

Mathematical Sciences

MA 5201 - Combinatorial Algorithms

Basic algorithmic and computational methods used in the solution of fundamental combinatorial problems. Topics may include but are not limited to backtracking, hill-climbing, combinatorial optimization, linear and integer programming, and network analysis.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2001-2002 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5211 - Discrete Optimization

Optimization problems (traveling salesman, minimal spanning tree, linear programming, scheduling, etc.), simplex algorithm, primal-dual algorithms, complexity, matching, weighted matching, spanning trees, matroid theory, integer linear programming, approximation algorithms, branch-and-bound, local search, polyhedral theory.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2002-2003 academic year

MA 5221 - Graph Theory

Review of basic graph theory followed by one or more advanced topics which may include topological graph theory, algebraic graph theory, graph decomposition or graph coloring.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MA 5301 or MA 4209

MA 5222 - Design Theory

Methods for the construction of different combinatorial structures such as difference sets, symmetric designs, projective geometries, orthogonal latin squares, transversal designs, steiner systems and tournaments.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MA 4209 and MA 5301

MA 5231 - Error-Correcting Codes

Basic concepts, motivation from information transmission, finite fields, bounds, optimal codes, projective spaces, duality and orthogonal arrays, important families of codes, MacWilliams' identities, applications.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2002-2003 academic year

Pre-Requisite(s): MA 5301

MA 5232 - Cryptography

Classical cryptography, public key systems, signature schemes, key exchange, authentication codes, secret sharing schemes, protocols.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2002-2003 academic year

Pre-Requisite(s): MA 5221

MA 5301 - Finite Groups and Finite Fields

Basic theory of finite groups (subgroups, normality, homomorphisms, abelian groups, cyclic groups, commutators, order, cosets, index, conjugacy, simple groups, Sylow Theorems), basic theory of finite fields (prime fields, irreducible polynomials, Galois groups, trace), families of groups defined over finite fields (linear groups).

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MA 4310

MA 5302 - Rings and Modules

A continuation of MA5301. Topics include rings and fields, ideal theory, polynomials, Galois theory, modules, and linear operators.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): MA 5301

MA 5401 - Real Analysis

A graduate-level study of the Lebesgue integral including its comparison with the Riemann integral; the Lebesgue measure, measurable functions and measurable sets. Integrable functions, the monotone convergence theorem, the dominated convergence theorem, and Fatou's lemma.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2005-2006 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5405 - Complex Variables

The Cauchy-Goursat theorem; the argument principle and winding numbers; the Riemann mapping theorem; conformal mappings and application in hydrodynamics; Poisson's formula and the Dirichlet problem for harmonic functions; analytic continuation; infinite products; the gamma and zeta functions, and the distribution of primes.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2001-2002 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5504 - Mathematical Modeling

Construction, analysis, and testing of mathematical models (continuum, discrete, deterministic, or stochastic). Possible models include acoustical, biological, chemical, dynamical, ecological, economics, electromagnetics, financial, geological, mechanical, medical, metallurgical, optical, process, robotics, systems, thermal, material (solid, liquid, gas, plasma, multiphase) dynamics.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2003-2004 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5510 - Ordinary Differential Equations I

First order equations, general theory of linear equations, constant coefficient equations, matrix methods, singular points, infinite series methods, plane autonomous systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2002-2003 academic year

Pre-Requisite(s): MA 4450 and MA 4330

MA 5524 - Functional Analysis

Metric spaces, Banach spaces, Hilbert spaces, fundamental convergence and mapping theorems, spectral theory, weak topologies and weak compactness, unbounded operators and their adjoints, fixed point theorems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year

Pre-Requisite(s): (MA 4330 or MA 4610) and MA 4450

MA 5545 - Applied Integral Equations

Linear integral equations of the first and second kind, Fredholm theory with applications, Hilbert-Schmidt theory with applications, computational methods for approximate solutions of integral equations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5548 - Mathematical Continuum Mechanics

Lagrangian and Eulerian coordinate systems, stress and strain in elastic, viscoelastic, and plastic materials. Constitutive equations, viscosity, balance laws of fluid and solid mechanics, elasticity, Euler equations, and Navier-Stokes equations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5565 - Partial Differential Equations

