Course Master Catalog

MATH

MATH6001

Advanced Calculus I

This course studies the analysis of functions on Euclidean space and on metric spaces, starting with basic set theory and axioms of real numbers. Notions of continuity, convergence, differentiation and integration are emphasized. Material covered includes: Axioms of real numbers. Metric spaces. Completeness axiom. Open, closed, and compact sets in Euclidean spaces. Convergent sequences, Cauchy sequences. Upper and lower limits. Bolzano-Weierstrass and Heine-Borel theorems. Series, tests for convergence and absolute convergence. Limits and continuity of functions on metric spaces. Continuity in terms of open sets. Continuity with compactness, connectedness. Derivatives of functions on the real line, product, quotient, chain rules. Mean value, intermediate value, and Taylor theorems. Riemann integration on the real line, integrability of step functions, uniform limits of integrable functions, continuous functions. Change of variable. Students will be expected to have a strong background in single- and multivariable calculus (MATH 1062 and 2063) as well as the prior experience of a proof-based course (MATH 3001 or 3002 or equivalent). Credit Level:U,G Credit Hrs:4 Pre-req: See your college advisor for details. Baccalaureate Competency: Critical Thinking, Effective Communication, Information Literacy, Knowledge Integration.

MATH6002

Advanced Calculus II

This is a direct continuation of Math 6001 with the emphasis on the calculus of mappings between general Euclidean spaces. Material covered includes: linear maps, differentiability, partial derivatives, differentiability of functions whose partial derivatives are continuous, chain rule, Jacobian, inverse and implicit function theorems. Uniform convergence of sequences of functions, Arzela-Ascoli theorem. Basics of Fourier series. Students will be expected to have completed MATH 6001 or the equivalent. Credit Level:U,G Credit Hrs:4 Pre-req: See your college advisor for details. Baccalaureate Competency: Critical Thinking, Effective Communication, Information Literacy, Knowledge Integration.

MATH6003

Abstract Linear Algebra

The course will study topics in linear algebra in the abstract setting, including abstract vector spaces, subspaces, isomorphisms, quotient spaces, linear independence, basis, dimension. Additional topics include linear functionals, duals, codimension, linear mappings, null space, range, Rank-Nullity theorem, transpositions, similarity, projections, matrices, Gaussian elimination, determinants, eigenvalues, eigenvectors, Spectral Mapping and Cayley-Hamilton theorems, minimal and characteristic polynomials, similarity of matrices, canonical forms. Credit Level:U,G Credit Hrs:3 Pre-req: See your college advisor for details. Baccalaureate Competency: Critical Thinking, Effective Communication, Knowledge Integration.

MATH6004

Group Theory

Definition of groups. Examples: symmetric group, dihedral group, matrixgroup, cyclic and abelian groups.Maps of groups, homomorphisms, epimorphisms, and isomorphisms. Order of a group, finite and infinite groups.Subgroups. Centralizers, normalizers, stabilizers, and kernels. The lattice of subgroups. Cosets. Normal subgroups and simple groups. The isomoprhisms theorems. Lagrange theorem.Group actions. Permutations representations, Cayley's theorem and action of a group on a set of cosets, order of orbits, index of stabilizer, class equation. Automoprhisms. Sylow theorems. Frobenius' proof, Wieland's proof, Simplicity of the alternating group.New groups from old. The isomorphism types of group of order less than 15. The direct product, internal and external. The direct sum, internal and external. The semidirect product. Classes of groups: nilpotent groups, solvable groups, free groups, generators and relations. Credit Level:U,G Credit Hrs:3 Pre-req: See your college advisor for details. Baccalaureate Competency: Critical Thinking, Effective Communication, Information Literacy, Knowledge Integration.

