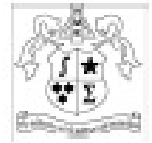




Pi Mu Epsilon

& GAMECOCK MATH CLUB



**Getting to Know Your
500-Level
MATH Courses
at the
University of South Carolina**

Event sponsored in part by



MATH 511/STAT 511: Probability

Prerequisite: Grade of C or higher in MATH 241

The purpose of this course is to give you an introduction to probability theory and probability distributions. The material presented will not only serve as a basis for the subsequent courses, STAT 512/513, but is also extremely useful and fascinating in its own right. STAT 511 has a prerequisite of a standard multivariable calculus course, and a strong familiarity with differentiation, integration, infinite series and sequences, and related facts, is necessary. This course is very important for those of you considering careers in actuarial sciences.

The course covers the axiomatic approach to probability, counting techniques, Bayes Theorem, random variables, probability distributions for discrete and continuous random variables, mathematical expectation, moment generating functions, joint and conditional distributions for multiple random variables, and measures of association (covariance and correlation). This course focuses on both theory and application. You will be expected to derive theoretical results using algebra and calculus and apply these results to problems from a multitude of applications.

Spring 2015 Professor:



Hong Wang

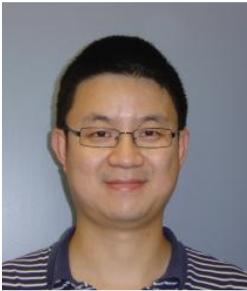
MATH 520: Ordinary Differential Equations

Prerequisite: MATH 544 or MATH 526

Upon completion of this course, students will be knowledgeable about and will be able to analyze solutions to differential equations of the first order and linear systems of ordinary differential equations. They will also be able to apply these ideas to determine elementary qualitative properties of nonlinear systems.

Differential equations is the language of science. Many basic scientific laws express the change in one quantity in terms of the values of the other quantities. These laws can be combined to create a mathematical model for the physical situation. Once the model is found the challenge is to understand the “solution” to the model – often without actually having explicit formulas. The primary focus of this course is the mathematical analysis of differential equations. Students will learn a few special techniques to find analytic (but not necessarily explicit) solutions to differential equations.

Spring 2015 Professor:



Yi Sun

MATH 521: Boundary Value Problems and Partial Differential Equations

Prerequisite: MATH 520 or MATH 241 and 242

Many principles and laws underlying the behavior of the natural world are given by differential equations. To understand and to investigate the problems in the natural world, it is imperative to solve the differential equations or to understand their properties. This course aims at providing students with elementary methods of solving simple partial differential equations (ODE). The scope of the course covers the methods for first order linear partial differential equations, heat, wave, and Poisson equations and some applications involving these partial differential equations. Boundary value problems and Fourier methods are introduced to develop efficient methods for solving partial differential equations. Students will master basic concepts and methods for solving first order linear, heat, wave, and Poisson equations and associated eigenvalue problems.

Spring 2015 Professor:



Doug Meade

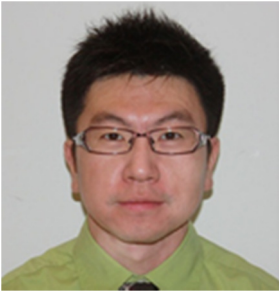
MATH 526: Numerical Linear Algebra

Prerequisite: Grade of C or higher in MATH 241

Linear algebra is the area of mathematics that looks at properties of systems of linear equations. In many realistic cases, these systems contain thousands, if not millions, of equations and unknowns. It is customary to formulate these problems in terms of matrices and vectors. This course is an introduction to the subject of linear algebra with attention given to numerical computations.

A linear system of equations in two dimensions corresponds to a collection of lines; in three dimensions to a collection of planes. Visualization in higher dimensions is not possible, but the same structure and general methods of analysis apply. Students will learn about properties of matrices, Gaussian elimination, ill-conditioned matrices, iterative solution methods, eigenvalue decomposition of a matrix, linear independence of vectors and over-determined systems.

