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Winter Term Course Descriptions

Math 206 A Tour of Mathematics (1 credit; S/Cr/NC)
Instructors: Many of us
Time: Fridays only, 6a (3:30-4:30)

Are you considering a math major, but wondering just what will follow after all the calculus and linear algebra, or where the frontiers of mathematical knowledge are to be found? Are you already a major who would enjoy some fresh perspectives on, and new insights into, your chosen subject? Come join us for a series of lectures on a variety of mathematical topics, with emphasis on exciting ideas, concepts and results rather than on systematic coverage of any particular subject (we have other courses for that). Although this course has been offered yearly, there should be no overlap in lectures with last winter's offering, so you can "repeat" once if you took the 2014 Tour.

Math 236 Mathematical Structures
Instructor: Helen Wong
Time: 3a
Prerequisite: Math 232

Ever wonder what goes on inside the head of your favorite (or not) math professor? Structures will teach you how to walk the walk and talk the talk of a mathematician. The course might not be able to tell you *what* your favorite (or not) math professor is thinking about at any given time, but it might tell you *how* they might be thinking about it. We'll cover some fundamental concepts in mathematics (even more fundamental than calculus), and we'll think about what it means to prove that a statement is true and some techniques for doing so. Definitely take this class if you're considering a math major, as it's a prerequisite for most upper-level math courses.

Math 241 Ordinary Differential Equations
Instructor: Mark Krusemeyer
Time: 5a
Prerequisite: Math 232 or permission of the instructor

In calculus you may well study separable first-order differential equations for a bit, but that's just the tip of the iceberg! In any field where mathematics is applied, you are likely to find equations relating unknown functions and their derivatives. Over the centuries, following the lead of Newton, Leibniz, and the Bernoullis, mathematicians have come to grips with many such equations. Naturally, they prefer to get exact solutions if possible, and we'll look at some of the systematic methods (and a few of the clever *ad hoc* tricks) that have been developed to find solutions. On the other hand, there are times when finding an exact solution is too difficult, or even potentially misleading -- for instance, because the mathematical model that leads to the differential equation is imprecise to begin with. In such cases, it is often best to concentrate on the qualitative behavior of solutions; for example, you might try to predict what will happen in the long run. In this course, you'll find plenty of calculus-style computation, including ample opportunity to brush up on your techniques of integration (*Mathematica* can help with some of that), but also a few theoretical discussions, some geometric ideas, and a bit of mathematical modeling. The textbook we'll be using, which was written by a close (younger!) relative, does not really presuppose linear algebra, but concepts from linear algebra, ranging from vector spaces of functions through linear transformations and kernels to eigenvalues and eigenvectors, will be mentioned and used with some regularity in class.

Math 245 Applied Regression Analysis
Instructor: Laura Chihara
Time: 3a
Prerequisite: Math 215 (AP Statistics 4/5) or Math 275

On the night of January 27, 1986, engineers at Morton Thiokol teleconferenced with engineers and managers at the Marshall Space Flight Center and Kennedy Space Center to determine whether it was too cold (31 F) to launch space shuttle Challenger. Data from previous flights seemed to suggest that temperature had an effect on the integrity of the O-ring seals on the booster rockets, but the final recommendation was to launch the Challenger on schedule. Could a statistical analysis of the pre-accident data predicted the catastrophic failure of the shuttle? In this class, we will investigate the Challenger data and learn statistical model building and model checking techniques. We will use the software package R to aid in the modeling.

Math 251 Chaotic Dynamics
Instructor: Sam Patterson
Time: 2a
Prerequisite: Math 236

Dynamics is the mathematical study of systems that change with time. While dynamic natural processes have been studied using mathematical models since the time of Galileo, most of those models have been linear models because those are the ones that could be solved. Recently, however, attention has been turned to non-linear dynamical systems. This gave rise to the remarkable discovery that even very simple, deterministic, dynamical systems can exhibit astoundingly rich and even unpredictable behavior. In this course we develop the tools to understand the basic examples of Discrete Non-linear Dynamical Systems. Math 236 is a prerequisite and point-set topology, one of our critical tools, will be developed as needed.

Math 275 Introduction to Statistical Inference
Instructor: Katie St. Clair, Dave Watson
Time: 2a, 5a
Prerequisite: Math 265

Statistics is the art and craft of studying data and understanding variability. Though mathematics (in particular, probability) governs the underlying theory, statistics is driven by applications to real problems. We will cover basic statistical inference as well as modern computational approaches, all in the context of analyzing data and investigating interesting questions that arise in scientific (natural and social) and societal settings. The R statistical software package will be used.

IDSC 291 The L'Hospital Translation Project
Instructor: Sam Patterson
Prerequisite: Math 111 and French 204 or equivalent

If you enjoy both French and Calculus you may want to participate in the ongoing l'Hospital Translation Project. This is an endeavor at Carleton to produce an English translation of the Marquis de l'Hospital's Analyse des Infiniment Petits. This work, published in 1696, was the first calculus textbook and has never been translated into English.

Carleton students are working on this translation as 1 or 2 credit independent studies under the supervision of Sam Patterson. If you are interested, please see Sam Patterson.

Math 331 Real Analysis II
Instructor: Gail Nelson
Time: 4a
Prerequisite: Math 231

Now that you have mastered the ideas behind epsilon-delta proofs it is time to take advantage of your new skills. In this course we will delve even deeper into the notion of the integral. Specific topics will include Lebesgue measure, the Lebesgue integral, an introduction to general measure theory, and Banach and Hilbert spaces. Not only is this your chance to "integrate" your knowledge of functions, it is also an opportunity to better your understanding of the legal interchange of limit operations. And, of course, the Cantor set will make its usual appearance!

The flavor of the course will be similar to a graduate-level course in analysis. If there is a possibility that you are headed for graduate school in mathematics or a related field, this course comes highly recommended.

Math 342 Abstract Algebra I
Instructor: Eric Egge
Time: 3a
Prerequisite: Math 236

Abstract algebra (not to be confused with elementary algebra, which you studied in high school or before) is a pillar of pure mathematics which supports a large body of work both within and outside of mathematics. Although most of abstract algebra was first studied for their intrinsic interest, ideas and results from the subject have also been applied in theoretical physics, in the design of error-correcting codes, in quantum chemistry, and even in the study of symmetry and artistic patterns like those in Escher's "Regular Division of the Plane" drawings. In this course we will study groups, rings, and fields, which generalize ordinary arithmetic systems like "clock arithmetic," matrix multiplication, permutations, and the set of real numbers, in the same way that abstract vector spaces generalize **R**^n. Along the way we'll see how a few simple axioms can give rise to both a remarkably rich theory and a zoo of fascinating examples.

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