

MATHEMATICS 5410

Introduction to Differential Equations

Fall semester 2004

Time: MTWF 8:35–9:25am

Instructor: Professor Grant B. Gustafson¹, JWB 113, 581-6879.

Office Hours: JWB 113, MWF 9:55-10:30am and 11:45-12:15. Other times will appear on my door card and on the internet due date page.

Telephone: 581-6879. Please use email whenever possible.

Email and web site: gustafso@math.utah.edu <http://www.math.utah.edu/~gustafso/>

Consultations: See me in my office 113 JWB, at posted hours. The Math Department Tutoring Center, located in LCB, is open for free maple help from 8 a.m. to 8 p.m. on M-Th, and from 8 a.m. to 2 p.m. on Friday. For more information, consult the web address www.math.utah.edu/ugrad/tutoring.html.

Texts:

Differential Equations: An Applied Approach, 1st edition, by Jim M. Cushing, Prentice-Hall 2004 (the required text).

Student Solution Manual, for Cushing's text *Differential Equations: An Applied Approach*, 1st edition.

Online Java programs: www.prenhall.com/cushing/.

WWW documents for 5410, by GB Gustafson, at web site www.math.utah.edu/~gustafso.

All are pdf or text documents that can be printed from Netscape or MS explorer web browsers.

Prerequisites:

Math 2270 (Linear Algebra) or the equivalent. Assumed is first-year Calculus, with a very brief introduction to linear differential equations. Background is required in planar curves, velocity and acceleration vectors from Physics 2210 or Math 2210, or their equivalent courses.

A passive knowledge of **maple** is assumed. The entire course can be done without **maple**, but all computer code examples are supplied in **maple** only.

Persons without the passive knowledge of **maple** and **unix** may attend one of the *tutorials* on the subject offered during the first two weeks of the term. The instructor for these tutorials is Angie Gardiner, 585-9478, gardiner@math.utah.edu. The dates and times are printed on Angie's door MC 155A (building LCB). See also the tutoring web address cited above. Free maple tutoring is available in the LCB tutoring center 8:00 a.m. to 8:00 p.m. daily except until 6:00pm on Friday, closed weekends and semester holidays.

Course content:

This course is an introduction to differential equations for mathematics majors and science majors. All chapters of Jim Cushing's text plus class notes will make up the course material.

¹Pronunciation: In the phrase *Gust of Wind* change *Wind* to *Sun*

Grading:

Final grades will be based on:

Textbook problems and maple labs, called **dailies**, 116 scores.

Written midterm examinations (3).

A term paper worth one midterm score.

Written In-Class Exams:

There are three (3) in-class midterm exams. Some portion of each midterm is done outside of class and submitted separately (usually one problem out of five). The outside work is due at class time on certain dates before the in-class exam. There is a term paper due in week 12, which counts as a fourth midterm exam. All submitted work is graded by G.B. Gustafson. No outside graders are employed.

Hand-written Dailies:

There will be 124 dailies due during the semester, including textbook problems and maple labs. Of these, 116 count towards a grade.

Textbook problems:

Textbook problems to be submitted for grading are listed on the **gradesheet** for the course. Tentative dates are set for each problem set. Visit the web site for extra copies. The actual due dates for problems appear only on the web site and they are dynamically updated to reflect the reality of what was discussed in class. Generally, problems are submitted shortly after they are discussed in class, and hopefully during the week printed on the gradesheet.

Submitted textbook problems must be your own work in your own handwriting. Collaboration is permitted and encouraged on textbook problems. However, you must write your own report: no joint reports, please!

There are certain **suggestions** for writing up the textbook problems and the take-home portion of a midterm exam. A full accounting of the *format suggestions* contributed by Utah students appears on the internet course page as *format for submitted work*. Kindly apply the ideas therein to your written work, both textbook problems and take-home midterm exam problems.

Take-home exam problems:

A portion of each of the three midterms is a take-home exam, to be completed and submitted by the due date published on the web site. The format suggestions apply strictly: what you submit is considered to be **your very best work**. It will be judged accordingly against the submissions of others.