Theory of partial differential equations. Covers classification, appropriate boundary conditions and initial conditions, PDEs of mathematical physics, characteristics, Green's functions, and variational principles.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2003-2004 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MA 4450 and MA 4330

MA 5627 - Numerical Linear Algebra

Analysis and design of algorithms for the numerical solutions of linear systems of equations using direct and iterative methods; eigenvalue problems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MA 4330 or MA 4630

MA 5628 - Numerical Ordinary Differential Equations

Analysis and design of algorithms for the numerical solutions of ordinary differential equations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year

Pre-Requisite(s): MA 3520 or MA 3521 or MA 3530 or MA 3560 or MA 4630

MA 5629 - Numerical Partial Differential Equations

Analysis and design of algorithms for the numerical solution of partial differential equations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year

Pre-Requisite(s): MA 4630 or MA 5628 or MA 4515

MA 5630 - Numerical Optimization

Numerical solution of unconstrained and constrained optimization problems and nonlinear equations. Topics include optimality conditions, local convergence of Newton and Quasi-Newton methods, line search and trust region globalization techniques, quadratic penalty and augmented Lagrangian methods for equality-constrained problems, logarithmic barrier method for inequality-constrained problems, and Sequential Quadratic Programming.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2002-2003 academic year

Pre-Requisite(s): MA 4330 or MA 4610 or MA 4630 or MA 5627

MA 5640 - Computational Fluid Dynamics

Topics include equations of continuum mechanics, principles and applications of numerical methods to discretize equations, stability and error analysis, linear and nonlinear solvers, boundary conditions, incompressible and compressible flows, transient and stationary flows, pre- and post-processing, and applications.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2003-2004 academic year

Restrictions: Permission of instructor required

MA 5701 - Statistical Methods

Introduction to design, conduct, and analysis of statistical studies, with an introduction to statistical computing and preparation of statistical reports. Topics include design, descriptive, and graphical methods, probability models, parameter estimation and hypothesis testing.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5711 - Mathematical Statistics I

Review of distribution theory and transformation theory of random variables. Topics include sufficiency; exponential and Bayesian models; estimation methods, including optimality theory; basics of confidence procedures and hypothesis testing, including the Neyman-Pearson framework.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 4450 and MA 4760 and MA 4770

MA 5712 - Mathematical Statistics II

Optimal tests and decision theory. Other topics may include regression and analysis of variance, discrete data analysis, nonparametric models.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MA 5711

MA 5721 - Stochastic Processes

Markov chains and their stationary distributions; Markov processes; second-order processes, including Gaussian processes and Brownian motion; differentiation and integration of second-order processes, white noise, and stochastic differential equations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year

Pre-Requisite(s): MA 3710

MA 5731 - Linear Models

A unified development of linear statistical models that includes the following topics: matrices and quadratic forms, normal and chi-square distribution theory, ordinary and generalized least squares modeling, estimability, estimation and tests of hypothesis.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year

Pre-Requisite(s): MA 4710 and MA 4720 and MA 4760 and MA 4330

MA 5740 - Advanced Sampling Methods

Runs concurrently with MA 4740 and covers the same topics as MA 4740, but students meet an additional one hour per week to prove results and discuss advanced topics. Students cannot receive credit for both MA 4740 and MA 5740.

Credits: 4.0

Lec-Rec-Lab: (0-4-0)

Semesters Offered: On Demand

Pre-Requisite(s): MA 5701 and MA 4770

MA 5750 - Statistical Genetics

Application of statistical methods to solve problems in genetics such as locating genes. Topics include basic concepts of genetics, linkage analysis and association studies of family data, association tests based on population samples (for both qualitative and quantitative traits), gene mapping methods based on family data and population samples.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2006-2007 academic year

MA 5761 - Computational Statistics

Introduction to computationally intensive statistical methods. Topics include resampling methods, Monte Carlo simulation methods, smoothing technique to estimate functions, and methods to explore data structure. This course will use the statistical software S-plus.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 4770(C)

MA 5791 - Categorical Data Analysis

Structure of 2-way contingency tables. Goodness-of-fit tests and Fisher's exact test for categorical data. Fitting models, including logistic regression, logit models, probit and extreme value models for binary response variables. Building and applying log linear models for contingency tables.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year

