**MATHEMATICS (MATH)**

**MATH 5000 Special Problems** (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

**MATH 5001 Special Topics** (LEC 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

**MATH 5010 Graduate Seminar** (SEM 1.0)
Discussion of advanced or current topics.

**MATH 5040 Oral Examination** (IND 0.0)
After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

**MATH 5099 Graduate Research** (IND 0.0-6.0)
Investigation of an advanced nature leading to the preparation of a MS thesis or dissertation.

**MATH 5105 Modern Algebra I** (LEC 3.0)
Equivalence relations and functions, basic properties of groups, subgroups, permutations, cosets and Lagrange’s Theorem, homomorphisms and isomorphisms, factor groups. Prerequisite: Math 3109 or graduate standing; preceded or accompanied by Math 3108.

**MATH 5106 Modern Algebra II** (LEC 3.0)
This course is a continuation of Math 5105. Rings and fields are discussed. Euclidean domains, principal ideal domains, unique factorization domains, vector spaces, finite fields and field extensions are studied. Prerequisite: Math 5105.

**MATH 5107 Combinatorics And Graph Theory** (LEC 3.0)
Covers some basics of enumeration and graph theory. Topics are selected from the following: permutations combinations, the inclusion/exclusion principle, generating functions, recurrence relations, trees, networks, graph connectivity and graph coloring. Prerequisite: Comp Sci 1200 or Math 3109.

**MATH 5108 Linear Algebra II** (LEC 3.0)
Eigenvalue problems, Cayley-Hamilton theorem, Jordan normal form, linear functionals, bilinear forms, quadratic forms, orthogonal and unitary transformations, selected applications of linear algebra. Prerequisite: Math 3108.

**MATH 5154 Mathematical Logic I** (LEC 3.0)
A mathematical introduction to logic with some applications. Functional and relational languages, satisfaction, soundness and completeness theorems, compactness theorems. Examples from Mathematics, Philosophy, Computer Science, and/or Computer Engineering. Prerequisite: Philos 3254 or Math 5105 or Comp Sci 2500 or Comp Eng 2210. (Co-listed with Comp Eng 5803, Comp Sci 5203 and Philos 4354).

**MATH 5215 Introduction To Real Analysis** (LEC 3.0)
Riemann-Stieltjes integration, sequences and series of functions, uniform approximation, the Banach Space C(a,b), Lebesgue measure and integration, the space LP(a,b), Fourier series. Prerequisite: Math 4209.

**MATH 5222 Vector And Tensor Analysis** (LEC 3.0)
Vector algebra, vector differential and integral calculus, line and surface integrals, theorems of Stokes and Gauss, tensor algebra and tensor analysis, applications to problems in kinematics, elasticity theory, fluid mechanics, electromagnetic theory, relativity theory. Prerequisite: Math 2222; Math 3103 or Math 3108.

**MATH 5302 Intermediate Differential Equations** (LEC 3.0)
Linear differential equations, vector-matrix systems, existence and uniqueness theory, nonlinear systems, phase-plane analysis, introduction to stability theory. Prerequisite: Math 3304 or Math 3329.

**MATH 5325 Partial Differential Equations** (LEC 3.0)
Linear equations, heat equation, eigenfunction expansions, Green’s formula, inhomogeneous problems, Fourier series, wave equation. Prerequisite: Math 3304 with a grade of "C" or better.

**MATH 5351 Introduction To Complex Variables** (LEC 3.0)
The basic tools of complex variables are studied. These include the Cauchy-Riemann equations, complex contour integration, the Cauchy-Goursat theorem, conformal mappings, the calculus of residues and applications to boundary value problems. Prerequisite: Math 3304.

**MATH 5483 Operational Calculus** (LEC 3.0)
The Laplace transformation, properties of the transformation, various applications to ordinary and partial differential equations, systems with step and Dirac functions as driving forces, various non-elementary functions and their transforms, problems in heat conduction and wave motion, Fourier transforms and their operational properties. Prerequisite: Math 3304.

**MATH 5530 Topics in Geometry - Graduate Option** (LEC 3.0)
A survey of non-Euclidean geometries, finite geometries, affine and projective planes, metric postulates for the Euclidean plane, and selected topics. Students will demonstrate graduate-level mastery of the subject matter. Credit will not be given for both Math 4530 and Math 5530. Prerequisites: MATH 3108.