Collaboration on take-home exam problems is not sanctioned. Duplicate solutions will be considered a deliberate act of plagiarism.

In-class midterm exam problems:

A midterm sample in-class exam or outline is supplied a few days before the in-class exam. Exam problems are modelled after those in the sample or outline.

Books, tables, notes and calculators are not allowed on exam day.

An in-class Midterm exam has different presentation rules, and none of the textbook problem

suggestions apply in this case. Basically, the in-class exam is a first draft with no answer checks or reference dialog.

Computer projects:

There will be six computer projects assigned during the semester, related to the classroom material. They will be written by hand and use the software package **maple**. There is a Math Department Computer Lab in building LCB at which registered students automatically own accounts. Drop-in maple tutoring in the computer lab in building LCB starts the second week of the semester.

Final exam:

There is a term paper requirement instead of a final exam. The term paper is due in week 12. Details will be distributed on the web site. The idea is to present the theory and solutions to selected problems from applications given at the end of each of chapters 1-8.

Withdrawal:

It is the Math Department policy, and mine as well, to grant any withdrawal request until the University deadline. This promise also means that such a withdrawal requires no explanation. Withdrawals are always initiated by the registered student. All paperwork is the duty of the student. My job is the signature.

ADA statement:

The American with Disabilities Act requires that reasonable accommodations be provided for students with physical, sensory, cognitive, systemic, learning, and psychiatric disabilities. Please contact me at the beginning of the semester to discuss accommodation (113 JWB or 581-6879), which is to say, accommodation shall be made.

Grading Scale:

A = 95-100, A- = 92-94, B+ = 88-91, B = 84-87,
B- = 80-83, C+ = 75-79, C = 65-74, C- = 60-64

This scale is determined from 40% passing use grade point average (GPA) increments. It is used for grading and for final letter grade reporting. This scale is for internal use only.

Grading Details:

Rite of passage: A passing grade in the course requires at least 75 of the 124 dailies (includes computer projects) to be submitted. A grade of *E* is assigned if less than 75 Dailies are submitted. The scores on the 75 dailies are expected to be passing at *C* level or higher.

The right of passage is absolute, similar to the European system, which requires a body of work to be presented before written and oral final exams are taken. For example, the Czech *vypočet* is a requirement to show a body of completed work as the entrance requirement to administration of written and oral final exams.

Final grade: It will be determined as follows:

$$\text{Final Grade} = \frac{30}{100}(\text{Dailies Average}) + \frac{70}{100}(\text{Midterm} + \text{Term Paper Average}).$$

An example: the Dailies Average for 116 textbook problems and maple labs is 91% and the Exam Average of the three midterms and the term paper is 86%. The final grade is $0.3(91) + 0.7(86) =$

87.5%, which by the scale above is a B . While 87.5 rounds to 88, a $B+$, the deciding factor is really the exam average of 86, which is squarely a B . The final grade is B . If the dailies average was 93 or higher, then the final grade would be 88.1 or higher for a $B+$.

Purpose of the textbook problems. The *purpose* of the problems is to practice doing mathematics, that is, to write out in detail the solutions to problems. A textbook problem is either a proof or else a routine “crank” problem. The process:

- **Understand the problem.** Understanding usually involves reading the *problem notes* and the textbook. Answers are usually not provided. You may get an outline of the solution, to increase the probability that the project gets completed on schedule. Problems are discussed in class in greater detail.
- **Background reading.** To solve a problem, a second opinion of the theory and method is essential. It might be that you can flesh it out of your book’s examples, a linear algebra text, an advanced calculus text or some alternate mathematics book. No matter, go to a source that works for you. This is *reading* and not a tutorial.
- **Scratch Paper Write-up.** The initial creation of a solution is the essence of the learning process. Everyone learns by repetition, and here is where you do it. Use a pencil and a big eraser, lots of paper, and flesh out a first draft at full speed. This is not the paper you turn in.
- **Final Copy.** The final copy of the solution uses the scratch paper draft as raw material to *present* the details of the solution. As such, it is more than a collection of formulas on paper. There is no strict requirement, except that *neatness* and *completeness* are a must.
- **Final Copy Format.** The most successful format to date was invented by numerous mathematics and engineering mathematics students over the years 1990–2004. This format is described below and in greater detail in the internet document *format for submitted work*.