MATH6005

Introduction to Complex Analysis

Complex numbers considered algebraically and geometrically, polar form, powers and roots, derivative of complex-valued functions, analyticity, Cauchy-Riemann equations, harmonic functions, elementary functions, and their derivatives, visualization of complex-valued functions, conformal mapping, elementary functions as conformal mappings, integration of complex-valued functions, Cauchy's Integral Theorem, Cauchy's Integral Formula, residue theory and applications, basics of Mobius transformations. Students will be expected to have a strong background in multivariable calculus (MATH 2063). Credit Level:U,G Credit Hrs:3 Baccalaureate Competency: Critical Thinking, Effective Communication, Knowledge Integration.

MATH6006

Numerical Analysis

Topics will include floating point arithmetic, rootfinding for nonlinear equations, fixed point analysis, stability, interpolation theory, least squares methods for function approximation and numerical methods for integration. A primary focus is on the use of Taylor's theorem to analyze the methods.The analysis will be emphasized here instead of computation. Carefully chosen model or prototype problems will be examined in order to furnish theorems and insight into the behavior of the approximation methods. Credit Level:U,G Credit Hrs:3 Baccalaureate Competency: Critical Thinking, Effective Communication, Information Literacy, Knowledge Integration.

MATH6007

Partial Differential Equations and Fourier Analysis

Heat equation, method of separation of variables, Fourier series. Wave equation: vibrating strings, and membranes. Sturm-Liouville eigenvalue problems. Non-homogenous problems. Green's functions for time-independent problems and/or Infinite domain problems: Fourier transform solutions of partial differential equations. Students will be expected to have a working knowledge of multivariable calculus (Math 2063) and differential equations (Math 2073). Some knowledge of linear algebra would be helpful (Math 2076). Credit Level:U,G Credit Hrs:3 Baccalaureate Competency: Critical Thinking, Effective Communication, Information Literacy, Knowledge Integration, Social Responsibility.

MATH6008

Applied Probability and Stochastic Processes

A review of random variables and probability theory with an emphasis on conditioning as a technique for computing probabilities and expectations. Detailed study of discrete and continuous time Markov chains and Poisson processes, with introduction to one or more of the following: martingales, Brownian motion, random walks, renewal theory. Students will be expected to have a working knowledge of multivariable calculus (MATH 2063), linear algebra (MATH 2076) and an introduction to probability (STAT2037 or MATH 4008). Credit Level:U,G Credit Hrs:3 Baccalaureate Competency: Critical Thinking, Effective Communication, Information Literacy, Knowledge Integration, Social Responsibility.

MATH6010

Probabilistic Aspects of Financial Modeling

This course begins with models for finite financial markets in discrete time, covering derivatives, arbitrage pricing, market completeness, trading strategies, replicating portfolios, and risk neutral measures in this context, and constructing single and multiple period binomial tree models for modeling stock prices and pricing options. Then the analogous continuous time theory is developed. Concepts and techniques from probability and stochastic processes are introduced, including Brownian motion, martingales and stochastic calculus, in order to derive the martingale (risk-neutral) approach to solving the Black-Scholes p.d.e. and pricing a variety of financial contracts and derivatives. This course will be useful for students preparing for the Financial Economics segment of Actuarial Exam M. Credit Level:U,G Credit Hrs:3 Pre-req: See your college advisor for details. Baccalaureate Competency: Critical Thinking, Effective Communication, Information Literacy, Knowledge Integration, Social Responsibility.

MATH6011

Computational Financial Mathematics

The course covers financial mathematics from the basics to advanced techniques and concepts. Financial mathematics and corresponding mathematical concepts are explained and derived mathematically while being implemented through programming in Mathematica at the same time. No knowledge of Mathematica is required, but will be gained quickly, as it is used extensively. Topics include: Elementary stochastic differential equation (SDE); Monte-Carlo simulations; Ito chain rule; Log-Normal market model; derivation of the Black-Scholes partial differential equation (PDE) - pricing and hedging in complete markets; statistics of SDEs; statistical and implied volatility; local volatility pricing models and numerical PDEs; American options and free boundary problems; optimal portfolio theory; introduction to pricing and hedging in incomplete markets. Students will be expected to have a strong background in multivariable calculus (MATH 2063), differential equations (MATH 2073), linear algebra (MATH 2076), and an introduction to probability theory (STAT 2037). Credit Level:U,G Credit Hrs:3 Baccalaureate Competency: Critical Thinking, Effective Communication, Information Literacy, Knowledge Integration, Social Responsibility.

