Mathematics (MATH)

math.uconn.edu

5000. Mathematical Pedagogy

One credit. Prerequisite: Open to graduate students in Mathematics, others with instructor consent.

The theory and practice of teaching mathematics at the college level. Basic skills, grading methods, cooperative learning, active learning, use of technology, classroom problems, history of learning theory, reflective practice. May not be used to satisfy degree requirements in mathematics.

5010. Topics in Analysis I

Three credits. Prerequisite: Instructor consent. May be repeated for credit with change in content.

Advanced topics in analysis.

5011. Topics in Analysis II

Three credits. Prerequisite: MATH 5010; instructor consent required. With a change of content, may be repeated for credit.

Advanced topics in analysis.

5016. Topics in Probability

Three credits. May be repeated for a maximum of 12 credits with change in content.

Advanced topics in probability theory, theory of random processes, mathematical statistics, and related fields.

5020. Topics in Algebra

Three credits. Prerequisite: MATH 5211. May be repeated for credit.

Advanced topics chosen from group theory, ring theory, number theory, Lie theory, combinatorics, commutative algebra, algebraic geometry, homological algebra, and representation theory.

5026. Topics in Mathematical Logic

Three credits. Prerequisite: MATH 5260; instructor consent required. May be repeated for credit.

Topics include, but are not restricted to, Computability Theory, Model Theory, and Set Theory.

5030. Topics in Geometry and Topology I

Three credits. Prerequisite: Instructor consent. May be repeated for a maximum of 12 credits with change in content.

Advanced topics in Geometry and Topology.

5031. Topics in Geometry and Topology II

Three credits. Prerequisite: MATH 5030; instructor consent required. With a change of content, may be repeated for credit.

Advanced topics in Geometry and Topology.

5040. Topics in Applied Analysis I

Three credits. Prerequisite: Instructor consent. May be repeated for a maximum of 12 credits.

Advanced topics from the theory of ordinary or partial differential equations. Other possible topics: integral equations, optimization theory, the calculus of variations, advanced approximation theory.

5041. Topics in Applied Analysis II

Three credits. Prerequisite: Instructor consent. May be repeated for a maximum of 12 credits.

Advanced topics from the theory of ordinary or partial differential equations. Other possible topics: integral equations, optimization theory, the calculus of variations, advanced approximation theory.

5046. Introduction to Complex Variables

Three credits. Not open for credit to students who have passed MATH 3146.

Functions of a complex variable, integration in the complex plane, conformal mapping. Open for master's credit but not doctoral credit toward degree in Mathematics.

5050. Analysis

Three credits. Not open for credit to students who have passed MATH 3150.

Introduction to the theory of functions of a real variable. Open for master's credit but not doctoral credit toward degree in Mathematics.

5070. Topics in Scientific Computation

Three credits. May be repeated for a total of 12 credits.

5110. Introduction to Modern Analysis

Three credits.

Metric spaces, sequences and series, continuity, differentiation, the Riemann-Stielties integral, functions of several variables.

5111. Measure and Integration

Three credits. Prerequisite: MATH 5110.

General theory of measure and Lebesgue integration, L^p-spaces.

5120. Complex Function Theory I

Three credits. Prerequisite: MATH 5110.

An introduction to the theory of analytic functions, with emphasis on modern points of view.

5121. Topics in Complex Function Theory

Three credits. Prerequisite: MATH 5120. May be repeated for credit with a change in content and consent of the instructor.

Advanced topics of contemporary interest. These include Riemann surfaces, Kleinian groups, entire functions, conformal mapping, several complex variables, and automorphic functions, among others.

5130. Functional Analysis I

Three credits. Prerequisite: MATH 5111.

Normed linear spaces and algebras, the theory of linear operators, spectral analysis.

5131. Functional Analysis II

Three credits. Prerequisite: MATH 5111. With a change of content, may be repeated for a maximum of six credits.