MA 5901 - Teaching College Mathematics I

Survey key issues in undergraduate mathematics education, including course preparation, assessment, student learning, developing assignments, instructional strategies, technology, motivating students and institutional resources. The lab involves practical training in the computer algebra system used in the mathematics lab.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Mathematics; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MA 5903 - Introduction to Scientific Programming

Topics include program control, input/output, data structures, procedural and modular programming, and floating point arithmetic. Emphasis on techniques and structures for computational mathematics. Requires programming assignments and projects.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

MA 5920 - Statistics for Educators

Intended for practicing teachers, this course focuses on strengthening understanding of statistical topics required at the secondary level and associated pedagogical issues. Includes descriptive statistics, probability, normal distribution, interpretation/analysis of univariate and bivariate data, and exploring variability in systems.

Credits: 4.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5980 - Special Topics in Mathematics

Special topics in mathematics.

Credits: variable to 12.0; Repeatable to a Max of 48

Semesters Offered: Fall, Spring, Summer

MA 5999 - Graduate Research in Mathematics

Original investigation in theoretical, or applied mathematics, and submission of a thesis in partial fulfillment of the requirements for the master's degree in mathematics.

Credits: variable to 12.0; Repeatable to a Max of 48; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

MA 6200 - Advanced Topics in Discrete Mathematics

Reflects the current research interests of the discrete mathematics faculty. Topics may include but are not limited to finite fields, permutation groups, projective geometries, design theory, graph theory, coding theory, probabilistic methods, extremal set theory, and combinatorial matrix theory.

Credits: variable to 12.0; Repeatable to a Max of 48

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 6201 - Finite Geometries

Introduction to finite geometries and its links to groups and codes. Topics include projective and affine geometries over finite fields, geometric description of error-correcting codes, bilinear forms and their groups (the classical groups, geometric algebra), group geometries (Dynkin diagrams, projective planes, generalized quadrangles), coordinatization of projective planes.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2003-2004 academic year

Pre-Requisite(s): MA 5301

MA 6301 - Permutation Groups and Enumeration

Introduction to finite groups, permutations and their applications. Covers a review of finite group theory (Lagrange's theorem, simple groups, p-groups, Sylow theorems), permutation groups (Burnside's lemma, orbit formula, primitivity, t-fold transitivity, linear groups, the Mathieu groups). Applications include Polya theory (counting group orbits) and its use in chemistry, construction of combinatorial designs.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2003-2004 academic year

Pre-Requisite(s): MA 5301

MA 6302 - Algebraic Curves and Algebraic Codes

Introduction to the theory of algebraic curves, equivalent algebraic function fields (main theorems Riemann-Roch theorem and Hasse-Weil theorem) and the construction of error-correcting codes from algebraic curves with finite fields of constants.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2002-2003 academic year

Pre-Requisite(s): MA 5301

MA 6700 - Advanced Topics in Statistics

Topics may include but are not limited to experimental designs, methods of quality improvement, discrete data analysis, regression analysis, sampling theory, multivariate methods, resampling methods, statistical computing, integral and measure theory, stochastic processes, asymptotic methods, optimization, modeling, nonparametric and parametric statistics.

Credits: variable to 12.0; Repeatable to a Max of 48

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 6701 - Probability

Review of discrete probability, probability measures, random variables, distribution functions, expectation as a Lebesgue-Stieltjes integral, independence, modes of convergence, laws of large numbers and iterated logarithms, characteristic functions, central limit theorems, conditional expectation, martingales, introduction to stochastic processes.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): MA 3720 and MA 4450

MA 6980 - Special Topics in Mathematics

Special topics in mathematics.

Credits: variable to 12.0; Repeatable to a Max of 48

Semesters Offered: Fall, Spring, Summer

MA 6999 - Mathematical Sciences Doctoral Research

Taken in partial fulfillment of the doctoral thesis requirement.

Credits: variable to 12.0; Repeatable to a Max of 48; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Graduate Course Descriptions Effective Fall 2007

https://www.banweb.mtu.edu/pls/owa/stu_ctg_utils.p_online_all_courses_gr

For more information, contact

Office of Student Records and Registration

Michigan Technological University

1400 Townsend Drive

Houghton, Michigan 49931-1295

906/487-2319

Fax: 906/487-3343

Email: stuosrr@mtu.edu