MATH6012

Applied Linear Algebra

Gaussian elimination, matrix operations, LDU factorization, inverses. Vector spaces, basis and dimension, the fundamental subspaces of a matrix. Linear transformations, matrix representations, change of bases. Orthogonality, Gram-Schmidt method, QR factorization, projections, least squares. Determinants, properties and applications. Eigenvalues and eigenvectors, diagonalization of a matrix, similarity transformations, symmetric matrices, applications to difference equations and differential equations. The Jordan form. Credit Level:U,G Credit Hrs:3 Baccalaureate Competency: Critical Thinking, Effective Communication, Information Literacy, Knowledge Integration, Social Responsibility.

MATH6015

Mathematical Programming

Applications of mathematical programming using packages such as MATLAB and Mathematica. Projects will encompass calculus, linear algebra, and differential equations. Students will be expected to have a working knowledge of multivariable calculus (MATH 2063), linear algebra (MATH 2076), and differential equations (MATH 2073). Credit Level:U,G Credit Hrs:3 Baccalaureate Competency: Critical Thinking, Effective Communication, Information Literacy, Knowledge Integration, Social Responsibility.

MATH6048

Advanced Topics in Math/Stat I

The course will vary according to the topic. Credit Level:U,G Credit Hrs:2 - 4 Pre-req: See your college advisor for details. Baccalaureate Competency: Critical Thinking.

MATH6049

Advanced Topics in Math/Stat II

The course will vary according to the topic. Credit Level:U,G Credit Hrs:2 - 4 Baccalaureate Competency: Critical Thinking.

MATH6051

Applied Ordinary Differential Equations

This course is intended for undergraduates and for graduate students in other departments; it is not intended for graduate students in the mathematical sciences. It covers the theory of ordinary differential equations, with an emphasis on applications. Basic concepts, special types of differential equations of the first order,and problems that lead to them.Linear differential equations of order greater than one and problems that lead to them. Linear vector spaces.Systems of differential equations, linearization of first order systems, problems giving rise to systems.Existence and uniqueness theorem for first order differential equations. Existence and uniqueness theorem for a system of first order differential equations and for linear and nonlinear differential equations of order greater than one. Wronskians.Other supplementary topics: state variable description of systems, fundamental matrix, state transition matrix, matrix exponential, stability of linear systems.Time permitting: Operators and Laplace transforms, series methods Credit Level:U,G Credit Hrs:3 Baccalaureate Competency: Critical Thinking, Information Literacy, Knowledge Integration, Social Responsibility.

MATH7001

Complex Analysis

The Riemann sphere and stereographic projection, elementary functions.Holomorphic maps: complex versus real differentiability, the Cauchy-Riemann equations, conformal and isogonal diffeomorphisms, power series.Möbius transformations: circle preservation property, cross ratios, symmetry, self-maps of disks on the sphere.Cauchy Theory: Cauchy's theorem and integral formulas, winding number, Morera's theorem, Liousville's theorem, maximum principle, local analysis of holomorphic functions (factorization theorem, branched covering principle, interior uniqueness theorem), open mapping theorem, Schwarz's lemma, Taylor series.Singularities and residues: isolated singularities, Laurent series, residue theorem, argument principle, evaluation of definite integrals, Rouche's theorem. Credit Level:G Credit Hrs:4 Pre-req: See your college advisor for details.