Spring 2015 Professor:



Xiaofeng Yang

MATH 532: Modern Geometry

Prerequisite: Grade of C or higher in MATH 241

Students will master concepts and be able to solve problems associated with the topic of Non-Euclidian Geometry, focusing on axiomatic systems, finite projective planes, and finite affine planes, and with the use of vectors and matrices to obtain results in Euclidian Geometry, in particular with results associated with translations and rotations.

Spring 2015 Professor:



Ralph Howard

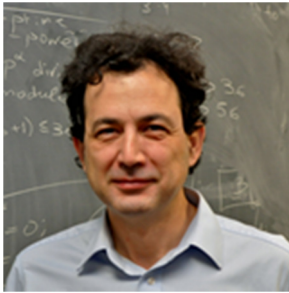
MATH 544: Linear Algebra

Prerequisite: Grade of C or higher in MATH 241

Linear algebra is one of the fundamental topics in mathematics. Even if you do not know what linear algebra is, we have all been using many of the ideas for several years. While matrices will be common in this course, linear algebra is much more than “matrix algebra”. A second and equally important objective of this course is the exposure to mathematical proofs. The early parts of the course emphasize manipulative aspects more than theoretical issues. As the course progresses, however, the same topics will be revisited – with more of an emphasis on the abstract theory of linear algebra. Students will master concepts and solve problems based on matrix algebra, solution of linear systems, notions of vector space, linear independence, basis, and dimension, linear transformations, change of basis, eigenvalues, eigenvectors, and diagonalization.

A solid knowledge of linear algebra – both manipulations and theory – will be helpful in almost any upper-division course in mathematics or any course that uses mathematics: differential equations, numerical analysis, optimization, etc.

Spring 2015 Professors:



Ognian Trifonov



Adela Vraciu

MATH 546: Algebraic Structures I

Prerequisite: Grade of C or higher in MATH 241

In this course, the student gets to experience mathematical thought beyond Calculus. As such, more sophistication is expected of the student. Most of the course will focus on group theory. Group theory is perhaps the area of mathematics with the fewest moving parts and the most ubiquity. Through studying group theory, each student will be exposed to the thought process involved in higher-level mathematics. Students will master concepts and solve problems based on permutation and abstract groups, subgroups, quotient groups, homomorphisms, isomorphisms, direct products, and rings.

This course is the first of a two-semester sequence. Both courses of the sequence are recommended for students planning to attend graduate school in mathematics.

Spring 2015 Professor:



Jesse Kass

MATH 547: Algebraic Structures II

Prerequisite: MATH 546

MATH 547 is the continuation of MATH 546. MATH 546 is about groups, while MATH 547 is about rings and fields. A field is a set F with two operations, usually called addition and multiplication. Under addition, F is an abelian group, with an identity element called 0. Under multiplication, $F \setminus \{0\}$, is an abelian group. The distributive axiom describes the interplay between the two operations. A ring is a set with two operations. Some of the field axioms hold in a ring. Some examples of fields are: the set of rational numbers, the set of real numbers, and the set of complex numbers. Every field is automatically a ring. The set of integers is a good example of a ring which is not a field. If R is a ring, then the set of all polynomials $\{f(x)\}$ with coefficients from R is another ring.

Students in this course will master concepts and solve problems on rings: ideals, polynomial rings, Euclidean domains, unique factorization domains; fields: extensions, Galois Theory, Euclidean constructions: modules over principal ideal domains.

Spring 2015 Professor:



Frank Thorne

MATH 550: Vector Analysis

Prerequisite: Grade of C or higher in MATH 241

This course is an extension of MATH 241 and has much the same problem solving character with a dose of theory and abstraction. Proofs will be given in class and you will be expected to do some computationally driven proofs on your own, but the course will not have the same proof oriented character as a course like MATH 554. This course makes a nice transition from calculus to higher-level theoretical math courses.

After a quick review of MATH 241, the main material of the course consists of the “Big Three” Theorems of Green, Stokes, and Gauss and how to use them. Students will demonstrate an understanding of vector functions by solving problems in the context of vector fields (e.g., by distinguishing gradient fields from non-gradient fields), line integrals, surface integrals, divergence and curl. Students will be able to exploit algebraic and geometric methods to compute integrals using the theorems of Green, Stokes, and Gauss, as well as direct computation using parameterizations.