Some Format Suggestions

1. Use engineering paper or plain white paper. Lined notebook paper and graph paper are inferior, because they cause inappropriate vertical white space for mathematics.
2. Reports are hand-written. They start with a problem statement followed by the book’s answer or by a final answer summary. Supporting material appears at the end, like a tax return.
3. One equal sign per line. Justify equations left or align on the equal signs. Mathematical notation might appear on the left, text on the right, about a 60% to 40% ratio.
4. Text includes explanations, references by keyword or page number, statements and definitions, references to delayed details (long calculations, graphics, answer checks). Text might be left-justified on the right side in a column 40% of the text width.
5. Any of rules 1-4 can be broken.
6. Every report has an answer check. For odd-numbered problems it is usual to see “*the answer matches the textbook.*” For even-numbered problems, a full answer check is expected.

Plagiarism is defined as

the unauthorized use of language and thoughts of another and the representation of them as one's own.

Textbook problems have **answers** and **solutions** published by Jim Cushing. He *owns* the work. You are authorized to cite *answers* without reference, in the course of doing a problem. To copy Jim's *solution* from the solution manual and represent it as your own work is plagiarism. A blatant violation is the submission of a solution no different than what is found in the solution manual, or a problem statement followed by no work or explanation, just the author's answer. Such circumstances are rewarded with zero credit; forfeited are opportunities to redo the problem for credit.

Maple computer labs are plagiarized by xeroxing an identical copy of a maple lab without citation. You are allowed to work in groups, but you must cite the other authors to receive credit. That is, John and Jack can have identical maple printouts provided they cite each other. The safest plan is to write your own lab using suggestions from others. Such singular efforts do not require citation.

Cooperative efforts are allowed and encouraged in groups of two. Where appropriate, **citations** are required for those who help you, with the exception of mathematics staff and tutoring staff. There is no penalty for getting help from others – it is encouraged. Please cite those who help, because it is an honorable and meritorious gift to those who spend their time on you.

Presentation is expected to improve throughout the 14 weeks of the course. You are not expected to be an expert in the first week. Correctness of answers will be checked. The class notes might contain answers plus a solution outline. Your job is to *improve* upon the initial start into the solution. Add the particulars, make comments, chase down the details from background courses. Writing up the solution identifies the hurdles and it forces a review of background material.

References are required on the first occurrence. After that, omit the citation. It is appropriate, however, to refer to the previous location on which the citations originated. A statement like "References parallel Exercises 1-5" is enough.

Due dates. All due dates are updated dynamically, at www.math.utah.edu/~gustafso/. Consult this resource often. To repeat: **the due dates are not given in class!** Sometimes, email communication about due dates and exams will be made from the registrar's list. If your campus information data becomes dated and incorrect, then please visit the campus WWW system to update the information.

Makeups and Late Work. Due to the number of dailies being collected, work is considered late and therefore unacceptable when two (2) days have elapsed since collection in class. The lowest eight (8) dailies are dropped from consideration in order to eliminate makeups. If more than six textbook problems have zero scores, then please call 581-6879 or email gustafso@math.utah.edu and discuss the situation and options for getting a passing grade in the course.

Missed Deadlines. There is an absolute deadline for each collection. After the stack has been graded, all late work received henceforth earns a zero.

Iterations and Redos. You may be asked to iterate your work from Chapter zero in order to straighten out bugs in the presentation or details. Kindly mark your work **REDO**. Submit whatever is requested, but no more, in order to keep the paper trail brief. Such requests end after

chapter zero has been returned and all bugs resolved.

Missed Midterm Exams. Missing an in-class exam is a disaster and therefore there will be a scheme to makeup one exam. If you miss two exams, then please equip yourself with reasons in writing and see me in JWB 113, write email or call 581-6879. Likely, the scheme is 50-minute midterm exam 4, to be given in the last week of classes. The content and level of midterm exam 4 parallels a final exam.