MATH7002

Real Analysis

Measure and integration with emphasis on the real line and the plane. Measures and measurable functions, Lusin and Egoroff theorems, Lebesgue integral, Fatou's lemma, monotone and dominated convergence. Convergences: uniform, a.e., in measure, in mean. Product measures, Fubini and Tonelli theorems. Radon-Nikodym theorem. Absolute continuity, bounded variation, and the fundamental theorem of calculus on the real line. Credit Level:G Credit Hrs:4 Pre-req: See your college advisor for details.

MATH7003

Rings, Fields and Galois Theory

Rings, homomorphisms and ideals, quotient rings, integral domains and fraction fields, prime and irreducible elements. Unique factorization domains, principal ideal domains and Euclidean domains, Gauss' lemma.Fields and field extensions, algebraic and transcendental elements, adjunction of roots, finite fields.Galois theory: splitting fields, normal and separable extensions, the Main Theorem of Galois theory. Cyclic and cyclotomic extensions, solvable and radical extensions, insolvability of the quintic equation. Credit Level:G Credit Hrs:4 Pre-req: See your college advisor for details.

MATH7004

Topology

Pointset topology (approximately 10 weeks): Topological spaces, closed sets, subspaces, closure, boundary, interior, connectedness, path-connectedness, compactness, normal topology, Hausdorff property, continuity at a point (topological continuity and sequential continuity), continuous maps, Urysohn metrization theorem, Tietze extension theorem, quotient topology, weak topology, Baire category theorem, nets, convergence with respect to nets.Fundamental groups (approximately 4 weeks): Homotopy of paths, homotopy of maps, fundamental groups, fundamental groups of (i) circles, (ii) spheres, (iii) torii, (iv) Möbius strip and (v) Klein bottle, free groups, simply connected spaces, covering spaces, homotopy lifting theorem. Credit Level:G Credit Hrs:4 Pre-req: See your college advisor for details.

MATH7005

Ordinary Differential Equations

Linear systems: linear systems with constant coefficients, phase portraits and dynamical classification, linear systems and exponentials of operators, linear systems and canonical forms of operators.Fundamental theory: existence and uniqueness, continuity and differentiability of solutions in initial conditions, extending solutions, global solutions.Nonlinear systems: nonlinear sinks and sources, hyperbolicity, stability, limit sets, gradient and Hamiltonian systems, other topics at instructor's discretion. Credit Level:G Credit Hrs:4 Pre-req: See your college advisor for details.

MATH7006

Partial Differential Equations

Four important linear partial differential equations: 1)Transport equations, initial value problem; 2) Laplace equation: fundamental solution, mean-value formulas, Green's function; 3) Heat equation, fundamental solution, maximum principle; 4) Wave equations, solution by spherical means, energy methods.Nonlinear first-order PDEs: complete integrals, characteristics, introduction to Hamilton-Jacobi equations, and introduction to conservation laws.Other ways to represent solutions: separation of variables, Fourier transform, Laplace transform, noncharacteristic surfaces, real analytic functions, Cauchy-Kovalevskaya theorem. Credit Level:G Credit Hrs:4 Pre-req: See your college advisor for details.

MATH7011

Advanced Mathematical Modeling

Mathematical modeling with ordinary and partial differential equations is used to simulate and understand physical systems in a broad range of applications in fields including engineering, physics, chemistry, biology and sociology. This course, which is intended for graduate students in Mathematics, Engineering, Physics, and Chemistry, will introduce techniques used to derive these types of models as well as a wide range of methods to solve them including non-dimensionalization, qualitative analysis, regular and singular perturbations, traveling waves, and scientific computing. Possible example problems involving solidification, phase separation, physiological flow, enzyme kinetics, population growth, neuronal networks, calcium dynamics, glycolysis, climate change, and tumor growth will be given to illustrate the modeling and solution techniques. Students will be expected to have a strong background in single- and multivariable calculus (MATH 1062, 2063), differential equations (MATH 2073), linear algebra (MATH 2076), and basic computer programming skills. Credit Level:G Credit Hrs:4

