Math 244: Differential Equations for Engineers

Summer 2003, Section C1

Course Syllabus

Basic Information:

Course: 01:640:244:C1, registration #90663
Math Department Office: Hill Center, Room 303
Summer Session Office: 191 College Ave.
Classroom: Campbell Hall A1
Meeting times: MTWTh 8:15-10:00 AM, May 27-July 17
Final exam: In Frelinghuysen B4, July 17, 8:15-11:15, closed book
Prerequisites: One of 01:640:243, 01:640:251, or 01:640:291 or an equivalent multivariable calculus course from another institution
Text: Boyce and DiPrima, *Elementary Differential Equations*, 7th edition, ISBN 0-471-31998-8

Instructor:

Nicholas Weininger
Office: Hardenbergh Hall B7 (office hours), Hill Center 620 (general)
Office hours: MW 4-5 PM, or by appointment
Office phone: (732) 445-8211
Email: `nweining@rci.rutgers.edu`
Course website: `http://www.math.rutgers.edu/~nweining/math244-s03/244_index.html`

Note: all updates to the syllabus and calendar will be posted on the website, as well as important notices relating to the class, solutions to all assignments, and review problems for exams.

Introduction:

A differential equation is an equation relating a function and its derivatives. Physicists, biologists, and engineers frequently use differential equations to model the observed behavior of physical systems. If we are given a differential equation and can write down a function that satisfies it, that function then provides a complete description of the physical model's evolution over time; in this case the function is called a solution to the differential equation. However, for many types of differential equations we cannot find any such explicit solution.

In this course, we will cover a variety of techniques for finding solutions to some relatively simple types of differential equations: first- and second-order linear equations and systems of first-order linear equations. We will also cover techniques for analyzing the behavior of solutions when they cannot be explicitly written down, as often occurs in the case of nonlinear differential equations.

Course objectives:

Students should have the following knowledge and skills upon completing this course.

- You should understand the role of differential equations in mathematical modeling. You should be able to generate differential equations to model certain physical systems, and to interpret information about the solutions.
- You should understand and be able to use terminology employed in the study of differential equations.
- You should understand the concepts of an initial value problem and of the evolution of a solution over time. You should be able to qualitatively analyze the evolution of solutions to a differential equation without knowing the explicit form of the solutions.
- You should be able to use the collection of techniques for solving certain special types of differential equations presented in this class.

Assignments and Grading:

Each test, quiz, or homework assignment will be worth a designated number of points. There will be a total of 600 points in the course, and at the end of the semester I will take the number of points you have earned and divide by six to get a number between 0 and 100. I will then assign letter grades based on the approximate scale of: A=90-100%, B+=85-89%, B=80-84%, C+=75-79%, C=70-74%, D=60-69%, F=0-59%. This scale may be adjusted slightly to account for clustering in grades.

There will be three types of assignments that will contribute to your grade:

1. **Quizzes.** A 15-minute quiz will be given at the beginning of every other lecture, on Mondays and Wednesdays. I will typically return the quiz and discuss the quiz problems at the beginning of the following lecture. Material for each quiz will be drawn from the previous lectures and the suggested reading and homework problems from the textbook. The frequency of the quizzes is meant to encourage attendance and keeping up with the class, as well as to give you practice applying the techniques we learn to simple problems. Quizzes are worth eight points each, for a total of 120 points (20% of your total grade). All quizzes will be closed-book and closed-notes.

2. **Exams.** There will be two 80-minute midterm exams and a three-hour final exam. The first midterm will be held on Thursday, June 12, from 8:15-9:35 AM, and will cover material from chapters 1,2, and 3. The second midterm will be held on Tuesday, July 1, from 8:15-9:35 AM, and will cover material from chapters 4,6, and 7.1-7.5. The final will be held on Thursday, July 17th from 8:15-11:15 AM in Frelinghuysen B4; it will be cumulative, with special emphasis on material from chapters 6, 7.6-7.9, and 9. The midterms are worth 100 points each (16 2/3% of your total grade), and the final is worth 200 points (33 1/3% of your total grade).
   All exams will be closed-book and closed-notes. You will be allowed to bring a formula sheet comprising one side of a standard 8.5-by-11 inch sheet of paper to each midterm, and a formula sheet comprising both sides of such a sheet of paper to the final. Problems on the exams will typically be similar to the suggested homework problems from the book and/or problems presented on quizzes.

3. **Homework writeups.** Each Monday I will hand out a homework assignment for you to write up and hand in, usually the following Monday. These assignments will typically require you to apply solution and analysis techniques to differential equations describing physical models. For each such assignment I will expect you to write out a full, neat, detailed description of your solution, with supporting diagrams and justifications as indicated. The intent of these assignments is to gauge your high-level conceptual understanding of, and ability to apply, the techniques we learn in class, as well as your ability to explain clearly how to apply these techniques. Accordingly, I will grade these assignments based on how clearly and completely you explain your work. More detailed guidelines will accompany each individual assignment. These assignments will be worth a total of 80 points (13 1/3% of your grade).

I will not generally allow make-up quizzes and exams, nor give extensions on homework writeups. The only exceptions are if you have a note from the dean excusing your absence, or some extraordinary circumstance occurs which you discuss with me beforehand.

In addition to these assignments, the class website lists suggested readings and homework problems drawn from the textbook. I do not expect you to hand in the suggested homework problems, and I will not grade them. Nevertheless, I strongly encourage you to do as many of the suggested problems as you can; practice at doing these kinds of problems is the best way to really learn the techniques involved, and is also one of the best ways to prepare for the exams. If you have questions about the suggested homework problems, the readings, or any other problems related to this course, I encourage you to come to my office hours and discuss them with me. If you cannot come to the regularly scheduled office hour times, please email me so that we can set up an appointment at another time.

Also, the math department has prepared Maple labs for use in exploring the concepts and techniques covered in this course. Due to the shortness of the summer term, we do not have time to make use of the Maple labs as assignments, but you may find these labs helpful in practicing needed techniques and developing your ability to analyze solutions to differential equations. A link to these labs is provided on the class website, and I will be happy to discuss the labs with you during office hours if you wish.

I encourage you to talk to your classmates about the readings and problems, to work in groups when solving homework problems, and in general to gather information from whatever sources are available to you. However, for the homework writeup assignments, while you may work with your classmates to solve the problems, **you must write up your own individual solution**, in your own words, with your own diagrams and explanations. In addition, if you have received any help from a classmate in solving a problem that you write up, I expect you to acknowledge that help in your writeup. Plagiarism of these writeups will be dealt with according to the University policy on academic integrity.

"If it be then your Pleasure, ye Lovers of Study, come always; be not restrained through any Fear, nor retarded by too much Modesty, what you may do by your Right, you shall make me do willingly, nay gladly and joyfully. Ask your Questions, make your Enquiries, bid and command; you shall neither find me averse nor refractory to your Commands, but officious and obedient. If you meet with any Obstacles or Difficulties, or are retarded with any Doubts while you are walking in the cumbersome Road of this Study of Mathematics, I beg you to impart them, and I shall endeavour to remove every Hindrance out of your Way to the best of my Knowledge and Ability."

–Isaac Barrow, on the occasion of his installation as first Lucasian Professor of Mathematics, Cambridge University, March 14, 1664

(with thanks to David Bressoud)