Upper Level in Mathematics 2009-2010

Math 3A03 Real Analysis I Fall Dr E. Sawyer

Sequences of real numbers; supremum, continuity. Riemann integral, differentiation. Sequences and series of functions; uniform continuity and uniform convergence.

Math 3B03 Geometry Fall Dr. M. Wang

Selected topics from: affine and projective geometry, Euclidean , spherical and hyperbolic geometry, differential geometry of curves and surfaces.

Math 3C03 Mathematical Physics 1 Fall Dr. Z. V. Kovarik

Linear algebra and eigenvalue problems; partial differential equations, orthogonal functions, Fourier series, Legendre functions, spherical harmonics.

Math 3D03 Mathematical Physics II Winter Dr. Z. V. Kovarik

Functions of a complex variable, probability and statistics, boundary value problems, Bessel functions.

Math 3E03 Algebra I Fall Dr M. Harada

An introduction to group theory, including Sylow theorems and structure of finitely generated Abelian groups; applications of group theory.

Math 3EE3 Algebra II Winter Dr A. Nicas

Topics in ring and module theory, in particular principal ideal domains, unique factorization domains, Euclidean rings; field theory and Galois theory.

Math 3F03 Advanced Differential Equations Fall Dr J. Cuadros

Systems of ordinary differential equations, autonomous systems in the plane, phase portraits, linear systems, stability, Lyapunov's method, Poincare-Bendixson theorem, applications.

Math 3FF3 Partial Differential Equations I Winter Dr D. Pelinovsky
First order equations, well-posedness, characteristics, wave equation, heat equation, Laplace equation, boundary conditions, Fourier series, applications.

Math 3G03 Problem Solving Winter Dr Z. V. Kovarik
A course designed to illustrate the principles of mathematical problem solving. Maximum enrolment is 20 students.

Math 3GP3 Geometric Ideas in Physics Winter Dr. M. Min-Oo

Geometry is one of the oldest disciplines of Science and dates back to ancient times. The Egyptians used geometric formulas to measure the land, whence the Greek word: geometry. The Greeks themselves adored the subject and cultivated it into a beautiful abstract piece of Mathematics, as epitomized in Euclid's books. Modern Differential Geometry began with Gauss' work on the Theory of Surfaces in the early 19th century. Gauss was again partly motivated by practical surveying problems about mapping the surface of the earth. By that time it was well known that the earth is not flat and hence that Euclidean Geometry is not adequate. Gauss applied the powerful method of the Infinitesimal Calculus, invented about a century earlier by Newton and Leibniz, in his investigations on the curvature of surfaces. A few decades later this Gaussian theory was generalized to a higher level of abstraction and dimension by Riemann, who introduced the notion of a manifold as an appropriate form of space where one can study geometries. Euclidean geometry then became just one very special case among an infinity of possible geometries and the laws of Euclidean geometry were postulated to be true only for measurements at a very small scale, to be precise, at the infinitesimal level. These Euclidean measurements, in other words, the metric, is now allowed to vary from one point to the next.
The idea of space itself as a dynamic entity was born. It was the genius of Einstein who realized that these new geometric ideas should be the basis for understanding not just the shape of the earth but that of the while universe of space and time. His revolutionary General Theory of Relativity is a masterpiece of Geometric Physics explaining that mysterious fundamental force of Nature, Gravitation, which holds the universe together on a large scale, as a manifestation of the curvature of space-time itself. In his later years Einstein dreamed of generalizing his theory to encompass all the other known forces of Nature. This dream, known as the GUT (Grand Unified Theory), is still pursued by theoretical physicists and over the last four decades, there

has been some spectacular new theoretical advances. The main problem here is to resolve the basic "contradiction" between General Relativity and Quantum Mechanics.

This course will attempt to give a view of the deep holistic connection between geometry and physics, with special emphasis on General Relativity. We will discuss in detail two specific model solutions to Einstein's field equations: (i) the Schwarzschild black-hole metric and (ii) The Friedmann-Robertson-Walker cosmological model.

At an elementary level, the course is based only on Vector Calculus and Linear Algebra, but we will learn some of the key techniques and methods of Differential Geometry which are crucial in understanding the physical laws of the Universe.

