MATHEMATICS 2250
Ordinary Differential Equations and Linear Algebra
Fall Semester 2006 Evening

Time: MTWF 7:30–8:20am EMCB 101
MTWF 10:45-11:35am LS 101
T-TH 5:55–7:30pm JFB 101

Instructor: Professor Grant B. Gustafson[1], JWB 113, 581-6879.

Tuesday Lecturer: G. Hunter and H. Lee

Office Hours: JWB 113, MWF 8:55-10:15am. Other times appear on my door card and on the course web page door card link.

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

Email and web site: `ggustaf@math.utah.edu` `http://www.math.utah.edu/~gustafso/` `hunter@math.utah.edu` `hlee@math.utah.edu`.

Tuesday Lab: Please attend one or more times as advertised below, e.g., attend 7:30, 10:45 or 5:55 lab sessions. It is usual to attend two sessions for 20 minutes each to obtain help on dailies, maple labs, take-home exam problems and sample midterm exams.

Tuesday 7:30-8:20 a.m.	EMCB 101
Tuesday 10:45-11:35 a.m.	LS 101
Wednesday 5:55-6:45 p.m.	JFB 102

Tutoring: The *Math Center*, also called the Tutoring Center, is located in LCB, and it is open for free tutoring from 8 a.m. to 8 p.m. on M-Th, and from 8 a.m. to 2 p.m. on Friday. Some, but not all of the math tutors welcome questions from Math 2250 students. To see the times and specialities of various tutors, consult the web address `www.math.utah.edu/ugrad/mathcenter.html`.

Texts:

Differential Equations and Linear Algebra, by C.H. Edwards Jr. and David E. Penney, Second Edition (the required text). New problems and text material appear in the second edition. The old blue first edition could be used, provided you can adjust to page number changes and missing text material.

Differential Equations, Cliff's Notes series. Contains concise examples and readable explanations of topics found in the Edwards-Penney text.

Student Solution Manual, for the Edwards and Penney text *Differential Equations and Linear Algebra*. The bookstore bundles it with E & P Second Edition, called a *custom edition*, the Fat Book.

WWW documents for 2250 at web site `http://www.math.utah.edu/~gustafso/`. All are pdf or text documents that can be printed from `Mozilla Firefox`, `Netscape` or `MS internet explorer` web browsers. Author: G.B. Gustafson.

Prerequisites:

Math 1210 and 1220 or the equivalent (Calculus I and II). This is first-year Calculus, with a very brief introduction to linear differential equations. The old Math courses 111-112-113 of

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

1997-98 fulfill the requirement. In addition, background is required in planar curves, velocity and acceleration vectors from Physics 2210 or Math 2210 (Calculus III), or their equivalent courses.

A passive knowledge of `maple` is assumed (see *tutorials* below). `Matlab` experience is helpful but not a substitute for learning the basics of `Maple`. Yes, Matlab contains a Maple engine, but Maple is a computer language and a computing laboratory different and distinct from Matlab.

All computer code examples are supplied in `maple` only. Persons without computer training might use a graphing calculator and Microsoft's `Excel` or the MathWork's `matlab` to complete the first few Maple labs. To cooperate with the engineering programs on campus, some `maple` contact is required in the course work for 2250. The co-requisite is Physics 2210 (old 301), with actual use of physics minimal.

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 Sandy Hiskey, 585-1985, `hiskey@math.utah.edu`. The dates and times are published on Sandy's web page `www.math.utah.edu/ugrad/mathcenter.html`. Her office is 214 in building LCB.

Free tutoring is available in the LCB math 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 linear algebra and differential equations in engineering and science. Chapters 1-7 and 10 in the Edwards-Penney text plus class notes and `www` documents will make up the course material.

Grading:

Final grades will be based on:

> Textbook problems, the major part of the **dailies**, about 111 scores.
>
> Five computer projects form the minor part of the **dailies**. Each project is counted like several textbook problems, total 24 scores.
>
> Written midterm examinations (3).
>
> An in-class 2-hour final examination that counts as two additional midterm scores.

Written In-Class Exams:

There are three (3) midterm exams. There is a 2-hour in-class final exam as scheduled by the university. The midterm and final exams are graded by G.B. Gustafson and the Tuesday lecturers.