Normed linear spaces and algebras, the theory of linear operators, spectral analysis.

5140. Fourier Analysis

Three credits. Prerequisite: MATH 5111.

Foundations of harmonic analysis developed through the study of Fourier series and Fourier transforms.

5141. Fourier Analysis on Groups

Three credits. Prerequisite: MATH 5111.

5160. Probability Theory and Stochastic Processes I

Three credits.

Convergence of random variables and their probability laws, maximal inequalities, series of independent random variables and laws of large numbers, central limit theorems, martingales, Brownian motion.

5161. Probability Theory and Stochastic Processes II

Three credits. Prerequisite: MATH 5160. May be repeated for a maximum of 12 credits.

Contemporary theory of stochastic processes, including stopping times, stochastic integration, stochastic differential equations and Markov processes, Gaussian processes, and empirical and related processes with applications in asymptotic statistics.

5210. Abstract Algebra I

Three credits.

Group theory, ring theory and modules, and universal mapping properties.

5211. Abstract Algebra II

Three credits. Prerequisite: MATH 5210.

Linear and multilinear algebra, Galois theory, category theory, and commutative algebra.

5220. Introduction to Representation Theory

Three credits. Prerequisite: MATH 5210.

Semi-simple rings, Jacobson radical, density theory, Wedderburn's Theorem, representations and characters of groups, orthogonality relations, Burnside’s theorem.

5230. Algebraic Number Theory

Three credits. Prerequisite: MATH 5211.

Algebraic integers, ideal class group, ramification, Frobenius elements in Galois groups, Dirichlet's unit theorem, localization, and completion. Further topics (zeta-functions, function fields, non-maximal orders) as time permits.

5250. Modern Matrix Theory and Linear Algebra

Three credits.

The LU, QR, symmetric, polar, and singular value matrix decompositions. Schur and Jordan normal forms. Symmetric, positive-definite, normal and unitary matrices. Perron-Frobenius theory and graph criteria in the theory of non-negative matrices.

5260. Mathematical Logic I

Three credits. Prerequisite: MATH 5210.

Predicate calculus, completeness, compactness, Lowenheim-Skolem theorems, formal theories with applications to algebra, Godel's incompleteness theorem. Further topics chosen from: axiomatic set theory, model theory, recursion theory, computational complexity, automata theory and formal languages.

5310. Introduction to Geometry and Topology I

Three credits. Prerequisite or corequisite: MATH 5110.

Topological spaces, maps, induced topologies, separation axioms, compactness, connectedness, classification of surfaces, the fundamental group and its applications, covering spaces.

5311. Introduction to Geometry and Topology II

Three credits. Prerequisite: MATH 5310. With a change in content, may be repeated for a maximum of 12 credits.

Smooth manifolds, vector fields, differential forms, de Rham cohomology, homology theory, singular (co)homology, Poincaré duality.

5320. Algebraic Geometry I

Three credits. Prerequisite: MATH 5211 and 5310, which may be taken concurrently.

This course is an introduction to algebraic varieties: affine and projective varieties, dimension of varieties and subvarieties, algebraic curves, singular points, divisors and line bundles, differentials, intersections.

5321. Algebraic Geometry II

Three credits. Prerequisite: MATH 5320.

This course introduces further concepts and methods of modern algebraic geometry, including schemes and cohomology.

5360. Differential Geometry

Three credits.

This course is an introduction to the study of differentiable manifolds on which various differential and integral calculi are developed. The topics include covariant derivatives and connections, geodesics and exponential map, Riemannian metrics, curvature tensor, Ricci and scalar curvature.

5410. Introduction to Applied Mathematics I

Three credits.

Banach spaces, linear operator theory and application to differential equations, nonlinear operators, compact sets on Banach spaces, the adjoint operator on Hilbert space, linear compact operators, Fredholm alternative, fixed point theorems and application to differential equations, spectral theory, distributions.

5411. Introduction to Applied Mathematics II

Three credits.

