MATHEMATICS 2280
Introduction to Differential Equations
Spring Semester 2009

Time: 8:35am MTWF in LCB 215

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

Office Hours: JWB 113, MTWF 9:40-10:30am and after 3pm by appointment. Other times will appear on my door card and on the internet page below, 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/`

Tutoring: The Math Department 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 6 p.m. on Friday. Some, but not all of the math tutors welcome questions from Math 2280 students. To see the times and specialities of various tutors, consult the web address `www.math.utah.edu/ugrad/tutoring.html`.

Texts:

> *Differential Equations and Boundary Value Problems, Computing and Modeling*, **4E**, 2008, by C.Henry Edwards and David E. Penney. Book and student manual, ISBN-10: 0131561073 or ISBN-13: 9780131561076.
>
> The 3rd edition of this book contain similar material, but there have been major edits since 2005. Patchwork would be needed to use the older 3rd edition.
>
> *Student Solution Manual*, for the Edwards-Penney text *Differential Equations and Boundary Value Problems*, 4th edition. It is normally offered as a package with the textbook.
>
> *WWW documents for 2280*, by GB Gustafson, at web site `www.math.utah.edu/~gustafso/`. All are pdf or text documents that can be printed from `Netscape`, `Mozilla Thunderbird` or `MS explorer` web browsers.

Prerequisites:

Math 1210 and 1220 (Calculus I and II) or the equivalent and Math 2270 (Linear Algebra). The first two courses are first-year Calculus, with a very brief introduction to linear differential equations. The old Math courses 111-112-113 of 1997-98 fulfill the requirement. In addition, background is required in planar curves, line integrals, Divergence Theorem, velocity and acceleration vectors from Physics 2210 or Math 2210 (Calculus III), or their equivalent courses. Used explicitly throughout the course are partial derivatives, vectors and matrices from Vector Analysis and Linear Algebra.

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 available at the tutoring

[1]Pronunciation: In the phrase $\boxed{\textit{Gust of Wind}}$ change $\boxed{\textit{Wind}}$ to $\boxed{\textit{Sun}}$

web address cited above. Free 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 the Edwards-Penney text plus class and web notes will make up the course material.

Grading:

Final grades will be based on:

> Textbook problems and maple problems, call **dailies**, 158 scores.
>
> The dailies include six computer projects.
>
> 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 final exam (in-class, 2 hours) as scheduled by the university. The midterm and final exams are graded by G.B. Gustafson.

Hand-written Dailies:

There will be 158 dailies due during the semester, including textbook problems and maple labs. They will be graded by a staff of readers employed by Angie Gardiner. The 158 dailies, including maple labs, will be checked checked by a grader employed by Angie Gardiner (score 100 each). The other assigned problems will not be graded, but the class effort will be to contribute complete solutions, to be checked by class members, and eventually published at the web site.

Textbook problems:

Textbook problems to be submitted for grading are listed on the `gradesheet` for the course [also at the end of this document]. 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 on the date printed on the gradesheet.

All students must complete each textbook problem and submit their work in their own handwriting. Collaboration is encouraged.

There are certain **rules** or **suggestions** for writing up the textbook problems. A full accounting of the *format rules* 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.

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 those already solved on the take-home portion of the exam.

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 a few computer projects assigned during the semester, related to the classroom material. They will be written by hand and use in addition the software package `maple`as a computer algebra assist. There is a Math Department Computer Lab in building LCB at which registered students automatically own accounts. 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 exam for the 8:35 MTWF class is Wednesday May 6, 7:30-10am in the regular classroom.

The final exam is comprehensive. About one hour of the exam covers the last three weeks of the course. The remaining time covers all topics that appeared on the previous three midterm exams.

