Mathematics (3450)

3450:501 History of Mathematics (3 Credits)
Prerequisite: departmental permission. Origin and development of mathematical ideas. Course does not meet degree requirements in the department.

3450:510 Advanced Linear Algebra (3 Credits)
Prerequisite: departmental permission. Study of vector spaces, linear transformation, canonical and quadratic forms, inner product spaces.

3450:511 Abstract Algebra I (3 Credits)
Prerequisite: Departmental permission. Study of groups, rings, fields, integral domains, vector spaces, field extensions. Galois theory. May not be used to meet master’s degree requirements in mathematics.

3450:512 Abstract Algebra II (3 Credits)
Prerequisite: 3450:511 or departmental permission. Study of groups, rings, fields, integral domains, vector spaces, field extensions, Galois theory.

3450:513 Theory of Numbers (3 Credits)
Prerequisite: departmental permission. Euclidean algorithm, unique factorization theorem, congruences, primitive roots, indices, quadratic residues, number-theoretic functions, Gaussian integers and continued fractions.

3450:515 Combinatorics & Graph Theory (3 Credits)
Prerequisite: departmental permission. Introduction to basic ideas and techniques of mathematical counting; properties of structure of systems.

3450:520 Mathematical Technology and Communication (3 Credits)
Prerequisites: departmental permission. Graphical, numerical, and algebraic computation with applications using a variety of mathematical hardware and software: symbolic manipulators, dynamic geometry software, programs, scripts and web-browsers.

3450:521 Advanced Calculus I (3 Credits)
Sequential. Prerequisite: Departmental permission. Real number system, sequences, series, set theory, continuity, differentiation, integration, partial derivatives, multiple integration, maxima and minima, convergences and uniform convergences, power series, improper integrals, transformations, line and surface integrals. May not be used to meet master’s degree requirements for mathematics or applied mathematics.

3450:522 Advanced Calculus II (3 Credits)
Sequential. Prerequisite: departmental permission. Real number system, sequences, series, set theory, continuity, differentiation, integration, partial derivatives, multiple integration, maxima and minima, convergence and uniform convergence, power series, improper integrals, transformations, line and surface integrals.

3450:525 Complex Variables (3 Credits)
Prerequisite: departmental permission. Complex variables; elementary functions, differentiation and analytic functions; integration and Cauchy’s theorem; power series and Laurent series; residue theorem; applications such as conformal mappings, inversion of integral transform.

3450:527 Applied Numerical Methods I (3 Credits)
Prerequisite: departmental permission. Numerical methods in polynomial interpolation, root finding, numerical integration, and numerical linear algebra. May not be used to meet master’s degree requirements for applied mathematics.

3450:528 Applied Numerical Methods II (3 Credits)
Prerequisite: departmental permission. Numerical methods in the solution of ordinary and partial differential equations. Numerical differentiation, Runge-Kutta methods, and iterative methods for ODEs, finite differences for PDEs.

3450:532 Introduction to Partial Differential Equations (3 Credits)
Prerequisite: departmental permission. Studies of various aspects of the analysis of Partial Differential Equations, including the construction of solutions, their uniqueness, behavior and qualitative properties.

3450:535 Systems of Ordinary Differential Equations (3 Credits)
Prerequisites: departmental permission. Analysis, solution of systems of equations, linear, nonlinear. Topics: stability theory, perturbation methods, asymptotic methods, applications from physical, social sciences.

3450:536 Mathematical Models (3 Credits)
Prerequisite: departmental permission. Matrices, eigenvalue problems, systems of ODEs, vector analysis, complex variables. May not be used to meet master’s requirements for applied mathematics.

3450:539 Advanced Engineering Mathematics II (3 Credits)
Prerequisite: departmental permission. Special functions, fourier series and transforms, PDEs.

3450:541 Concepts in Geometry (4 Credits)
Prerequisite: departmental permission. Axiomatic treatment of both Euclidean and non-Euclidean geometries. Other concepts included are finite geometry, transformations, constructions and inversions.

