Math 411, Differential Equations
Spring 2005

Course Description Ordinary differential equations as dynamical systems. Geometric methods, existence and uniqueness theorems, linear systems, phase-plane analysis, bifurcations, eigenvalue problems.

Prerequisites Math 230 or 231 and 250 or 251 are prerequisites for this class.

General Information This is a course on the modern, qualitative theory of ordinary differential equations. The emphasis is not on producing elaborate formulae for 'exact solutions' but on understanding the structural features of such solutions: do they settle to equilbrium? do they oscillate? what happens if the parameters are changed? and so on. The course is fast-paced and demanding.

Class Meeting Times The class meets twice a week, on Tuesdays and Thursdays at 9.45–11.00 a.m. in 109 Osmond. (Occasionally, we may meet in another room for experiments or technology demonstrations; these meetings will be notified in the previous class and by email.)

Instructor John Roe
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Office Hours Tuesday 2–3 p.m. and Wednesday, 10.30–11.30 a.m.

Students are strongly encouraged to make use of the available office hours to discuss any questions or problems that they may have about the course or about mathematics more generally. If you are unable to attend the posted office hours, feel free to email me for an appointment at another time.

Text Steven H. Strogatz, *Nonlinear Dynamics and Chaos*, Addison-Wesley 1995. We shall be studying material from chapters 2 through 8. If you should want to study a drier and more mathematically rigorous textbook covering the same material, take a look at Gerald Teschl's online text, available for free download from `http://www.mat.univie.ac.at/~gald/ftp/book-ode`.

Calculators and Computers

Calculators will not be necessary for the course, and are not permitted on the tests or on the final exam. You will need to use the computer programs DFIELD and PPLANE for plotting the solutions to differential equations. These are available from `http://math.rice.edu/~dfield/dfpp.html` in Java versions which should run in any Java-enabled web browser.

Lecture Schedule

My plan is to cover the material in seven main sections, roughly as follows:

Section Name	Lectures	Textbook Reference
Geometric View of ODEs	4, finish 1/20	Chapter 2
Bifurcations	3, finish 2/1	Chapter 3
Flows on the Circle	3, finish 2/10	Chapter 4
Linear Systems	4, finish 2/25	Chapter 5
Review	3/1	
Midterm	3/3	
Phase Plane Analysis	5, finish 3/29	Chapter 6
Limit Cycles	5, finish 4/14	Chapter 7
Bifurcations in 2D	4, finish 4/28	Chapter 8

Needless to say, this plan is subject to revision as the semester progresses.

Homework

There will be seven homework assignments, due in class on the following Thursdays: 1/20, 2/3, 2/17, 3/17, 3/31, 4/14, 4/28 You will be provided with your homework assignments at least a week in advance. Each assignment will consist of 5 questions, each worth 5 points, for a total of 25 points per assignment. Homework will be returned the Tuesday after it is due. Late homework will be accepted if delivered to my office on the Friday after it is due; a 20% penalty will apply. The lowest homework score will be dropped when calculating your final grade.

It is very important that you present solutions to the homework problems which are clear and well-organized. Poor presentation, unreadable handwriting, and spelling mistakes will adversely affect your score! Don't show your scratch calculations: once you have figured out what the solution to a problem is, start from the beginning and write up a clear account of what you did to arrive at the solution. Someone reading your answer should be able to easily retrace the steps of your calculation or argument.

Exams

An in-class midterm test will take place on Thursday, March 3rd. A comprehensive final exam will be scheduled during the week of Monday May 2nd – Friday May 6th. *Students should not make arrangements to leave University Park before the end of this period*. The midterm will be graded out of 50 points, and the final exam will be graded out of 100.

Group work versus individual work

You can often learn a great deal by discussing problems together; this is the way that professional mathematicians work. However, it is essential to the learning experience, and only fair to everyone, that each student contribute his or her own effort to each assignment. As a bare minimum, once a solution has been determined, each student should write up his or her own answer completely independently of everyone else, and any significant help should be acknowledged. Misrepresenting the work of others as your own (plagiarism) is a form of academic dishonesty and may result in failing the course. See the section 'Academic Integrity' at the end of this syllabus. For complete information about the University's academic integrity policy, consult the Policies and Rules section of the Student Guide to the University.

Practice Problems

During (almost) every Tuesday class you will be assigned practice problems, which you should solve — or try to solve — before the next class meeting. Each Thursday class will begin with a discussion of the previous day's practice problems. It is extremely important that you work on these problems. Proficiency in mathematics will come only through such an effort.

In order to encourage you to do the practice problems (which will not otherwise be graded in any way) the midterm and the final will both include one or more problems taken more or less directly from the practice lists.

Grading

As mentioned above, each homework will be graded out of 25 points, the midterm out of 50, the final out of 100, for a total of 300 points for the course. How will this translate into grades? I will *try* to follow the following scheme:

Point Range	Grade Range
245–300	$A-$, A
205–244	$B-$, B, $B+$
180–204	C, $C+$
165–179	D
0–164	F

If the above scheme will have to be changed I will let you know well before the end of the semester, so that you will have a clear picture of how you are doing in the course.

Home Page

There is a course home page at

`http://www.math.psu.edu/roe/411/home.html`

The home page contains copies of the syllabus and course diary, the homework and practice problem assignments, useful links, and a form for contributing feedback on the course to the instructor.

Academic Integrity

All Penn State policies regarding ethics and honorable behavior apply to this course. Academic integrity is the pursuit of scholarly activity free from fraud and deception and is an educational objective of this institution. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating of information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. For any material or ideas obtained from other sources, such as the text or things you see on the web, in the library, etc., a source reference must be given. Direct quotes from any source must be identified as such. All exam answers must be your own, and you must not provide any assistance to other students during exams. Any instances of academic dishonesty will be pursued under the University and Eberly College of Science regulations concerning academic integrity.