MATH7047

Individual Work in Graduate Mathematical Sciences

Individual Work in Graduate Mathematical Sciences allows students to focus on topics outside in the standard curriculum in Mathematics and Statistics. Students work closely with faculty to develop reading lists and assignments. Permission of the Graduate Program Director and Graduate Advisor is required. Credit Level:G Credit Hrs:1 - 8

MATH7071

Algebra & Number Theory 1

Properties of the Integers, Rationals, Reals, Complexes and Integers mod m. Solutions of linear and quadratic equations. Division and Euclidean algorithm. Prime factorization. Number theoretic functions, representations of numbers. Credit Level:G Credit Hrs:3

MATH7072

Algebra & Number Theory 2

Theory of primes and factorization in Euclidean domains especially the Gaussian Integers and polynomial rings over subfields of Complexes. Rational and irrational numbers, constructable numbers. Credit Level:G Credit Hrs:3

MATH7073

Probability and Statistical Inference

Probability axioms and finite probability spaces. Combinatorics. Binomial and Normal distributions. Historical topics. Design of statistical studies and methods of statistical inference. Credit Level:G Credit Hrs:2

MATH7074

Technology for Statistics

Spreadsheets and statistical packages for handling and exploring data, doing simulations, and illustrating concepts of statistics. Project-oriented with cooperative learning component. Credit Level:G Credit Hrs:1

MATH7075

Geometry 1

Axiomatic geometry, both neutral and Euclidean. Credit Level:G Credit Hrs:3

MATH7076

Geometry 2

Transformational geometry, topics in analytical geometry Credit Level:G Credit Hrs:3

MATH7077

Linear Algebra For Geometry

Study of vectors and linear transformations from a geometric viewpoint; the algebra of matrices. Focus is on dimensions 2 and 3; isometries and symmetry groups. Credit Level:G Credit Hrs:2

MATH7078

Technology for Geometry

Technology for teaching geometry including: dynamic geometry programs such as GeoGebra; computer graphics; technical word processing. Design of lessons that use technology. Project-oriented with cooperative learning component. Credit Level:G Credit Hrs:1

MATH7079

Analysis 1

Theory of calculus of one variable. Continuity and differentiability. Credit Level:G Credit Hrs:3

MATH7080

Analysis 2

Theory of calculus of one variable. Riemann integral and infinite series. Credit Level:G Credit Hrs:3

MATH7081

Mathematical Models

Development and analysis of mathematical models of continuous phenomena with special attention to topics from high school physics an chemistry. Illustrates and uses concepts from Analysis 1 and 2 Credit Level:G Credit Hrs:2

MATH7082

Technology for Calculus

Introduction to the use of technology for teaching analysis (pre-calculus and calculus). Graphing calculators, symbolic algebra programs, dynamic geometry programs. Design and delivery of lessons that use technology. Project-oriented with cooperative learning component. Credit Level:G Credit Hrs:1

MATH7083

MAT Project

This is a directed study that allows the student to pursue personal interests related to mathematics and the teaching of mathematics. Credit Level:G Credit Hrs:3

MATH8001

Geometric Function Theory

This course will cover selected topics from the following list: normal families, Arzela-Ascoli Theorem, Riemann Mapping Theorem, boundary behavior of conformal mappings, measures of distortion, conformal maps and Liouville's Theorem in higher dimensions, quasiconformal and quasiregular mappings, mappings of finite distortion, hyperbolic and other conformal metrics. Credit Level:G Credit Hrs:3

MATH8002

Geometric Analysis

This course will cover selected topics from the following list: Quasiconformal mappings between metric spaces, Uniform metric spaces and Gromov hyperbolicity, Metric space analysis, Potential theory in metric measure spaces, Geometric measure theory (Euclidean or metric space). Credit Level:G Credit Hrs:3