Hand-written Dailies:

There will be 132 dailies due during the semester, including textbook problems and three maple labs. They will be graded by a staff of readers employed by Sandy Hiskey. Accounting of the dailies is by `xcel` computer records, which is ultimately electronic and web-based (keys replace names). During the course, the record is printed once or twice and distributed in class like returned homework.

Textbook problems:

Textbook problems to be submitted for grading are listed on the `gradesheet` for the course. Visit the web site for extra copies. The 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.

All students must complete each textbook problem and submit their work in their own handwriting. Collaboration is permitted and encouraged on textbook problems in teams of not more than 2. Submit a separate handwritten report for each partner.

There are certain **suggestions** or **rules** for writing up the textbook problems. A full accounting of the *format suggestions* contributed by students of 2250 appears on the internet course page as *format for submitted work*. Kindly apply the ideas therein to your written work.

In-class midterm exam problems:

A midterm sample in-class exam is supplied a few days before the in-class exam. Exam problems are modeled after the sample exam. There are available on the web page solution keys to old exams, including all midterm and final exams for the last year or so. You may print these for reference. The final exam has a separate study guide, also available at the site.

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 rules apply in this case. Basically, the in-class exam is a first draft.

Computer projects:

There will be five computer projects assigned during the semester, related to the classroom material. Each project counts the same as 2 to 12 daily problems from the textbook, for a total of 24 scores on the dailies. 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, and there are other labs around campus where `maple` is also available, for example at the College of Engineering. There will be *free* tutoring support for these projects (Tue 7:30, 10:45 and Wed 5:55pm) and for your other course work as well. Drop-in tutoring in the computer lab in building LCB starts the second week of the semester.

Final exam:

Two hours are reserved for this written exam. As published by the university, the final exams are: 7:30 class: Thursday December 14, 10:10-12:45; 10:45 class: Wednesday, December 13, 7:45-10:15am, 6:00pm class: Tuesday December 12, 6:00-8:30pm. Finals are held in the regular classroom.

The final exam is comprehensive. It covers chapters 3, 4, 5, 6, 7 and 10 with weight distributed evenly across the chapters listed. A study guide consisting of problem types by chapter plus several final exam solution keys for previous final exams appear at the web site.

No notes, calculators, tables, books or aids of any kind are allowed on the final exam. Please bring pencils and eraser. Paper will be supplied.

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:

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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 using GPA increments. It is used for grading and for final letter grade reporting. This scale is for internal use only. Fractional scores are truncated (not rounded) when fitting a score to a letter grade – see below for examples.

Grading Details:

Rite of passage: A passing grade in the course requires at least 75 of the 132 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:

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

An example: the Dailies Average for 132 textbook problems and maple labs is 91% and the Exam Average of the three midterms and the final exam 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+.

A precise description of the method of assigning letter grades follows. First, compute the course average $A = 0.3A_1 + 0.7A_2$ from the dailies average A_1 and the exam average A_2. Truncate A to an integer (e.g., $A = 94.96$ truncates to 94). Assign a letter grade L according to the grading scale (see above). Look at the final exam score F and the exam average A_2. If F would give a higher letter grade, then change L to the next possible higher letter grade, e.g., change a $B+$ to an $A-$ (but not $B+$ to A). In some cases, when F is low or A_1 is low, the average A_2 will be used to decide on the letter grade. An example: $A = 94.96$, $F = 92$, $A_1 = 94.86$, $A_2 = 95$. The letter grade is $A-$, but the exam average is 95 or A, therefore the letter grade $A-$ should be promoted to an A.

A grade of E is assigned if less than 75 Dailies are submitted. Please read the **Rite of passage** paragraph above.

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 generally an engineering–style "crank" problem, usually devoid of proofs. 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 great detail, often with the aid of transparencies and Xerox copies of same. Slides cover a similar problem or sometimes the exact problem considered in the project. The classroom slides are mirrored at the web site as pdf files, ready to print from an internet browser.

- **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, the college algebra text, the calculus text or some engineering 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 several engineering mathematics students over the years 1990–2005. This format is described in some detail below and also 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 not acceptable, 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. Mathematical notation is on the left, text on the right, about a 60% to 40% ratio. One equal sign per line. Justify equations left or align on the equal signs.

4. Text is left-justified on the right side. It includes explanations, references by keyword or page number, statements and definitions, references to delayed details (long calculations, graphics, answer checks).