Fall 2004 Weekly Problem List

The problems to be submitted for grading are a subset of these problems, which appear only on the **gradesheet**, an additional document. Term papers are constructed from the problems in the application sections, one at the end of each chapter. The applications suggested here identify the major topics for term papers. Review section problems are never submitted.

Intro Chapter 0: week 1	Page 7: 6,24,27,32,34,40,81,98,100,107 Page 16: 2a,4a,4c,9,13,19
Chapter 1: weeks 2-3	Page 25, 1.1: 2,4,6,12,16,27 Page 30, 1.2: 11,15 Page 39, 1.3: 6,7,8,12,13,14 Page 41, 1.4: 2,9 Page A-8, 1.5: 1,10
Chapter 2: weeks 4	Page 53, 2.1: 6,12,28,32,40,52,58,74 Page 60, 2.2: 2,6 Page 64, 2.3: 4,8,12,14,22,28 Page 69, 2.4: 2,4,10,14,20 Page 70, 2.5: 6,12,20,24,27,28,34,48,56,60,62,69 Page B-14, 2.6: 6,22,30
Chapter 3: weeks 5-6	Page 81, 3.1.1: 2,4,16 Page 89, 3.1.2: 2,7,16,20 Page 91, 3.1.3: 4,10 Page 91, 3.1.4: 9,11,24,30,38,40 Page 111, 3.2: 4,6,10,22,24,31 Page 115, 3.3: 2,14 Page 130, 3.4: 2,8,12,30,35 Page 133, 3.5: 7,18,28,33,46,62 Page C-26, 3.6: 2,10,21
Chapter 4: week 7	Page 141, 4.1: 2,8,13,18 Page 147, 4.2.1: 3,4 Page 151, 4.2.2: 2,5,7a,7d,14 Page 164, 4.3: 2,3,10,22,26 Page 172, 4.4: 2,10 Page 173, 4.5: 6,17,29,30,48 Page D-13, 4.6: 15

Chapter 5: weeks 8-9	Page 180, 5.1:	2,4
	Page 191, 5.2:	2,8,14,19,21
	Page 195, 5.3:	2,4,6,13,16
	Page 212, 5.4:	4,14,18,20,22
	Page 218, 5.5:	4,8,14,21
	Page 223, 5.6:	4,6,11,16
	Page 224, 5.7:	6,10,24,26,27
	Page E-19, 5.8:	3,10,16,20
Chapter 6: week 10	Page 233, 6.1:	2,5,10,13,23,27,30
	Page 244, 6.2:	4,8,17
	Page 253, 6.3:	2,6
	Page 254, 6.4:	3,12,18,20,22
	Page F-11, 6.5:	3,15,19
Chapter 7: week 11	Page 267, 7.1:	2,8,12,21
	Page 275, 7.2:	4,10
	Page 283, 7.3:	4,8,10,16,17
	Page 284, 7.4:	1,3,5,9,14,15
	Page G-6, 7.5:	7,9
Chapter 8: weeks 12-13	Page 291, 8.2:	1c,2,6,8,10,15,25
	Page 298, 8.3:	4,9,10,11
	Page 303, 8.4:	7,8,9,10,14
	Page 309, 8.5:	9,11,16,18,26
	Page 319, 8.6:	2,6,12,18
	Page 328, 8.7:	3,4,5,9,11
	Page 329, 8.8:	4,10,16,17,20
Chapter 9: week 14	Page H-19, 8.9:	1,5,6,16,20
	Page 338, 9.1:	2,6,10,13,16,20,22,27
	Page 345, 9.2:	2,3,4,8,12
	Page 348, 9.3:	2,8,11
	Page 358, 9.4:	2,3,4,14,24,32,42,52,58,60, 64,72,76,84,98,100,102,106
	Page 368, 9.5:	10,16,20,24,30,32
	Page 370, 9.6:	6,14,22,31,39
Chapter 9: week 14	Page 328, 9.7:	4