MATH8003

Functional Analysis

Banach Spaces, examples including Lp spaces, continuous functions, smooth functions. Brief introduction to Hilbert spaces. Main theorems: Hahn-Banach, uniform boundedness, open mapping, closed graph, Banach Alaoglu. Duality and weak topologies. Examples and applications including Sobolev spaces and representation theorems. Introduction to C*-algebras. Abelian algebras, Gelfand theorem. GNS theorem. Credit Level:G Credit Hrs:3

MATH8004

Operator Theory

Hilbert spaces, orthonormal bases, examples, including wavelets, Fourier series.Bounded linear operators, selfadjoints operators, projections, spectra, resolvents. Compact operators and Fredholm operators and examples from integral equations and other applications. The spectral theorem for selfadjoint operators. Unbounded operators. Examples from differential equations. Time permitting, an introduction to operator algebras. Credit Level:G Credit Hrs:3

MATH8005

Introduction to Algebraic Geometry

Affine varieties. Correspondence between ideals and varieties, Zariski topology, Hilbert's nullstellensatz. Hilbert's basis theorem, Polynomial and rational functions.Projective varieties. Projective space and varieties, maps between projective varieties, adjunction of roots, finite fields.Tangent spaces, smoothness and dimension, localization and the tangent space at a point,smooth and singular points, dimension of a variety.Optional topics: Elliptic Curves. Plane curves. Classification of smooth cubics. Group structure of an elliptic curve. Theory of Curves. Divisors on curves, Bezout's theorem, Linear systems on curvesComputational algebraic geometry, Groebner basis algorithm, existence and uniqueness of Groebner bases, implementation of the algorithm Credit Level:G Credit Hrs:3

MATH8006

Algebra and Cryptography

This course is an introduction to Algebra and Cryptography, where we show how algebra plays the role of foundation of modern cryptography. We will first cover the basic structures of finite fields including all the basic concepts and theorems. Then we will introduce the theory of multivariate public key cryptosytems including the basics of MPKCs and constructions of MPKCs, the fundamental problems behind the security of MPKCs, and different attack and defense methods.We will next cover the basics of symmetric ciphers, their explicit constructions, the fundamental problems behind the security of symmetric ciphers and different attack and defense methods, in particular, algebraic attacks. The last topic we will cover is about the new Mutant XL family of polynomial solving algorithms and implementations. This course should enable students to develop a solid foundation in applying modern algebraic theory to cryptography.Optional topics: RSA, Diffie-hellman, Elliptic curve cryptography, factoring problem,discrete logarithm problem. Credit Level:G Credit Hrs:3

MATH8007

Advanced Stochastic Processes

Martingales, Kolmogorov's Existence Theorem, Kolmogorov's continuity criterion, Wiener process, point processes. Other examples and methods from the area of stochastic processes, depending on student interest and instructor choice. Students will be expected to have prior knowledge of either real analysis (MATH 7002) or measure-theoretic probability (STAT 7032). Credit Level:G Credit Hrs:3

MATH8008

Stochastic Differential Equations

Wiener process; Itô's integral; Itô's chain rule and the martingale representation theorem; stochastic differential equations - existence and uniqueness; the filtering problem; Itô diffusions - generator, Kolmogorov's backward equation; Girsanov's theorem; optimal stopping problem - connection with variational inequality; stochastic control; applications drawn from finance, statistics, or second-order partial differential equations. Credit Level:G Credit Hrs:3

MATH8009

Advanced Partial Differential Equations

Theory of Sobolev spaces: Holder spaces, Sobolev spaces, approximation by smooth functions, extensions, traces, Sobolev inequalities, compact embedding, other spaces of functions.Second order elliptical equations: existence of weak solutions, regularity, maximum principles, eigenfunctions and eigenvalues. Second order parabolic equations: existence of weak solutions, regularity, maximum principles.Second order hyperbolic equations: existence of weak solutions, regularity, propagation of disturbances.Fixed point methods, method of subsolutions and supersolutions. Credit Level:G Credit Hrs:3