5. Any of rules 1-4 can be broken. Please develop your own style.

6. Every report has an answer check. For problems with textbook answers, it is usual to see "*the answer matches the textbook*," or briefly **B.O.B.** For problems without a textbook answer, a full answer check is expected.

Cooperative efforts are allowed and encouraged. Kindly produce individual handwritten reports. There is no penalty for getting help from others – it is encouraged. This includes tutorial staff, teaching assistants and fellow students.

English language deficiencies will be tolerated but not excused. Graders prefer precise English comments, and fewer comments. If English is your second language, then try to improve your writing skills: (1) shorten comments and (2) use page references to the textbook.

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 problem notes might contain answers plus a solution outline. In class, further details are communicated. Your job is to *improve* on the initial start into the solution. Add the particulars, make comments,

chase down the details from algebra and calculus. The difficulty is generally college algebra, with calculus running a close second. Writing up the solution identifies the stumbling blocks and 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 assignment 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 dates will often not be given in class! Sometimes, email communication about due dates and exams will be made from the registrar's list. If your campus information data is 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 the stack of papers exits 113JWB and goes to the grader. The lowest eight (8) dailies are dropped from consideration in order to eliminate makeups. If more than ten (10) textbook problems have zero scores, then please call 581–6879 or email `ggustaf@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 is sent to the grading assistant, all late work received henceforth earns a zero. Are you an exception? It is better to ask than to assume anything.

Iterations and Redos. You may be asked to iterate your work from Chapter one in order to straighten out bugs in the presentation or details. Kindly mark your work **REDO**, in big letters. Submit whatever is requested, but no more, in order to keep the paper trail brief. The deadline for a **redo** is 5 days from the date returned. **Redo requests end** after chapter one has been returned: **no re-do** for Chapters 2-10.

Missed Midterm Exams. Missing an in-class exam is a disaster and therefore there will be a scheme to deal with a missed exam. If you miss an exam, then please equip yourself with reasons in writing and see me in JWB 113, write email or call 581-6879.

Tentative Due Dates and Lectures 2250 Fall 2006

Lecture Week 1, Aug 24
Sections 1.1,1.2,1.3.

Nothing due.

Lecture Week 2, Aug 29,30,31
Sections 1.3,1.4,1.5.

29 Aug Page 16, 1.2: 2,
29 Aug Page 16, 1.2: 4, 6, 10
30 Aug, Report examples in lab.
31 Aug Page 26, 1.3: 8, 14

Lecture Week 3, Sep 5,6,7
Sections 2.1,2.2,2.3,2.4.

04 Sep Holiday 05 Sep Page 41, 1.4: 6, 12 05 Sep Page 41, 1.4: 18, 22, 26
06 Sep, Begin maple 1 in lab.
08 Sep Page 54, 1.5: 8, 18, 20, 34

Lecture Week 4, Sep 12,13,14
Sections 2.5,2.6,3.1.

12 Sep Page 86, 2.1: 8, 16
12 Sep Page 96, 2.2: 10, 14
13 Sep, Begin maple 2 in lab.
14 Sep Page 106, 2.3: 10, 20
14 Sep Maple Lab 1:

Intro maple L1.1, L1.2

Lecture Week 5, Sep 19,20,21
Sections 3.2,3.3,3.4.

19 Sep Page 119 2.4: 6, 12 Symbolic sol
19 Sep Lab lecture on Numerical sol
[29 Sep maple 3: 2.4,2.5,2.6-6,12]
21 Sep Page 152, 3.1: 6, 16, 26
21 Sep Maple Lab 2: Newton Cooling
L2.1, L2.2, L2.3,
L2.4

Lecture Week 6, Sep 26,27,28
Sections 3.5,3.6.

26 Sep Page 162, 3.2: 10, 14, 24
26 Sep Page 170, 3.3: 10, 20
27 Sep, Exam 1 review in lab.
28 Sep, Maple 3, Numerical DE
[2.4,2.5,2.6-6,12] due, 1200 possible

Lecture Week 7, Oct 3,4
Sections 4.1,4.2.

03 Oct Page 182, 3.4: 20, 30, 34, 40
03 Oct Ch4 starts. Exam 1 review continued
04 Oct Midterm 1 100 possible
05-06 Oct Fall Break

Lecture Week 8, Oct 10,11,12
Sections 4.3,4.4,4.5,4.6.