Banach spaces, linear operator theory and application to differential equations, nonlinear operators, compact sets on Banach spaces, the adjoint operator on Hilbert space, linear compact operators, Fredholm alternative, fixed point theorems and application to differential equations, spectral theory, distributions.

5420. Ordinary Differential Equations

Three credits. Prerequisite: MATH 5111.

Existence and uniqueness of solutions, stability and asymptotic behavior. If time permits: eigenvalue problems, dynamical systems, existence and stability of periodic solutions.

5430. Applied Analysis

Three credits. Not open for credit to students who have passed MATH 3430. May not be used for credit for Mathematics graduate degrees.

Convergence of Fourier Series, Legendre and Hermite polynomials, existence and uniqueness theorems, two-point boundary value problems and Green's functions.

5435. Introduction to Partial Differential Equations

Three credits. Not open to students who have passed MATH 3435. Not open for graduate credit toward degrees in Mathematics.

Solution of first and second order partial differential equations with applications to engineering and science.

5440. Partial Differential Equations

Three credits. Prerequisite or corequisite: MATH 5120.

Cauchy Kowalewsky Theorem, classification of second-order equations, systems of hyperbolic equations, the wave equation, the potential equation, the heat equation in Rn.

5510. Numerical Analysis and Approximation Theory I

Three credits. Prerequisite or corequisite: MATH 5110.

The study of convergence, numerical stability, roundoff error, and discretization error arising from the approximation of differential and integral operators.

5511. Numerical Analysis and Approximation Theory II

Three credits. Prerequisite: MATH 5510.

The study of convergence, numerical stability, roundoff error, and discretization error arising from the approximation of differential and integral operators.

5520. Finite Element Solution Methods I

Three credits.

Numerical solution of elliptic, parabolic and hyperbolic partial differential equations by finite element solution methods. Applications.

5521. Finite Element Solution Methods II

Three credits. Prerequisite: MATH 5520.

Numerical solution of elliptic, parabolic and hyperbolic partial differential equations by finite element solution methods. Applications.

5580. Optimization

Three credits.

Theory of linear programming: convexity, bases, simplex method, dual and integer programming, assignment, transportation, and flow problems. Theory of nonlinear programming: unconstrained local optimization, Lagrange multipliers, Kuhn-Tucker conditions, computational algorithms. Concrete applications.

5600. Fundamentals of Financial Mathematics

Three credits.

The risk-neutral model for pricing and hedging derivative financial instruments within the context of binomial and trinomial models of the stock price process.

5620. Financial Mathematics I

Three credits. Not open for credit to students who have passed MATH 2620.

The mathematics of measurement of interest, accumulation and discount, present value, annuities, loans, bonds, and other securities.

5630. Long-Term Actuarial Mathematics I

Four credits. Prerequisite: MATH 2620 or 5620, which may be taken concurrently. Not open for credit to students who have passed MATH 3630.

Long-term insurance products, survival and longevity models, life tables, life insurance, life annuities, premium calculations, reserves.

5631. Long-Term Actuarial Mathematics II

Four credits. Prerequisite: MATH 5630. Not open to students who have passed MATH 3631.

A continuation of Long-Term Actuarial Mathematics I. Topics include multiple state models, multiple decrements, multiple lives, profit and loss analysis, pension plans and funding, retirement benefits, long-term health and disability.

5637. Statistics for Actuarial Modeling

Four credits. Not open to students who have passed MATH 3636 or 3637.

Data analysis for actuaries, linear models including generalized linear models, time series, principal component analysis, decision trees, cluster analysis, statistical computing with R, actuarial applications.

5638. Predictive Analytics for Actuaries

Three credits. Prerequisite: MATH 5637.

Models for predictive analytics, model building, selection, estimation, validation and diagnostics, and limitations; actuarial applications, and communication of results.

5639. Actuarial Loss Models

Three credits. Not open to students who have passed MATH 3639.

