Mathematics 212
Spring, 1997

Textbook:

- George Simmons, *Differential Equations with Applications and Historical Notes*, 2nd Edition, 1991.

Other References:

- Dennis Zill, *A First Course in Differential Equations*, 1993.
- Abramovitz and Stegun, *Handbook of Mathematical Functions*, 1964.
- Vladimir Arnol'd, *Ordinary Differential Equations*, 3rd Edition, 1992.

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Office Hours: M–F: 2–3 p.m. Also by appointment (use e-mail).

Course Content: Mathematics 212 is a first course on ordinary differential equations (o.d.e.s). See the proposed calendar of topics at the end for specifics.

Course Goals: Upon completion of this course you should primarily

- be able to solve various o.d.e.s by various methods;
- be familiar with and be able to apply the main points in the general theory of o.d.e.s;
- be able to investigate some qualitative aspects of a given o.d.e. even if it cannot be solved explicitly.

Written Work: Thoughts are expressed by sentences: just so in mathematics. Pay attention to your textbook: it is written in sentences. **Your written work must be in complete sentences.** Use mathematical symbols wherever appropriate; do not use a lot of words. Your work needs to be neat and orderly to be intelligible. It is common practice to rewrite solutions once they are found.

Problems: A list of problems will be maintained and augmented weekly. Each problem will have a point value. Every Monday (or the next school day if Monday is a holiday) from this list a set of problems worth 30 points will be due in my office by noon. The problems sets must be from the previous week's new problems except for problem sets due on 17 March and 28 April. You may propose your own problems; I will determine the point value. A problem which is accepted will earn the proposer bonus points equal to one-fifth of the point value assigned the problem. The proposer may solve his or her own problem for full credit. You may solve additional problems for bonus credit equal to one-third of the original value.

Any books and your class notes may be used as long as your sources are properly cited. No persons may be consulted.

Tests: There will be two tests. They will be take-home and closed-book. They will be given out on Tuesday, 4 February and Tuesday, 8 April. The tests are due in class at the next class meeting.

Midterm Examination: A cumulative midterm examination will be given in class on Thursday, 6 March. The exam will be closed-book, but you may use one page of notes prepared by you. You may collaborate with other people on the content of the notes, but you must prepare the notes yourself.

Final Exam: A cumulative final will be given at the scheduled time. You may use one page of notes prepared by you.

Project: A research project investigating one of several special mathematical functions will be due at the end of the term. The project will consist of both a written and an oral component. The written component is due in my office by noon, Wednesday, 30 April. The oral presentations will be given in class on Thursday, 24 April and Tuesday, 29 April. Further details of the project will be given at the appropriate time in the semester.

Grading: Evaluation will be based on the following:

Problems (14 @ 30 pts)	420 points
Project	100 points
Tests (2 @ 100 pts)	200 points
Midterm Exam	150 points
Final Exam	230 points
	1100 points possible

A rough guide to letter grades: A - 990 and up, B - 880–990, C - 770–880, D - 660–770, F - below 660. Plus "+" and minus "–" (A^-, B^+, etc.) will be applied to grades.

Homework: Problem assignments from the textbook and handouts are for the your benefit and will not be collected. It is important that you complete most of the problems assigned.

Honor Code: The Honor Code of Oxford College applies to all work submitted for credit in this course. All such work will be pledged to be yours and yours alone. This is the case when you place your name on work submitted. The Honor Code applies to all tests, problem sets, and any other work you may submit.

Calendar:

Day	Topics
14 Jan.	Differentials, Differential Equations, Direction Fields (§§1–2)
16 Jan.	Orthogonal Trajectories, Examples (§§3–4)
21 Jan.	Motion, Brachistochrone (§§5–6)
23 Jan.	First Order Equations: Homogeneous and Exact Equations (§§7–8)
28 Jan.	Integrating Factors, Linear Equations (§§9–10)
30 Jan.	Reduction of Order; Applications (§§11–13)
4 Feb.	Phase Space(§58); Numerical Methods (§§71–72) **Test A** (take-home)
6 Feb.	Numerical Methods cont'd (§§73–75) **Test A due**
11 Feb.	Second Order Equations: Homogeneous Equations (§§14–15)
13 Feb.	" (§§16–17)
18 Feb.	" (§18); Inhomogeneous Equations: Variation of Parameters (§19)
20 Feb.	Applications (§§20–22)
25 Feb.	Operator Methods (§23); Review
27 Feb.	Qualitative Properties of Solutions (§§24–25)
4 Mar.	Review
6 Mar.	**Midterm Examination** (in class)
11 Mar. 13 Mar.	} *Midterm Break*
18 Mar.	Power Series and First Order Equations (§§26–27)
20 Mar.	Power Series and Second Order Equations (§§28–29)
25 Mar.	Singular Points (§§29–30)
27 Mar.	Systems of Equations (§§54–56)
1 Apr.	Matrix Algebra, Eigenvalues (Handout)
3 Apr.	Homogeneous Linear Systems: The Eigenvalue-Eigenvector Method (Handout)
8 Apr.	Fourier Series (§§33–34)* **Test B** (take-home)
10 Apr.	The Wave and Heat Equations (§§39–41)* **Test B due**
15 Apr.	Nonlinear equations and stability (§§57–60)
17 Apr.	Stability of linear systems (§60); Liapunov's Method (§61)
22 Apr.	Nonlinear systems (§§62–63)
24 Apr.	Projects
29 Apr.	Projects; Review

* This material, while its interest is compelling, is optional. We shall see whether or not we shall cover it.