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:

```
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. The letter grades are assigned from integers only. Any decimal score will be truncated, not rounded up), to an integer before fitting to the letter grade.

Grading Details:

Rite of passage: A passing grade in the course requires at least 70 of the 158 dailies to be submitted. A grade of E is assigned if less than 70 Dailies are submitted. The scores on the 70 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 150 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+.

About rounding. The score 87.5 is not rounded up to find the letter grade: it is truncated to 87 and letter grade B is assigned. The same is true if the score was 87.96. The grade of B is then adjusted up to a $B+$ (never higher than one level) provided the exam grades warrant a change. It is impossible to score a B and then, based on exams, receive an $A-$ or A: the maximum change would be B to $B+$, even if the final exam was 100%.

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 an engineering–style "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, the college algebra text, the 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 several engineering mathematics students over the years 1990–2008. 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. Develop your own style. Freely rob ideas from these suggestions and reject any that get in your way.

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

Cooperative efforts are allowed and encouraged. The uniform requirement is that you write in your own handwriting and submit your work in class as your own.

Presentation is expected to improve throughout the 15 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 algebra and calculus. Writing up the solution identifies the hurdles and it forces a review of background material.

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

Answer check. Every problem is required to have a written answer check, which can be as brief as *B.o.B* (Back of Book). If no answer or sanity check is available, then you are expected construct one, using a computer algebra system like `maple` when convenient. Proofs in particular are already *answer checks* and therefore statements like *B.o.B* make no sense.

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 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 leaves 113JWB and goes to the grader. The lowest four (4) dailies are dropped from consideration in order to eliminate makeups. If more than ten 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.

Missed Midterm Exams. Missing an in-class exam is a disaster. If you miss an exam, then see me in JWB 113, write email or call 581-6879.

Spring 2009 Daily Schedule

Questions: 581-6879, Email: ggustaf@math.utah.edu, Office: 113 JWB.

Boldface items will be examined by a grader for correctness. Each score is 100, making 15000 total. Maple labs are dailies. Other items are *not graded* but make up the **study guide** for the 3 midterm exams and final. Solution keys to study guide items are published on the web as a group effort of the class, volunteer participation expected.

Lectures Week 1, Jan 12-16
Read: Sections 1.2, 1.3, 1.4, 1.5.

1.1: **8**, **12**, 16, 29, **35**, **39**,
1.2: **5**, **10**, **17**, 30, **37**,

Lectures Week 2, Jan 19-23
Read: Sections 1.6, 2.1, 2.2, 2.3.

19 Jan, Holiday Monday.
1.3: 4, **33**,
1.4: **3**, **11**, **19**, 36, **54**, 58,
1.5: **9**, **15**, 33, **39**,

Lectures Week 3, Jan 26-30
Read: Sections 2.4, 2.5, 2.6, 3.1, 3.2.

1.6: 5, **18**, 34, **63**,
2.1: **7**, 13, **30**,
2.2: **9**, **21**, **23**,
2.3: **2**, 11, 21, **24**,

Lectures Week 4, Feb 2-6
Read: Sections 3.3, 3.4, some of 3.5

MapleLab1: **L1.1**, **L1.2**, **L1.3**, **L1.4**,
2.4: 4, 16, **L3.1**, YL4.1
2.5: 4, 16,
Parts 2,3,4 of Maple Labs 3-4 due after Spring Break
2.6: 4, 16,
3.1: **5**, 9, 12, **25**, 38, **46**,

Lectures Week 5, Feb 9-13
Read: Sections 7.1, 7.2, 7.3

3.2: **4**, 10, **15**, **23**, 27,
3.3: 9, **10**, **15**, 24, **28**, 35, **40**, **46**,
3.4: 3, **10**, **13**, 18, **35**, **36**, **37**, **38**,

Lectures Week 6, Feb 16-20
Read: Sections 7.4, 7.5, 7.6.

16 Feb, Holiday Monday.
7.1: 2, **4**, **15**, **25**, 29, **33**, **35**, **36**, 39, **41**,
7.2: 3, 14, **19**, **24**, 29, 33, **35**,
7.3: **3**, **7**, 10, **13**, 19, 30, 39,
MapleLab2: **L2.1**, **L2.2**, **L2.3**, **L2.4**,

Lectures Week 7, Feb 23-27
Read: Sections 3.5, 3.6, 3.7

25 Feb, Midterm Exam 1
7.4: **3**, 11, **14**, **17**, 20, **23**, **26**, 31, 36,
7.5: **5**, **14**, 25, **33**,

Lectures Week 8, Mar 2-6
Read: Sections 4.1, 4.2, 4.3, 5.1.

7.6: 3, 10, **15**, **17**, **21**,
3.5: **1**, 3, **5**, **7**, **9**, 18, **34**, **37**, **41**, **45**, 53, 60,
3.6: **4**, 10, **17**, **23**, 28,
3.7: 2, 3, **8**, **14**, 19,

Lectures Week 9, Mar 9-13
Read: Sections 5.2, 5.3, 5.4, 5.5. Spring break Mar 16-21.

4.1: **2**, 17, 24, 26, **27**, **4.2**: **8**, 15, **34**,
4.3: 6, **10**, **17**,
5.1: 32, 38,
MapleLab6: **L6.1**, **L6.2**, **L6.3**,

Lectures Week 10, Mar 23-27
Read: Sections 5.6, 6.1, 6.2, 6.3.

25 Mar, Midterm Exam 2
5.2: 9, 19, 30, **32**, **36**, 29,
5.3: **3**, 9, 14, **16**, **19**,
MapleLab3: **L3.2**, **L3.3**, **L3.4**,

Lectures Week 11, Mar 30,31 and Apr 1,3
Read: Sections 6.3, 6.4, 6.5.

5.4: 5, **12**, 22, **25**, **35**,
5.5: **3**, 7, **15**, **23**, 27,
5.6: 5, **16**, 22, **31**,
MapleLab4: **L4.2**, **L4.3**, **L4.4**,

Lectures Week 12, Apr 6-10
Read: Sections 9.1, 9.2, 9.3.

6.1: 11, **20**, 24,
6.2: 8, **15**, **27**, 33, **37**,
6.3: 3, **5**, **8**, **9**, **10**, **13**, **17**, 21,
6.4: 4, **12**,
6.5: nothing due
MapleLab7: **L7.1**, **L7.2**, **L7.3**, **L7.4**, **L7.5**,

Lectures Week 13, Apr 13-17
Read: Sections 9.4, 9.5, 9.6.

9.1: 15, **23**, **27**,
9.2: 13, **17**, 24a,
9.3: **4**, **9**, 11, **20**, 22,

Lectures Week 14, Apr 20-24
Read: Section 9.6, 9.7, Final Review.

20 Apr, Final Exam Review.
24 Apr, Midterm Exam 3
9.4: 3, **8**, **15**, **18**,
9.5: **3**, 10, **14**, 15, **17**, 18, **19**,

Lectures Week 15, Apr 27-29
Read: Final Exam review. Lectures end Apr 29. Reading day Apr 30.

9.6: **3**, **6**, **11**, **13**, **14**, **15**, **16**, **17**, **19**,
9.7: **5**, **9**, **11**,

Lectures Week 16, May 1-8
Read: Final exam period.

6 May, Final Exam, 7:30-10:00am, regular classroom.

Policy on Dailies: The highest 150 dailies will be counted. The lowest 8 of the 158 dailies will be dropped. Any record with less than 70 daily 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. Zeros can be erased by doing extra credit problems.

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.

Average of Midterms and Final (100+100+100+200)/5: $AV_1=$ $\square$

Average of dailies (150 items, 100 each): $AV_2=$ $\square$

Final Grade: $\frac{70}{100}AV_1 + \frac{30}{100}AV_2=$ $\square$