST 112 or
POI.

MST 206. Applied Matrix Algebra and Selected Topics. (2 h)
Matrices, determinants, solutions of linear equations, special matrices,
eigenvalues and eigenvectors of matrices. Additional topics will be
covered as time permits. Not to be counted toward any major offered by
the department except for the major in mathematical business. Credit not
allowed for both MST 206 and 121. Credit not allowed for both MST 206
and 205. P-MST 111 or POI.

MST 214. Multivariable Analysis. (3 h)
Functions between Euclidean spaces, multivariable limits, differentiation,
change of variables, line and surface integrals, vector fields, integration
theorems for vector fields, Implicit & Inverse Function Theorems,
Contraction Mapping Theorem, applications, other selected topics from
analysis in multiple dimensions. P-MST 113 and MST 121, or MST 205.

MST 225. Linear Algebra II. (3 h)
A continuation of the study of linear algebra and its applications over
the real and complex numbers. Topics may include the spectral theorem,
quadratic forms, the singular value decomposition, Gershgorin's circle
theorem, analytic functions of matrices, pseudo-inverses, and other topics
chosen by the instructor. P-MST 112 and 121 or POI.

MST 243. Codes and Cryptography. (3 h)
Essential concepts in coding theory and cryptography. Congruences,
cryptosystems, public key, Huffman codes, information theory, and other
coding methods. P - MST 117 or POI. (D)

MST 251. Ordinary Differential Equations. (3 h)
Linear equations with constant coefficients, linear equations with variable
coefficients, and existence and uniqueness theorems for first order
equations. Credit not allowed for both MST 251 and MST 205. P-MST 112
or POI. (D, QR)

MST 253. Operations Research. (3 h)
Mathematical models and optimization techniques. Studies in linear
programming, simplex method, duality, sensitivity analysis, and other
selected topics. P-MST 111 and MST 121, 205, or 206 or POI. (D, QR)

MST 254. Optimization Theory. (3 h)
Unconstrained and constrained optimization problems; Lagrange
multiplier methods; second-order sufficient conditions; inequality
constraints; and Karush-Kuhn-Tucker conditions. P - MST 113 and 121 or
POI.

MST 283. Topics in Mathematics. (1-3 h)
Topics in mathematics not considered in regular courses or which
continue study begun in regular courses. Content varies.

MST 306. Advanced Mathematics for the Physical Sciences. (3 h)
Advanced topics in linear algebra, special functions, integral transforms
and partial differential equations. Not to be counted toward any major
offered by the department except for the major in mathematical business.
P. - MST 205 or POI.

MST 311. Introductory Real Analysis I. (3 h)
Limits and continuity in metric spaces, sequences and series,
differentiation and Riemann-Stieltjes integration, uniform convergence,
power series and Fourier series, differentiation of vector functions,
implicit and inverse function theorems. P - MST 117 or POI. (D)

MST 312. Introductory Real Analysis II. (3 h)
Limits and continuity in metric spaces, sequences and series,
differentiation and Riemann-Stieltjes integration, uniform convergence,
power series and Fourier series, differentiation of vector functions,
implicit and inverse function theorems. P - MST 117 or POI. (D)
MST 317. Complex Analysis I. (3 h)
Analytic functions, Cauchy’s theorem and its consequences, power series, and residue calculus. P - MST 113 or POI. (D)

MST 321. Modern Algebra I. (3 h)
Introduction to modern abstract algebra through the study of groups, rings, integral domains, and fields. P - MST 121 or POI. (D)

MST 322. Modern Algebra II. (3 h)
A continuation of modern abstract algebra through the study of additional properties of groups, rings, and fields. P - MST 117 and 321 or POI. (D)

MST 324. Advanced Linear Algebra. (3 h)
Thorough treatment of vector spaces and linear transformations over an arbitrary field, canonical forms, inner product spaces, and linear groups. P - MST 121 and 321 or POI. (D)

MST 326. Numerical Linear Algebra. (3 h)
Numerical methods for solving matrix and related problems in science and engineering using a high-level matrix-oriented language such as MATLAB. Topics will include systems of linear equations, least squares methods, and eigenvalue computations. Special emphasis given to applications. Also listed as CSC 352. P-MST 112 and MST 121, 205 or 206 or POI. (D)

MST 331. Geometry. (3 h)
An introduction to axiomatic geometry including a comparison of Euclidean and non-Euclidean geometries. P - MST 117 or POI. (D)

MST 333. Introductory Topology. (3 h)
Topics vary and may include knot theory, topological spaces, homomorphisms, classification of surfaces, manifolds, Euler characteristic, and the fundamental group. P - MST 117 or POI.