Spring 2015 Professors:



Peter Nyikos



Pencho Petrushev

MATH 552: Applied Complex Analysis

Prerequisite: Grade of C or higher in MATH 241

The emphasis of this course will be on the analysis of functions whose domain and/or range are sets of complex numbers. Much of this analysis will be very similar to the real-valued calculus that is the prerequisite for this course. Another objective is to define versions of elementary functions when the argument is a complex number. The “new” functions should be consistent with their real-valued counterparts and should maintain all of the usual properties.

The Cauchy Integral Theorem is one of the major triumphs of complex analysis. This theorem can be viewed as an extension of Green’s Theorem (which provided a connection between double integrals and line integrals). One of the most important applications of the Cauchy Integral Theorem is the easy evaluation of many contour integrals.

Students will master the fundamental concepts from Complex Analysis, including the concept of a holomorphic function, complex line integrals, Cauchy’s Theorem, Cauchy’s Integral Formula, classification of zeros and singularities, and applications to residue calculus.

Spring 2015 Professor:



Daniel Dix

MATH 554: Analysis I

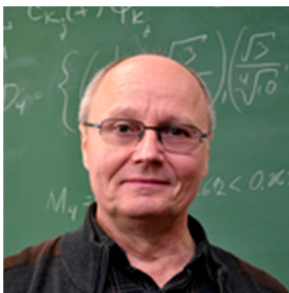
Prerequisite: Grade of C or higher in MATH 241

While most of science is based on inductive reasoning, mathematics is based on deductive reasoning. This means that new results are formed from logical combinations of hypothesis and statements accepted as true. Every result and technique learned in calculus (and other mathematics courses) is logically consistent and can be derived in a rigorous manner. In this course students begin to study some basic properties used to develop the fundamental calculus results including convergence of sequences, limit of a function, continuity (point-wise and uniform), derivative of a function, Rolle's theorem and the mean value theorem, L'Hospital's rule, inverse function theorem, Riemann integrals, Fundamental Theorem of Calculus, and derivatives of integrals. To be able to understand these results, and their proofs, it is necessary to develop a solid foundation in the real number system. It is also necessary to develop the ability to read, understand and write mathematical proofs. One of the most important steps in the creation of a mathematical proof is a solid understanding of the basic definitions. Unlike most previous courses you have taken, it is essential to pay attention to the details and technicalities. While this may be slightly unnatural, it is a skill that can be acquired through practice and patience.

Students will become knowledgeable about and will master concepts of real analysis. Students will improve their ability to write and read mathematical proofs, particularly those related to the least upper bound axiom, compactness, sequences, continuity, uniform continuity, differentiation, Riemann integration, and the Fundamental Theorem of Calculus.

This course is the first of a two-semester sequence. Both courses of the sequence are recommended for students planning to attend graduate school in mathematics.

Spring 2015 Professor:



Vladimir Temlyakov

MATH 555: Analysis II

Prerequisite: MATH 554

Students will become knowledgeable about and will master concepts of real analysis. They will improve their ability to write and read mathematical proofs, particularly those related to the least upper bound axiom, compactness, sequences, continuity, uniform continuity, differentiation, Riemann integration, power series, the Fundamental Theorem of Calculus, and interchange of limit processes.

Spring 2015 Professor:



Anton Schep

MATH 574: Discrete Mathematics

Prerequisite: Grade of C or higher in MATH 142

Students will master concepts and solve problems in discrete mathematics, including propositional and predicate logic, basic set theory, counting, relations, and graphs. Students will master the fundamentals of proof techniques, including proof by contradiction, induction and the pigeon-hole principle. They will also master the concepts and be able to solve problems associated with enumeration, permutations and combinations, recurrence relations, and the groundwork for the more advanced topics of graph theory and game theory.

Spring 2015 Professor:



Jerrold Griggs

MATH 576: Combinatorial Game Theory

Prerequisite: MATH 526, MATH 544, or MATH 574

Through this course, students learn the winning strategy in certain combinatorial games such as Nim, Hackenbush, and Domineering. Students will learn equalities and inequalities among games, Sprague-Gundy theory of impartial games, and games which are numbers.

Spring 2015 Professor:



Lincoln Lu