3450:545 Introduction to Topology (3 Credits)
Prerequisite: departmental permission. Introduction to topological spaces and topologies, mapping, cardinality, homeomorphisms, connected spaces, metric spaces.

3450:589 Topics in Mathematics (1-4 Credits)
(May be repeated for a total of 12 credits) Prerequisite: permission of instructor. Selected topics in mathematics and applied mathematics at an advanced level.

3450:591 Workshop in Mathematics (1-4 Credits)
(May be repeated) Group studies of special topics in mathematics and applied mathematics. May not be used to meet undergraduate or graduate credit requirements in mathematics. May be used for elective credit only.

3450:611 Topics in Algebra (3 Credits)
Prerequisite: 3450:512 or departmental permission. Advanced study of selected topics in some of the following areas: semigroups, groups, rings, modules and fields.

3450:621 Real Analysis (3 Credits)
Prerequisite: 3450:522 or departmental permission. In-depth study of real analysis - metric spaces, normed vector spaces, integration theory, Hilbert spaces.
3450:525 Analytic Function Theory (3 Credits)
Prerequisite: 3450:522 or departmental permission. Complex number system, holomorphic functions, continuity, differentiability, power series, complex integration, residue theory, singularities, analytic continuation, asymptotic expansion.

3450:627 Advanced Numerical Analysis I (3 Credits)
Prerequisites: 3450:522 (grade C- or better) and knowledge of C++, FORTRAN, or MATLAB or departmental permission. Error propagation; theoretical analysis of numerical methods in interpolation, integration and ordinary differential equations.

3450:628 Advanced Numerical Analysis II (3 Credits)
Prerequisites: 3450:522 (grade C- or better) and knowledge of C++, FORTRAN, or MATLAB or departmental permission. Theoretical analysis of numerical methods in linear algebra.

3450:631 Calculus of Variations (3 Credits)
Prerequisite: departmental permission. Problems with fixed and movable endpoints, problems with constraints, generalization to several variables, the maximality principle, linear time-optimal problems, the connective between classical theory and the maximality principle.

3450:632 Advanced Partial Differential Equations (3 Credits)
Prerequisite: 3450:532 or departmental permission. Existence, uniqueness and stability of solutions to general classes of partial differential equations. Methods for solving these classes introduced, emphasizing both analytical and numerical techniques.

3450:633 Methods of Applied Mathematics I (3 Credits)
Prerequisite: 3450:539 or departmental permission. Methods of applied mathematics concentrating on techniques for analysis of differential and integral equations - applied complex analysis, integral transforms, partial differential equations, and integral equations.

3450:634 Methods of Applied Mathematics II (3 Credits)
Prerequisite: 3450:539 or departmental permission. Methods of applied mathematics concentrating on techniques for analysis of differential and integral equations - applied complex analysis, integral transforms, partial differential equations, and integral equations.

3450:635 Optimization (3 Credits)
Prerequisite: 3450:522 or departmental permission. Unconstrained and constrained optimization theory and methods in applied problems.

3450:636 Advanced Combinatorics & Graph Theory (3 Credits)
Prerequisite: departmental permission. Theory and techniques of combinatorics as applied to network problems and graph theoretic problems.

3450:638 Theory & Application of Wavelets (3 Credits)
Prerequisite: permission of instructor. Theory of wavelets and applications to signal and image analysis. Topics include time-frequency representations, filter bands, discrete and continuous wavelet transforms, wavelet packets, and applications.

3450:689 Advanced Topics in Mathematics (1-3 Credits)
(May be repeated for a total of six credits) Prerequisite: permission of advisor. Seminar-type discussion on topics in mathematics leading to supervised research project. No more than 2 credits apply to major requirements.

3450:692 Seminar in Mathematics (3 Credits)
Prerequisite: permission of advisor. Seminar-type discussion on topics in mathematics leading to supervised research project.