MATH8010

Advanced Numerical Analysis

Partial differential equations (PDEs) model a wide range of physical phenomena including heat conduction, wave propagation, and fluid flow. Computer approximations to the solutions of the PDE problems that arise in these applications are usually required.This course will focus on the finite element method (FEM) and will use energy (Hilbert space) techniques. The first part of the course will cover error analysis for ordinary differential equations from the Atkinson text (Chapter 6) and also iterative methods for matrices (Sections 8.6-8.8).The second part of this course will discuss the mathematical foundations of the FEM in Sobolev spaces and develop a basic approximation theory. Once this background is established, we will survey error estimates developed in various applications which may include first order hyperbolic equations,nonlinear time-dependent parabolic problems including the Cahn-Hilliard (phase transitions) or the Navier-Stokes (fluid flow) equations. We may also look at discontinuous Galerkin discretizations in time and space. Nonconforming methods are also of interest as well as the development of a posteriori error estimates and how they are used to design adaptive schemes. Credit Level:G Credit Hrs:3

MATH8011

Scientific Computation

Fluid-structure interaction (FSI) problems are one of the popular topics in scientific computing that can be found in nature and many engineering systems. Examples include aircrafts, bridges, aneurysms in large arteries, biofilms, and artificial heart valves. FSI problems are often very complex and hard to solve analytically so they have to be analyzed by numerical simulation.The department has expertise in a wide range of modern computational techniques including the Immersed Boundary Method, the X-FEM scheme for problems with singularities and Moving Least Squares Meshless Methods. The first two are popular in applications in the biosciences and are used for FSI problems.Leading up to the special topics above will be consideration of finite difference (FD) schemes for stationary and time-dependent partial differential equation problems, iteration techniques such as preconditioned conjugate gradients and the use of FFT's for the FD approximation of solutions to the Poisson problem, fluid and elastodynamics problems and computational solutions, and the use of FEM packages such as PDE Tool in MATLAB. Credit Level:G Credit Hrs:3

MATH8012

Applied Mathematics Methods

While intended for Mathematics graduate students, those in Engineering, Physics, and Chemistry will also find this course useful. Techniques covered are valuable for solving, approximating, or simplifying a wide class of ordinary and partial differential equation problems modeling physical systems. These include: nondimensionalization, qualitative analysis, regular and singular perturbation techniques, multiscale analysis including two-timing, traveling waves, and modeling. Techniques are developed within applications which will vary depending on the instructor. Possible examples arise from solidification, climate change, cancer tumor growth, phase separation, kidney function, calcium dynamics, neurons and neuronal networks, enzyme kinetics, and osmotic flow. Others might focus on fluid dynamics. Here we would study theories of continuous fields including the continuum model, kinematics of deformable media, the material derivatives, field equations of continuum mechanics, and inviscid fluid flow. Students will be expected to have a working knowledge of Advanced Calculus (MATH 6002), Linear Algebra (MATH 6012), and PDEs (MATH 6007). Some knowledge of Complex Analysis (MATH 6005), ODEs (MATH 7005), and programming would be helpful. Credit Level:G Credit Hrs:3

MATH8048

Graduate Topics in Math/Stat I

The course will vary according to the topic. Credit Level:G Credit Hrs:2 - 4

MATH8049

Graduate Topics in Math/Stat II

The course will vary according to the topic. Credit Level:G Credit Hrs:2 - 4

MATH8098

Practicum in Applied Mathematics

This course is intended for graduate students who obtain internships in applied mathematics. Credit Level:G Credit Hrs:1 Pre-req: See your college advisor for details.