Math 3H03 Number Theory Fall Dr. M. Kolster

Math 3I03 Partial Differential Equations for Engineering Fall Dr. B. Galvao-Sousa

Topics in partial differential equations of interest to mechanical, material and ceramic engineering, including the wave equation, the heat diffusion equation and Laplace equation, in various co-ordinate systems.

Math 3Q03 Numerical Interpolation and Approximation Theory Fall Dr. N. Kevlahan

This course discusses both theoretical and practical aspects of numerical interpolation and approximation. Such techniques form the core of Numerical Analysis and are the basis for solution of many important problems. We review the relevant mathematical theory and show how it can be used to construct practical algorithms. These algorithms are implemented and tested in {\tt matlab}.

Our focus is on applications to numerical differentiation and integration of functions. However, we also review certain additional, closely related, topics such as solution of nonlinear equations and wavelet approximation theory.

Math 3T03 Inquiry in Topology Winter 2010 Dr. E. Martinez Pedroza

Modern Topology is at the core of mathematics. It deals with the notion of shape and continuity, and it is widely used in pure as well as applied mathematics. This is an introductory course to the subject. The topics that will be discussed are: Topological Spaces and Continuous Functions, Connectedness and Compactness, Countability and Separation Axioms, The Tychonoff Theorem, Metrization Theorems and paracompactness, Complete Metric Spaces and Function Spaces, Baire Spaces and Dimension Theory.

Math 3V03 Graph Theory Fall Dr. S. Azgin

Graphs, trees, bipartite graphs, connectivity, graph colouring, matrix representations, applications.

Math 3X03 Complex Analysis I Winter Dr Kaveh

Analytic functions, Cauchy's theorem, Cauchy's integral formula, residues, zeroes of analytic functions; Laurent series, the maximum principle.

Math 3Z03 Inquiry: History of Mathematics Winter Dr G. H. Moore

An introduction to the history of mathematics, including interaction with other phases of culture, with special emphasis on the past three centuries.

Math 4A03/6A03 Real Analysis II Fall Dr. S. Alama

Metric spaces, compactness. Spaces of continuous functions, functions of several variables, inverse and implicit function theorems. Lebesgue integration.

Math 4B03/6B03 Calculus on Manifolds Fall Dr. M. Min-Oo

Review of multivariable calculus, basic properties of manifolds, differential forms, Stokes' theorem, de Rham cohomology and applications.

Math 4E03 / 6E03 Galois Theory Fall Dr M. Kolster
Field extensions, splitting fields, normality and separability, Galois extensions, finite fields, solvability by radicals, cyclic extensions, cyclotomic extensions, algebraic closure, classical constructions, computations of Galois groups.

Math 4G03 / 6G03 Dynamical Systems Winter Dr . G. Wolkowicz
Topics to be selected from ordinary differential equations theory, bifurcation and stability theory.

Math 4K03 / 6K03 Mathematics of Finance Fall Dr T. Hurd

Options and forwards, efficient market hypothesis, no arbitrage condition, binomial asset pricing model, portfolio strategies, stochastic processes, conditional expectation, martingales, optimal portfolio selection, exotic options, stochastic interest rate models.

Math 4LT3 Topics in Logic Winter M. Valeriote

This course will provide an introduction to model theory. According to Wilfrid Hodges, "model theory is the study of the construction and classification of structures within specified classes of structures." In the course we will consider structures that can be specified using first-order predicate logic and we will work through some of the fundamental results of the subject, including the completeness and compactness theorems, the Lowenheim-Skolem theorem and the omitting types theorem.

Math 4Q03 / 6Q03 Numerical Methods for Differential Equations Winter Dr . R. Yapalparvi
Approximation error; methods for ordinary differential equations, stiffness; iterative methods for boundary value problems; weighted residuals; spectral methods; methods for partial differential equations, accuracy, consistency, convergence; stability analysis.

Math 4X03 / 6X03 Complex Analysis II Winter Dr E. Sawyer
Conformal maps, analytic continuation, harmonic functions, the Riemann mapping theorem, Riemann surfaces.