**MATH 5585 Introduction To Topology** (LEC 3.0)
Metric spaces; general topological spaces; connectedness, compactness, separation properties, functions and continuity. Prerequisite: Math 4209.
MATH 5603 Methods of Applied Mathematics (LEC 3.0)
Methods to develop and analyze mathematical models. Topics include dimensional analysis and scaling, perturbation methods, and the construction of ordinary and partial differential equation models. Prerequisites: Math 3304 or 3329 with a grade of "C" or better, programming competency.

MATH 5604 Introduction to Numerical Methods for Differential Equations (LEC 3.0)
An introduction to finite difference methods for ordinary and partial differential equations, including (1) the derivation of the numerical methods, (2) implementation of the methods in Matlab, and (3) the mathematical accuracy and stability analysis of the methods. Prerequisites: MATH 3304 and programming competency (preferably Matlab).

MATH 5737 Financial Mathematics (LEC 3.0)
The course objective is to provide an understanding of the fundamental concepts of financial mathematics. Topics include pricing, assets-liability management, capital budgeting, valuing cash flow, bonds, futures, swaps, options. Preparation for the financial mathematics actuarial exam will be provided. Prerequisites: Math 1215 or Math 1221, Econ 2100 or Econ 2200 or Finance 2150 or Finance 5160, Stat 3111 or Stat 3113 or Stat 3115 or Stat 3117 or Stat 5643. (Co-listed with Econ 5337).

MATH 5948 Mathematical Analysis For Secondary Teachers Practicum (LEC 1.0)
An instructional unit based on the discovery method used in Math 340 will be designed by each student. These units will be class tested. The unit and results of class testing will be presented both in written and oral format. Prerequisite: Math 2222 or equivalent.

MATH 5940 Mathematical Analysis For Secondary Teachers (LEC 3.0)
Designed to help teachers gain a deeper understanding of the fundamental idea in analysis, that of a limit. A discovery method is used which includes both individual and group work. Students will present their results in written and oral format. Prerequisite: Math 2222 or equivalent.

MATH 6005 Finite Fields And Applications (LEC 3.0)
A second course in matrix theory directed toward applications. Linear spaces, linear operators, equivalence and similarity, spectral theorem, canonical forms, congruence, inertia theorem, quadratic forms, singular value decomposition and other factorizations, generalized inverses. Applications to optimization, differential equations, stability. Prerequisites: Math 3103, 3108, or 5302.

MATH 6010 Graduate Seminar (RSD 1.0-3.0)
Discussion of topics of current interest. Prerequisite: Graduate standing.
MATH 6216 Functions Of A Real Variable II (LEC 3.0)
Abstract measures and integrals, the Daniell integration theory, integration on locally compact Hausdorff spaces, integration in function spaces, selected topics. Prerequisite: Must be preceded by Math 6215.

MATH 6330 Theory Of Differential Equations I (LEC 3.0)
Stability theory, Liapunov’s direct method, periodic solutions, Poincare-Bendixson theory, applications. Prerequisite: Math 5302.

MATH 6331 Theory Of Differential Equations II (LEC 3.0)
Continuation of Math 6330. Nonlinear oscillations, solutions near singular points, asymptotic methods, differential equations on manifolds, boundary-value problems. Prerequisite: Math 5302.

MATH 6351 Functions Of A Complex Variable I (LEC 3.0)
Complex plane, complex function theory, elementary Riemann surfaces, conformal mapping, complex integration, infinite complex series and sequences, calculus of residues with applications. Prerequisite: Math 4211.

MATH 6352 Functions Of A Complex Variable II (LEC 3.0)
Argument principle and consequences; harmonic functions and Dirichlet’s problem; infinite products; entire, meromorphic and rational functions; analytic continuation; symmetry principle; conformal mapping; functions of several complex variables. Prerequisite: Preceded by Math 6351.

MATH 6375 Theory Of Partial Differential Equations (LEC 3.0)
Sobolev spaces; existence, uniqueness, and regularity of weak solutions to linear elliptic, parabolic, and hyperbolic PDEs; selected topics. Prerequisite: Math 6417.

MATH 6383 Special Functions (LEC 3.0)
Legendre, Hermite, Laguerre, and Jacobi; elliptic functions, theta functions, Jacobian elliptic functions. Prerequisite: Math 6215.

