Course descriptions, Spring 2023

The following courses are tentatively being offered for the Spring 2023 semester. Descriptions have been given by some instructors; more may be added over time.

MATH 5093 Applied Numerical Methods
Instructor: Miro Kramar

MATH 5103 Mathematical Models
Instructor: John Albert

MATH 5163 Partial Differenatial Equations
Instructor: Meijun Zhu

MATH 5263 Issues and Problems in Mathematics Pedagogy
Instructor: Sepideh Stewart

MATH 5333 Elliptic Curves (Topics in Number Theory)
Instructor: Kimball Martin

Description: Elliptic curves, which are smooth curves with a group law, lie at the intersection of geometry, algebra and number theory. The goal is to study elliptic curves and their role in modern number theory, as well as learn some basic algebraic geometry and number theory along the way. By the end of the course, I hope to explain how elliptic curves are connected modular forms, their role in the proof of Fermat's Last Theorem, and the Birch and Swinnerton-Dyer Conjecture.

Prerequisites (actual, not official): First-year graduate algebra (5353/5363) will be assumed.

MATH 5363 Abstract Algebra II
Instructor: Jon Kujawa

MATH 5373 Abstract Linear Algebra
Instructor: Sepideh Stewart

MATH 5383 Applied Modern Algebra
Instructor: Greg Muller

MATH 5443 Intro to Analysis II
Instructor: Nicholas Miller

MATH 5463 Real Analysis II
Instructor: Alexander Grigo

MATH 5743 Intro to Mathematical Statistics
Instructor: Christian Remling

Description: 5743 Introduction to mathematical statistics gives an introduction to mathematical statistics. The main focus is on estimators and their properties. The approach is abstract and theoretical, with an attempt to give coherent, reasonably complete arguments, but all heavy machinery (measure theory, for example) is avoided.

MATH 5763 Intro to Stochastic Processes
Instructor: Pengfei Zhang

Description: The theory of stochastic processes studies systems that evolve randomly in time; it can be regarded as the "dynamical" part of probability theory. It has many important practical applications, as well as in other branches in mathematics such as partial differential equations. This course is a graduate-level introduction to stochastic processes, and should be of interest to students of mathematics, statistics, physics, engineering, and economics. The emphasis will be on the fundamental concepts, but we will avoid using the theory of Lebesgue measure and integration in any essential way. Many examples of stochastic phenomena in applications and some modeling issues will also be discussed in class and given as homework problems.

MATH 5863 Topology II
Instructor: Christian Remling

MATH 6383 Algebraic Geometry
Instructor: Greg Muller

MATH 6393 Literacy in Algebra
Instructors: Jon Kujawa, Andras Lorincz, Peter Patzt

Descriptions: (1) Kujawa: We will cover the basics of "categorification". The past 20 years have seen a revolution where algebraic objects (rings, algebras, modules, etc.) are each upgraded to a category. That is, starting with an algebra A, for example, a category is constructed for which if you suitably decategorify you recover the original algebra A. Why do this? Categories are significantly richer and more rigid than the original algebraic object. It allows you to prove new theorems, give an explanation for previously observed positivity and symmetry results, and develop new connections an applications to other areas of math. The goal is to understand Lauda's categorification of the enveloping algebra of sl_2 and its representations, and its generalization to semisimple Lie algebras by Khovanov-Lauda and Rouquier. Our goal will be to cover some of the basics of this area. It will be helpful to have some level of comfort with the language of categories, but no special background knowledge will be expected.

(3) Patzt: I am not a hundred percent sure what I will do. But likely I will say something about representation stability, in particular modules over categories (= functors from a category to Abelian groups or vector spaces or such).

MATH 6483 Functional Analysis II
Instructor: Alexander Grigo

Description: I will cover (amongst other things that are covered by the general course description) spectral theory and semigroups. I will provide applications of these to some problems from PDEs and stochastic processes. If students have particular interests in a topic I am willing to expand/include those.

MATH 6823 Algebraic Topology II
Instructor: Peter Patzt

Description: I will probably finish up with some cohomology stuff and then get into homotopy theory.

MATH 6833 Literacy in Topology
Instructors: Noel Brady, Michael Jablonski, Justin Malestein

Descriptions: (2) Jablonski: My 1/3 of a literacy class will be on the interaction between curvature and topology.