

Math 1381
Differential Equations
Spring 2009

Instructor:

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(click on the link “Differential Equations.”)

Office Hours (spring '09):

MTWΘF 8:45–9:45

Mon.& Wed. 1:00–2:30

Friday 1:30–3:00

...and by appointment or chance.

Text:

Martin Braun.

Differential Equations and Their Applications.

(4th edition)

Springer 1993.

A *differential equation* is an equation containing a function and its derivatives. They arise in just about every branch of science—physics, chemistry, economics and psychology come to mind—and the aim is either to find all functions that satisfy the equation or else to find one solution that matches particular data. Even in the second case, in which only one solution is sought, it is important to understand the what the total set of all possible solutions is, because one needs to be sure that the his/her solution is the **only** one that nature could have had in mind.

The goal is thus to solve an equation, just as it is in high-school algebra. But in this case the unknowns are functions not numbers, and the mathematics is much more involved. This course will introduce particular methods for solving particular equations, and it will develop some mathematical theory that applies broadly to large classes of equations. My goal is to teach much of the first three chapters of the text and some of Chapter 4.

Objectives. By the end of the semester, the successful student

- Will be able to solve first-order linear differential equations;
- Will be able to estimate solutions to first-order nonlinear equations;
- Will be able to attack second-order linear differential equations using a variety of methods;
- Will be able to apply linear algebra methods to linear systems of differential equations;
- Will be able to apply the method of Laplace transforms to a variety of differential equations.

Homework. Homework will be assigned almost every class. I will provide guidance and feedback in several ways: I will take questions on specific problems at the beginning of each class; I will distribute my own worked solutions to many of the problems I assign¹; and I will be happy to discuss homework one-on-one outside of class. Each Tuesday, I will collect homework assigned the previous week and grade a selection of the problems. It is extremely important that you keep up with the homework, which is really the heart of the course. The only way to learn this material is by doing; you must put in a lot of time concentrating on the concepts and techniques that will be flying at you in order to master them. This includes time spent staring at hard problems and maybe getting nowhere; time spent like this is **NOT** wasted. You should probably plan to spend about 15 hours per week, preferably in several separate sessions, on this task.

I strongly encourage you to work on homework in groups, and you may consult me or other members of the department. However, you must write the solution to each problem on your own; you must tell me with

¹ These are meant to serve as a detailed check for your work and as models for solutions to other problems. It will be up to you to **use these solutions intelligently**: simply reading my solutions in place of struggling with the problems yourself will not teach you the material and will not prepare you for tests or quizzes.

whom you worked on each problem (if anyone); and you must cite any help you receive from faculty members (including me).

Resubmission of problems. Each problem assignment will have both a first submission due-date and a resubmission due-date. You must submit a solution to each problem on or before the first date; but I will allow one resubmission of some problems on or before the second date.

There are four restrictions on resubmissions. **First:** only certain problems may be resubmitted. Any solution that earns a 7 or a 9 may be resubmitted, but only some solutions that earn 0's or 4's may be resubmitted. I will write next to each solution that receives a grade of 4 or 0 whether it is eligible for resubmission. **Second:** although I encourage you to work on homework together in groups, you may **NOT** discuss resubmissions with anyone **EXCEPT** me; I want this work to be solely yours. **Third:** If you wish to resubmit an eligible 4 or 0, you must discuss the problem with me first; I want to make sure you understand what corrections are needed. **Fourth:** each resubmission must be accompanied by the original submission.

Tests and grading. There will be two *in-class exams* (to be given on Tuesday February 10 and Tuesday March 31) and a *final exam*. There will also be weekly *quizzes* on current material (to be given on Tuesdays that aren't test days). Quizzes will be averaged so that points not quizzes receive equal weight.² Your final average will be a weighted average of these various components. I will compute it by the formula

$$\text{final ave.} = \frac{2 \cdot (\text{midterm \#1}) + 2 \cdot (\text{midterm \#2}) + 2 \cdot (\text{QZ average}) + 3 \cdot (\text{final exam}) + 2 \cdot (\text{HW average})}{11}.$$

My grading scale is the standard one: 93% earns an *A*; 80% earns a *B*; 70% earns a *C*; and 60% earns a *D*.

Additional Notes.

Note 1: Reading the text. Although most of the ideas and techniques you are expected to learn will be discussed in class, time constraints make it impossible to dot every single *i*. This makes it especially important for you to read each section of the text as we get to it. You will derive a bonus benefit from doing this: you will have two different points of view, the author's and mine. This can really help you to put the harder ideas into perspective: it is analogous to seeing a photo through a viewmaster or hearing music in stereo.

Note 2: Attendance. Class attendance is mandatory. While I do not enforce a rigid cut policy (in the sense that more than a certain number of cuts will result in an automatic grade of *F* for the course), I will nevertheless take roll most days and maintain attendance records; anyone who is doing poorly and who has missed a lot of classes will not get much sympathy from me. (If for some reason you need to miss a class, it is your responsibility to find out what you missed. You can do this by talking to me or to a classmate.)

Note 3: If you are having difficulty.... Differential Equations is a difficult course: much of the material is not easy, and there is a lot of it. You will have to learn hard material that is presented fast, with not a lot of class time devoted to repetition or reinforcement, and it can be fatal to let the course get away from you. If you need extra help, I urge you strongly to seek me out, either by coming to an office hour or by making an appointment with me.

Note 4: Calculators. You are required to have a calculator, which may be either a scientific or graphing calculator. You may use your calculator to do homework and in all tests and quizzes. However, in order to maintain a level playing field, I must forbid the use of symbolic calculators (such as the TI92) in tests and quizzes; and so I strongly discourage you from becoming dependent on such a calculator as a crutch.

Note 5: Cheating. Cheating is unacceptable.³ If you are caught cheating in any test or quiz, you will receive a zero; if I think the infraction warrants, I will impose a further penalty. A second infraction will result in an automatic grade of *F* for the course.

Note 6 (from Jim Scott): Those who have or think that they may have a disability (learning, physical or psychological) are encouraged to contact Services for Students with Disabilities—Room 113, Science Center, (610) 660-1774 or (610) 660-1620—as early as possible in the semester. Accommodations can be provided

² That is, your quiz average will be the fraction: $\frac{\text{your total points}}{\text{maximum possible total points}}$.

³ Working together on homework is **NOT** cheating, provided you follow the rules.

only to students with current (within 3 years) documentation. Students are encouraged to discuss their instructional (“reasonable academic adjustments”) and accommodation needs with their professors.

All student requests for extended time to take examinations in a distraction-free environment must be discussed with the professor a minimum of one week prior to the scheduled date of the exam; the student must complete the Extended-Time Request Form, obtain the professor’s approval, and submit the form to the this office a minimum of 3 days prior to the date of the scheduled exam. Failure to follow these procedures could result in a denial of the request. Exceptions to exam schedules require prior written approval of the professor.