3450:695 Practicum in Mathematics (1-3 Credits)
(May be repeated) Prerequisite: graduate teaching assistant or permission. Training and experience in college teaching of mathematics. May not be used to meet degree requirements. Credit/noncredit.

3450:697 Individual Reading: Mathematics (1-3 Credits)
(May be repeated for a total of four credits) Prerequisites: graduate standing and permission. Directed studies in mathematics at graduate level under guidance of selected faculty member.

3450:698 Master's Research (1-6 Credits)
(May be repeated) Prerequisite: permission of advisor. Research in suitable topics in mathematics or applied mathematics culminating in a research paper. May not be used to meet master's degree requirements for mathematics or applied mathematics.

3450:699 Master's Thesis (3 Credits)
Prerequisite: permission. A properly qualified candidate for the master's degree may obtain three credits for research that culminates in a public oral presentation of the faculty-supervised thesis.

3450:721 Functional Analysis I (3 Credits)
Prerequisites: 3450:510 and 3450:621 or departmental permission. These courses are sequential. Study of normed linear spaces and transformations between them with an emphasis on the formulation and analysis of differential and integral equations as operator equations on these spaces.

3450:722 Functional Analysis II (3 Credits)
Prerequisites: 3450:510 and 3450:621 or departmental permission. These courses are sequential. Study of normed linear spaces and transformations between them with an emphasis on the formulation and analysis of differential and integral equations as operator equations on these spaces.

3450:728 Matrix Iterative Analysis (3 Credits)
Prerequisite: departmental permission. Basic Iterative methods, Matrix Properties and Concepts, Linear and Nonlinear equation solver, Semi-iterative and conjugate-gradient methods.

3450:730 Advanced Numerical Solution of Partial Differential Equations (3 Credits)
Prerequisites: 3450:522 and 3450:528, or 3450:628, or departmental permission. Derivation, analysis, and implementation of difference and variational-based methods for the solution of partial differential equations and systems of differential equations.

3450:732 Advanced Partial Differential Equations II (3 Credits)

3450:733 Asymptotic Methods & Nonlinear Analysis I (3 Credits)
Prerequisites: 3450:633/634 or equivalent. Survey of asymptotic and perturbation methods as applied to integrals and differential equations. Topics: bifurcation and stability with applications from the physical sciences and engineering.

3450:734 Asymptotic Methods & Nonlinear Analysis II (3 Credits)
Prerequisites: 3450:633/634 or equivalent. Survey of asymptotic and perturbation methods as applied to integrals and differential equations. Topics: bifurcation and stability with applications from the physical sciences and engineering.

3450:539 or departmental permission. Methods of applied mathematics concentrating on techniques for analysis of differential and integral equations - applied complex analysis, integral transforms, partial differential equations, and integral equations.

These courses are sequential. Study of normed linear spaces and transformations between them with an emphasis on the formulation and analysis of differential and integral equations as operator equations on these spaces.

3450:730 Advanced Numerical Solution of Partial Differential Equations (3 Credits)
Prerequisites: 3450:522 and 3450:528, or 3450:628, or departmental permission. Derivation, analysis, and implementation of difference and variational-based methods for the solution of partial differential equations and systems of differential equations.

3450:732 Advanced Partial Differential Equations II (3 Credits)

3450:733 Asymptotic Methods & Nonlinear Analysis I (3 Credits)
Prerequisites: 3450:633/634 or equivalent. Survey of asymptotic and perturbation methods as applied to integrals and differential equations. Topics: bifurcation and stability with applications from the physical sciences and engineering.

3450:734 Asymptotic Methods & Nonlinear Analysis II (3 Credits)
Prerequisites: 3450:633/634 or equivalent. Survey of asymptotic and perturbation methods as applied to integrals and differential equations. Topics: bifurcation and stability with applications from the physical sciences and engineering.
3450:735 Dynamical Systems (3 Credits)
Prerequisite: 3450:522 or departmental permission. The study of mathematical models of systems which evolve over time. An introduction to maps and applications to ordinary differential equations.