MST 334. Differential Geometry. (3 h)
Introduction to the theory of curves and surfaces in two and three dimensional space, including such topics as curvature, geodesics, and minimal surfaces. P - MST 113 or POI. (D)

MST 345. Elementary Number Theory. (3 h)
Properties of integers, congruences, and prime numbers, with additional topics chosen from arithmetic functions, primitive roots, quadratic residues, Pythagorean triples, and sums of squares. P - MST 117. (D)

MST 346. Modern Number Theory. (3 h)
A selection of number-theory topics of recent interest. Some examples include elliptic curves, partitions, modular forms, the Riemann zeta function, and algebraic number theory. P - MST 113 or POI. (D)

MST 347. Graph Theory. (3 h)
Paths, circuits, trees, planar graphs, spanning trees, graph coloring, perfect graphs, Ramsey theory, directed graphs, enumeration of graphs, and graph theoretic algorithms. P-MST 117 or POI. (D)

MST 348. Combinatorial Analysis I. (3 h)
Enumeration techniques, generating functions, recurrence formulas, the principle of inclusion and exclusion, Polya theory, graph theory, combinatorial algorithms, partially ordered sets, designs, Ramsey theory, symmetric functions, and Schur functions. P - MST 117 or POI. (D)

MST 349. Combinatorial Analysis II. (3 h)
Enumeration techniques, generating functions, recurrence formulas, the principle of inclusion and exclusion, Polya theory, graph theory, combinatorial algorithms, partially ordered sets, designs, Ramsey theory, symmetric functions, and Schur functions. P - MST 117 or POI. (D)

MST 351. Introduction to Mathematical Modeling. (3 h)
Introduction to the mathematical modeling, analysis and simulation of continuous processes using MATLAB, Mathematics or Maple. Topics include dimensional analysis, stability analysis, bifurcation theory, one-dimensional flows, phase plane analysis, index theory, limit cycles, chaotic dynamics, hyperbolic conservation laws and traveling waves. P- MST 121 and 251 or POI.

MST 352. Partial Differential Equations. (3 h)
A detailed study of partial differential equations, including the heat, wave, and Laplace equations, using methods such as separation of variables, characteristics, Green’s functions, and the maximum principle. P - MST 113 and 251 or POI. (D)

MST 353. Probability Models. (3 h)
Introduction to probability models, Markov chains, Poisson processes and Markov decision processes. Applications will emphasize problems in business and management science. Also listed as STA 353. P-MST 111 and MST 121 or 205 or 206, or POI. (D)

MST 354. Discrete Dynamical Systems. (3 h)
Introduction to the theory of discrete dynamical systems as applied to disciplines such as biology and economics. Includes methods for finding explicit solutions, equilibrium and stability analysis, phase plane analysis, analysis of Markov chains, and bifurcation theory. P - MST 112 and 121 or POI. (D)

MST 355. Introduction to Numerical Methods. (3 h)
Numerical computations on modern computer architectures; floating point arithmetic and round-off error. Programming in a scientific/engineering language such as MATLAB, C, or FORTRAN. Algorithms and computer techniques for the solution of problems such as roots of functions, approximation, integration, systems of linear equations and lest squares methods. Also listed as CSC 355. P-MST 112 and MST 121, 205 or 206, or POI. (D)

MST 357. Probability. (3 h)
Probability distributions, mathematical expectation, and sampling distributions. MST 357 covers much of the material on the syllabus for the first Actuarial exam. Also listed as STA 310. P-MST 112 or 205 or POI. (D)

MST 359. Networks: Models and Analysis. (3 h)
A course in fundamental network theory concepts, including measures of network structure, community detection, clustering, and network modelling and inference. Topics also draw from recent advances in the analysis of networks and network data, as well as applications in economics, sociology, biology, computer science, and other areas. Also listed as STA 352. P-MST 117 or MST 121 or MST 205 or MST 206 and one course in STA at the 200 level or above. (D)

MST 381. Individual Study. (1-3 h)
A course of independent study directed by a faculty adviser. By rearrangement.

MST 383. Advanced Topics in Mathematics. (1-3 h)
Topics in mathematics not considered in regular courses or which continue study begun in regular courses. Content varies.

MST 391. Senior Seminar Preparation. (1 h)
Independent study or research directed by a faculty advisor by rearrangement with the adviser.

MST 392. Senior Seminar Presentation. (1 h)
Preparation of a paper, followed by a one-hour oral presentation based upon work in MST 391.