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MA 214.03: Introduction to Ordinary Differential Equations (Calculus IV)

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Office Hours: MWF: 9:00 AM - 10:00 AM and other times by appointment.
Class times: MWF: 11:00 AM - 11:50 PM in CB 335
Textbook: Boyce and DiPrima, *Elementary Differential Equations and Boundary Value Problems*, 8th Edition.
Required Software: Maxima. (See below).

What is this course about?

Calculus IV is more properly called an introduction to ordinary differential equations (ODE's). A *differential equation* is a relation between a function and its derivatives. A differential equation is called an *ordinary differential equation* if the function in the relation depends only on one variable. Ordinary (linear) differential equations are the easiest kinds of differential equations to deal with and these will be the primary object of study in this course.

Differential equations are the most important mathematical tool in the modeling of real life problems. In particular, the major laws of physics and engineering all have precise statements in the form of a differential equation. For example Newton's second law of motion says that force is the product of mass and acceleration. In many applications force depends on position $x(t)$ and we may write $F(x(t))$ to describe the force applied to a particle at position $x(t)$. Then Newton's law can be stated as

$$m\frac{d^2x}{dt^2} = F(x(t)).$$

Roughly, the goal of this course is to solve equations like this one for the unknown function $x(t)$ and then use the function $x(t)$ to predict the behavior of physical systems.

In this course we will present some of the basic theory of ordinary differential equations and describe how to solve many different kinds of equations. We will incorporate numerous classical application problems and attempt to highlight the great utility of differential equations in answering practical questions. The course will also require students to demonstrate competence in constructing basic mathematical proofs. I will provide some instruction in good form for mathematical proofs and will expect students to do simple proofs on exams and quizzes.

Coverage:

A complete first course in ordinary differential equations will include an introduction to:

1. Terminology associated to the theory of ordinary differential equations
2. Methods of solution for ordinary differential equations. This includes classical algebraic methods as well as power series and Laplace transform techniques.

3. Existence and uniqueness theory for solutions of ordinary differential equations
4. Classical application problems from mechanics
5. Numerical methods
6. Systems of differential equations

These topics are the content of chapters 1-7 in the text. We will attempt to provide good coverage of each of these but may adjust the depth of the coverage for time.

Grading:

The grading scheme for this course is:

Exam I	25%
Exam II	25%
Final Exam	25%
Homework Quizzes and Worksheets	25%

Exams:

This course has three exams. The tentative exam schedule is

Exam I	9/30
Exam II	11/7
Final Exam	12/16

The final exam is on Friday, December 16, 2011 at 10:30 AM in CB 335.

I will distribute review sheets for each exam. You may use a calculator for the exams however *you cannot use a calculator with any kind of computer algebra system*, so no TI 89s. Final course grades will be assigned on the traditional university scale: 100-90 A, 89-80 B, 79-70 C, 69-60 D, 59-0 E.

Homework:

The homework in this course is completely for your benefit and will neither be collected nor graded. At each lecture, I will assign a series of homework problems. I will always choose problems whose answers appear in the back of the book. This means that I expect you to check your answers and work on the problems until you get the correct answer. I will also give you an opportunity to ask questions about homework problems during each class period.

Homework Quizzes:

We will have a homework quiz most Fridays. I will announce the quiz and its coverage on the preceding Monday. Problems on the quiz will come directly from the homework problems assigned on previous lecture days. I will distribute the quiz approximately 15 minutes before the end of class. No notes or collaboration will be permitted on the quizzes.

No make-ups of the quizzes will be granted without a documented, university approved excuse, but I will drop the *lowest two* quiz scores at the end of the term.

Worksheets:

I will regularly distribute worksheets for you to work on outside of class. Please write up your answers to these worksheets neatly and turn them in on the due date. I will not accept worksheets after the specified due date has passed without a documented, university approved excuse.

Attendance:

You must attend every lecture but I will not formally take attendance. Given the length of the class and the difficulty of the material, if you miss class you will miss a lot of information. There are no make-ups of any kind except in the case of documented, university approved absences.

Maxima:

Maxima is a free, open-source computer algebra system with a history dating back to MIT in the 1960's. You must install a copy on your personal computer from
`http://maxima.sourceforge.net/`. Maxima can be very helpful in working with differential equations and investigating the behavior of solutions. I will make frequent reference to the software and include examples of how to use it on my website. I strongly encourage you to use Maxima to explore course concepts on your own. I love to talk about software for mathematics and I'm more than happy to help you use the program. Just send me an email.

Other software options are Maple and Mathematica. These are very expensive programs but you can access Maple in many university computer labs.

Cheating:

Don't do it. The consequences are very serious. Read the university handbook for more information.

Disability:

If you have a documented disability I am happy to provide you the accommodations to which you are entitled. Please see me.

Questions:

I enjoy talking about this subject, so feel free to ask questions in class, by email, or in office hours about anything you don't understand. Email is the best way to reach me outside of class. I will generally respond to your questions within 24 hours and usually much faster.