MATH 6417 Functional Analysis I (LEC 3.0)
Banach spaces, Hilbert spaces, linear transformations, Hahn-Banach theorem, duality, uniform boundedness principle, weak topologies, convexity, bounded linear maps, compact operators, and spectral theory. Prerequisites: Math 5215; Math 5108 or Math 5585.

MATH 6418 Functional Analysis II (LEC 3.0)
A continuation of Math 6417 with additional topics related to bounded and unbounded operators and their applications. Prerequisites: Math 6215 and Math 6417.

MATH 6461 Harmonic Analysis I (LEC 3.0)
Fourier series, norm and pointwise convergence of Fourier series, the conjugate and maximal functions, analytic functions in the unit disk and Hardy spaces, interpolation of linear operators and the Hausdorff-Young-Riesz Theorem, Sidon sets. Prerequisites: Math 5215 and Math 5351.

MATH 6462 Harmonic Analysis II (LEC 3.0)
Fourier integrals, almost-periodic functions on the real line, Banach algebras, Wiener's Tauberian Theorem and the prime number theorem, the Paley-Wiener Theorems, band-limited functions and Shannon's Theorem, the continuous wavelet transform, discrete wavelet transforms and frames, orthonormal bases of wavelets and multi-resolution analysis. Prerequisite: Must be preceded by Math 6461.

MATH 6540 Geometric Structures (LEC 3.0)
Selected topics in non-Euclidean, solid, projective, and fractal geometry. Prerequisite: Math 4530.

MATH 6548 Geometric Structures Practicum (LEC 1.0)
An instructional unit based on material learned in Math 6540 will be designed by each student. These units will be class tested. The unit and results of class testing will be presented both in written and oral format. Prerequisite: Math 6540.

MATH 6585 Topology I (LEC 3.0)
Topological spaces, uniform and quasi-uniform spaces, product and quotient spaces, separation properties and connected spaces, compactness. Prerequisite: Math 5585.

MATH 6586 Topology II (LEC 3.0)
Metrizability conditions, the theory of convergence using both filters and nets, completions and compactifications, and papers from the recent literature. Prerequisite: Math 6585.

MATH 6601 Numerical Analysis (LEC 3.0)
A proof based course emphasizing theoretical analysis of convergence and accuracy of various numerical methods including approximate solutions of linear and nonlinear equations, numerical integration, and function approximation, with implementation to validate results and illustrate the methods. Prerequisites: Any 4000 or higher level MATH course, or any instructor approved 4000 or higher level course from another discipline with a significant computational component.

MATH 6602 Mathematical Foundation of Finite Element Methods (LEC 3.0)
Implementation and theoretical analysis of the finite element method for the approximate solution of partial differential equations. Implementation of finite element methods for elliptic and parabolic equations. Theoretical analysis of convergence, accuracy, and stability of approximate solutions. Prerequisites: Any 4000 or higher level Mathematics course, or any instructor approved 4000 or higher level course from another discipline with a significant computational component.

MATH 6665 Mathematical Programming (LEC 3.0)
Linear optimization and its engineering applications; problem modeling, search-based optimization, the simplex method for solving linear problems, multi-objective optimization, discrete dynamic programming. Applications of optimization in the fields such as transportation, project management, manufacturing and facility location will be discussed. Prerequisites: One of the following: Stat 3113, Stat 3115, or Stat 3117; Math 3108. (Co-listed with Eng Mgt 6412 and Sys Eng 6412).
MATH 6737 Financial Mathematics II (LEC 3.0)
Continuation of Math 5737/Econ 5337. Topics include martingales and measures, stopping times, discrete and continuous time finance, Brownian motion, Ito calculus, stochastic differential equations, Black-Scholes-Merton formula, numerical procedures. Prerequisite: Math 5737 or Econ 5337. (Co-listed with Econ 6337).

MATH 6802 Mathematical Physics I (LEC 3.0)
Vector spaces, generalized coordinate transformations, vector analysis, tensors, partial differential equations in physics and boundary value problems, orthogonal functions and solutions to ordinary differential equations, hypergeometric, confluent hypergeometric, Legendre, Laguerre, and Bessel functions, Hermite polynomials, Green's functions in one dimension. (Co-listed with Physics 6403).

MATH 6803 Mathematical Physics II (LEC 3.0)
Green's functions in three dimensions, integral equations, complex variable theory and contour integration, group theory with applications to quantum mechanics, solid state and molecular physics. Prerequisite: Math 6802 or Physics 6403. (Co-listed with Physics 6413).