MATH 420. DIFFERENTIAL EQUATIONS: A DYNAMICAL SYSTEMS APPROACH. SPRING 2004

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Times and Location: Lectures TR 13:25 - 14:40, Malott Hall (MT), room 406.
Recitation: W 13:25 - 14:15, Malott Hall (MT) room 406.

Text: Hubbard, J. H. and West, B. H., *Differential Equations: A Dynamical Systems Approach.* TAM 5, Springer-Verlag, New York, 1991.
Hubbard and West, *Differential Equations: A Dynamical Systems Approach.* TAM 18, Springer-Verlag, New York, 1995.

Description: Differential equations are all around us. When we say that scientists use mathematics to describe a phenomenon, it usually means writing a differential equation that "models" it. Examples of phenomena that are modeled with differential equations are the weather, the airflow around a new SUV model, the spreading of gossip, the electronic circuits in a PlayStation, the trajectory of the recent space probe that landed in Mars and the transfer of information between neurons in our brains.

This introduction to ordinary differential equations (ODEs) will encompass three important aspects of the study of differential equations:

- Practical You will become proficient in dealing with and solving concrete ODEs. We will review methods of solution for many types of ODEs. Other more complicated examples require the use of approximation methods (used in computer simulations).
- Theoretical To gain a proper perspective in the study of differential equations, it is important to reach a rigorous understanding of several important results. The basic theory will be presented and justified with mathematical proofs.
- Intuitive Most ODEs are impossible to solve explicitly. This does not mean that you just drop your problem and go on to something else. The problem is still there and your future job may depend on what can you do about it. An important question to ask in this situation is "How will the solutions behave in the long run?" Attempts to answer questions like this, gave birth to the field of Dynamical Systems and, more recently, Chaos theory.

A portion of the course will be devoted to special topics. In particular: planetary motion, Bifurcation theory, Chaos and an elementary introduction to Partial Differential Equations.

Projects: To complement the material covered in class, you will be handed special projects. Some require you to walk around campus; others may have you visit the computer lab. Projects will be an essential component of you final grade.

Exams: There will be 2 preliminary exams and a cumulative final. Dates will be announced in advance.

Grading:
- Prelims: 20% each.
- Projects: 25%
- Final: 35%

Academic Integrity: Each student in this course is expected to abide by the Cornell University Code of Academic Integrity. Work in the course projects and exams is strictly individual unless explicitly stated.

Additional bibliography:
- Boyce and DiPrima, *Elementary Differential Equations and Boundary Value Problems.* John Wiley & Sons, 7th edition, 2001.
- Arnold, V. I., *Ordinary differential equations.* MIT Press, Cambridge, 1998.
- Hirsch and Smale, *Differential equations, dynamical systems, and linear algebra.* Academic Press, 1974.