MATH9001

Advanced Financial Mathematics

General SDE framework for financial mathematics; complete and incomplete markets; optimal portfolio theory; non-linear PDE of portfolio optimization; neutral pricing PDE systems - linear and non-linear; indifference pricing non-linear PDE systems; general portfolio hedging formula; applications in interest rate models, equity valuation models, equity derivatives, foreign exchange models and derivatives. Credit Level:G Credit Hrs:3

MATH9040

Proseminar in the Teaching of College Mathematics

This course is meant for first year graduate students, as an introduction to teaching in a college environment. This course cannot be used to satisfy the breadth requirement for the PhD program or the credit requirement for the MS program in Math or Stat. Credit Level:G Credit Hrs:1 - 3

MATH9051

Seminar in Functional Analysis

Participants will present recent results in their area of research interest, mainly in operator theory and operator algebras.This course can be repeated. Credit Level:G Credit Hrs:3

MATH9052

Seminar in Functional Analysis

Participants will present recent results in their area of research interest, mainly in operator theory and operator algebras.This course can be repeated. Credit Level:G Credit Hrs:3

MATH9053

Seminar in Geometric Analysis

Participants will present recent results in their area of research interest, mainly in geometric analysis.This course can be repeated. Credit Level:G Credit Hrs:3

MATH9054

Seminar in Geometric Analysis

Participants will present recent results in their area of research interest, mainly in geometric analysis.This course can be repeated. Credit Level:G Credit Hrs:3

MATH9055

Seminar in Algebra

Participants will present recent results in their area of research interest in various areas of algebra and its applications to cryptography. Credit Level:G Credit Hrs:3

MATH9056

Seminar in Algebra

Participants will present recent results in their area of research interest in various areas of algebra and its applications to cryptography. Credit Level:G Credit Hrs:3

MATH9057

Seminar in Partial Differential Equations

Participants will present recent results in their area of research interest in various areas of of partial differential equations.This course can be repeated. Credit Level:G Credit Hrs:3

MATH9058

Seminar in Partial Differential Equations

Participants will present recent results in their area of research interest in various areas of of partial differential equations. This course can be repeated. Credit Level:G Credit Hrs:3

MATH9059

Seminar in Probability

Participants will present recent results in their area of research interest in various areas of probability.This course can be repeated. Credit Level:G Credit Hrs:3

MATH9060

Seminar in Probability

Participants will present recent results in their area of research interest in various areas of probability. This course can be repeated. Credit Level:G Credit Hrs:3

MATH9061

Seminar in Applied Mathematics

Participants will present recent results in their area of research interest in various areas of applied mathematics. This course can be repeated. Credit Level:G Credit Hrs:3

MATH9062

Seminar in Applied Mathematics

Participants will present recent results in their area of research interest in various areas of applied mathematics. This course can be repeated. Credit Level:G Credit Hrs:3

MATH9063

Seminar in Financial Mathematics

Participants will present recent results in their area of research interest in financial mathematicsThis course can be repeated. Credit Level:G Credit Hrs:3

MATH9064

Seminar in Financial Mathematics

Participants will present recent results in their area of research interest in financial mathematics. This course can be repeated. Credit Level:G Credit Hrs:3

MATH9071

Thesis Research

Writing a doctoral dissertationThis course can be repeated. Credit Level:G Credit Hrs:1 - 12

MATH9072

Dissertation Research

Writing a doctoral dissertationThis course can be repeated. Credit Level:G Credit Hrs:1 - 12

MATH9073

Research

Research in mathematics.This course can be repeated. Credit Level:G Credit Hrs:1 - 12

MATH9074

Research

Research in mathematics.This course can be repeated. Credit Level:G Credit Hrs:1 - 12

MATH9075

Readings

Independent work on advanced mathematics texts and papers.This course can be repeated. Credit Level:G Credit Hrs:1 - 12

MATH9076

Readings

Independent work on advanced mathematics texts and papers.This course can be repeated. Credit Level:G Credit Hrs:1 - 12