Loss distribution models for claim frequency and severity, aggregate risk models, coverage modifications, risk measures, construction and selection of parametric models, introduction to simulation.

5640. Short-Term Insurance Ratemaking

Three credits. Prerequisite: MATH 5639. Not open to students who have passed MATH 3640.

Credibility theory, pricing for short-term insurance coverages, reinsurance, experience rating, risk classification, introduction to Bayesian statistics.

5641. Short-Term Insurance Reserving

Three credits. Prerequisite: MATH 5639. Not open to students who have passed MATH 3641.

Techniques for estimating unpaid claims, use of claims triangles, underlying statistical theory behind the techniques, basic adjustments to data and estimation techniques to account for internal and external environments, estimating recoveries, model adequacy and reasonableness.

5650. Financial Mathematics II

(Formerly offered as MATH 5621.) Four credits. Not open for credit to students who have passed MATH 3650.

The continuation of MATH 5620, focusing on the mathematics of finance: measurement of financial risk and the opportunity cost of capital, the mathematics of capital budgeting and securities valuation, mathematical analysis of financial decisions and capital structure, and option pricing theory. Provides VEE credit in the Corporate Finance subject area for Society of Actuaries and Casualty Actuarial Society requirements.

5660. Advanced Financial Mathematics

Three credits.

An introduction to the standard models of modern financial mathematics including martingales, the binomial asset pricing model, Brownian motion, stochastic integrals, stochastic differential equations, continuous time financial models, completeness of the financial market, the Black-Scholes formula, the fundamental theorem of finance, American options, and term structure models.

5661. Yield Curve Models

Three credits.

The theory and practice of stochastic models to analyze and value interest rate derivatives, and practical issues in the markets where they are traded.

5670. Financial Programming and Modeling

Three credits.

Optimization; linear and non-linear programming; data mining and machine learning in a financial context.

5671. Financial Data Mining and Big Data Analytics

Three credits.

Data structures and algorithms; regression; classification; clustering; recommender systems; anomaly detection; Big Data tools; databases

5800. Investigation of Special Topics

Variable (1-6) credits. Prerequisite: Instructor consent. May be repeated for a total of 36 credits.

Students who have well defined mathematical problems worthy of investigation and advanced reading should submit to the department a semester work plan.

5850. Graduate Field Study Internship

Variable (1-3) credits. Prerequisite: Instructor consent.

Participation in internship and paper describing experiences.

6000. Seminar in Current Mathematical Literature

Variable (1-6) credits. May be repeated for a total of 12 credits.

Participation and presentation of mathematical papers in joint student faculty seminars. Variable topics.

6010. Seminar in Analysis

Variable (1-6) credits. Students taking this course will be assigned a final grade of S (satisfactory) or U (unsatisfactory).

6020. Seminar in Algebra

Variable (1-6) credits. Prerequisite: MATH 5211. Students taking this course will be assigned a final grade of S (satisfactory) or U (unsatisfactory).

6026. Seminar in Mathematical Logic

Variable (1-6) credits. Prerequisite: MATH 5260. May be repeated for a maximum of 12 credits. Students taking this course will be assigned a final grade of S (satisfactory) or U (unsatisfactory).

6027. Seminar in Set Theory

Variable (1-6) credits. Prerequisite: MATH 5310. Students taking this course will be assigned a final grade of S (satisfactory) or U (unsatisfactory).

6030. Seminar in Topology

Variable (1-6) credits. Prerequisite: MATH 5321. Students taking this course will be assigned a final grade of S (satisfactory) or U (unsatisfactory).

6036. Seminar in Geometry

Variable (1-6) credits. Prerequisite: MATH 5360. Students taking this course will be assigned a final grade of S (satisfactory) or U (unsatisfactory).

6040. Seminar in Applied Mathematics

Variable (1-6) credits. Students taking this course will be assigned a final grade of S (satisfactory) or U (unsatisfactory).