Math 351: Differential Equations

Spring 2009

Instructor	:	Maria R. D'Orsogna
Lectures	:	Tu-Th 4:00 - 5:15pm in JR 217
Office hours	:	Wed 11-12 am and 2-3 pm in Santa Susana Hall 123
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Textbook	:	Elementary Differential Equations, Wiley, William Boyce and Richard Di Prima

Course description:

In this class we will introduce, study and solve differential equations. These often arise in the study of the natural world around us as simplified and concise ways to describe a problem in physics, biology, finance or engineering. In fact, mathematical modeling goes hand in hand with the study of differential equations. While we cannot hope to describe all facets of a complex system taken from real life, at times 'minimalist' models can be developed. Their usefulness is that although simple, they are amenable to mathematical treatment and can be used as building blocks for a deeper understanding.

Examples of the usefulness of analyzing the properties and knowing how to solve differential equations will be given throughout the course and in relation to many applied fields. When we introduce a particular type of differential equation that is relevant for any other discipline we will try to dissect the meaning behind every term and try to have a complete picture of the math and what it is useful for. At times, the same differential equation can be used to describe very different systems: the most notorious case is that of the same equations describing oscillations in mechanical systems and in electrical circuits. Indeed, this is the beauty of mathematics: once you know how to attack a certain class of problems from a mathematical standpoint, then you can use it in many different fields.

While getting to the solution will be important, at times we will be more interested in gaining insight into the behavior of the system that the differential equation is meant to

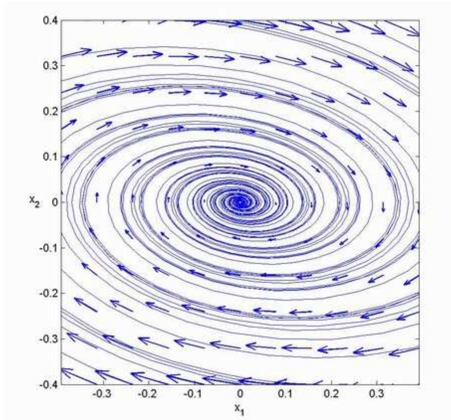

Figure 1: Phase plot for a system of ODE-s representing a non linear damped pendulum $\dot{\theta} = \omega, \dot{\omega} = -\sin(\theta) - \mu\omega$. In the picture the labels correspond to $\theta = x_1$ and $\omega = x_2$.

represent. Also, we may want to maximize or minimize certain properties by tuning and relevant parameters, or we may even try to find critical values that lead to qualitatevely different behaviors. Topics we will cover are taken from your textbook and include: Linear and systems of first order ordinary differential equations with examples, methods of solution and numerical applications, linear independence, the Wronskian, uniqueness of solutions. We will also study the Laplace Transform and time permitting, non-linear differential equations and their stability. Prerequisites for this class are Math 250 and 262. You will be expected to have or gain a working knowledge of Mathematica or Matlab.

Homework and Evaluation:

Your grade will be based on biweekly homework assignments (30 % each of your grade), a midterm (30 % of your grade) and a final cumulative exam (40 % of your grade). Expect a lot of homework: math is like going to the gym, you will gain muscles only if you keep practicing and practicing. It would be great if you wanted to work out even more problems than what assigned to you, and just to become better. Late homework will not be accepted under any circumstance. Calculators are superbanned. Copying is not allowed. Please write out clearly on your tests, as it will make everyone's life easier. The date of final exam will be announced during the semester.