10 Oct Page 194, 3.5: 16, 26, 44
11 Oct Lab: Begin maple 4 Matrices, Ch3 problem session.
12 Oct Page 212, 3.6: 6, 20, 32, 40, 60
12 Oct Page 233, 4.1: 16, 20, 32

Lecture Week 9, Oct 17,18,19
Sections 4.7,5.1,5.2,5.3.

17 Oct Page 240, 4.2: 4, 18, 28
17 Oct Page 248, 4.3: 18, 24
18 Oct Ch4 problem session 19 Oct Page 255, 4.4: 6, 24

Lecture Week 10, Oct 24,25,26
Sections 5.4,5.5,5.6.

24 Oct Page 263, 4.5: 6, 24, 28
24 Oct Page 271, 4.6: 2,
25 Oct, Exam 2 review in lab.
26 Oct Page 278, 4.7: 10, 20, 26
26 Oct Page 294, 5.1: 34, 36, 38, 40, 42, 46, 48

Lecture Week 11, Oct 31, Nov 1,2
Sections 6.1,6.2,7.1.

31 Oct, Ch6 and Exam 2 review continued from Oct 25.
01 Nov, Midterm 2 100 possible
02 Nov Page 306, 5.2: 18, 22
02 Nov Maple Lab 4: Matrices
L4.1, L4.2, L4.3

Lecture Week 12, Nov 7,8,9
Sections 7.2,7.3,7.4.

07 Nov Page 319, 5.3: 8, 10, 16, 32
08 Nov Maple 5 lecture in lab. First 1/4 of Exam 3 review.
09 Nov Page 331, 5.4: 20, 34
09 Nov Page 346, 5.5: 6, 12, 22, 54, 58,

Lecture Week 13, Nov 14,15,16
Sections 10.1,10.2,10.3.

14 Nov Page 357, 5.6: 4, 8, 18
15 Nov, Exam 3 review in lab, continued.
16 Nov Page 370, 6.1: 12, 20, 32, 36
16 Nov Page 379, 6.2: 6, 18, 28

Lecture Week 14, Nov 21,22
Sections 10.3,10.4.

21 Nov Page 400, 7.1: 8, 20
21 Nov Page 413, 7.2: 12, 14
22 Nov No lab scheduled. Appointments OK.
23-24 Nov Holiday

Lecture Week 15, Nov 28,29,30
Laplace problems and examples. Final exam review.

28 Nov Page 425, 7.3: 8, 20, 30
28 Nov Page 438, 7.4: 6
28 Nov, Exam 3 review in class. 29 Nov, Midterm 3 100 possible
30 Nov Page 576, 10.1: 18, 28
30 Nov Maple Lab 5: Resonance
L5.1, L5.2, L5.3

Lecture Week 16, Dec 5,6,7
Final exam review.

05 Dec Page 588, 10.2: 10, 16, 24
06 Dec, Final Exam review in lab.
07 Dec, Final Exam review in class.
07 Dec Page 597, 10.3: 6, 18, 20, 36
07 Dec Page 606, 10.4: 22
07 Dec, Lectures end.
08 Dec, Reading Day.

Week 17, Dec 11-15
Final exam for the 7:30 class is Thursday December 14, 10:10-12:45.
Final exam for the 10:45 class is Wednesday, December 13, 7:45-10:15am.
Final exam for the 6:00 class is Tuesday December 12, 6:00-8:30pm.
Final exam score == , 200 possible

Dec 16-Jan 7
Semester Break

Extra Credit: Under the door, 113jwb.

07 Dec, Ch10 Extra Credit,
10.3-24, 10.4-12, 10.5-6,
10.5-28, TBA, TBA,
07 Dec, Maple Makeup Lab 6:
Narrows L6.1, L6.2, L6.3
07 Dec, Maple Makeup Lab 7:
Quake L7.1, L7.2, L7.3,
Quake L7.4, L7.5, L7.6
No extra credit accepted after 9pm on 07 Dec.

Policy on Dailies: The highest 124 dailies will be counted. The lowest 8 of the 132 dailies will be dropped. Any record with less than 75 daily and lab scores earns a grade of **E**, regardless of midterm and final exam scores. Deadlines set at web site `www.math.utah.edu/~gustafso/`. Work not in the stack sent to the assistant is late and it earns a grade of zero.

Policy on Exams: The final exam is doubled before determining the exam average, to count like two midterms.

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.