MATHEMATICS 2280
Introduction to Differential Equations
Spring Semester 2017

Time: 12:55pm MTWF in LCB 219

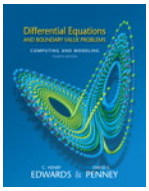
Instructor: Professor Grant B. Gustafson[1]

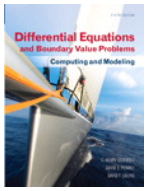
Office Hours: JWB 113, MTWF after class and other times by appointment. Office hour changes will appear on my office door card and on the duplicate internet door card http://www.math.utah.edu/ gustafso/doorcardS2017.pdf

Telephone: 801-581-6879. Email preferred.

Email Address: `ggustaf@math.utah.edu`

Course Web site: `http://www.math.utah.edu/~gustafso/`





Differential Equations and Boundary Value Problems, Computing and Modeling, **4/E** 2008 (recommended) or **5/E**, 2015 (bookstore), by C.Henry Edwards and David E. Penney. See the course web page for ISBN numbers plus differences in the two editions. Publisher site Pearson Higher Ed.

Additional Texts and References:

> **Older Editions**. Minimal patchwork (just section 5.3 of 5/E) is required to use edition 4/E. This is the edition used to prepare the course. Substantial patchwork would allow use of edition 3/E. Older editions like 2/E have different problem numbers, numerous missing problems and multiple section edits.
>
> *Student Solution Manual*, for the Edwards-Penney text *Differential Equations and Boundary Value Problems*, 4/E or 5/E.
>
> *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 commonly used web browsers `Safari`, `Mozilla Firefox` and `Microsoft Internet Explorer`.

Course Content. This course is an introduction to differential equations for mathematics majors and science majors. Chapters 1 to 7 and 9 of the Edwards-Penney text plus class and web notes will make up the course material.

Tutoring. The Math Department Tutoring Center is located in building LCB, in the **Math Center**. It is open for free tutoring from 8 AM to 8 PM on Mon-Thu, and Friday from 8 AM to 6 PM. The center is closed weekends and semester holidays. The times and specialities of available tutors are recorded at web address `www.math.utah.edu/ugrad/tutoring.html`.

Prerequisites. Calculus I and II (Math 1210 and 1220) or the equivalent, and Linear Algebra (Math 2270). The first two courses are first-year Calculus, with a very brief introduction to linear differential equations. In addition, background is required in planar curves, line integrals, velocity and acceleration, vectors, the Divergence Theorem, from Physics 2210 or Calculus III

[1] Pronunciation: Change the common phrase *Gust of Wind* to *Gust of Sun*. Please use **Dr. G** for email and questions.

(Math 2210), or equivalent courses. Used explicitly throughout the course are partial derivatives, vectors and matrices, from Vector Calculus and Linear Algebra.

Computer Background. Passive knowledge is assumed for a computer algebra system, e.g., `Maple`, `Matlab` with `Maxima`, `Mathematica`. The computer code examples are supplied in `Maple`. Use of `Matlab` on assignments is equivalent, however no sample code nor direct help will be available.

Math Center Computer Lab. Persons without passive knowledge of a computer algebra system may may be offered a *tutorial* on the subject during the first two weeks of the term. The Math Center director is Aryn DeJulis, 801-585-9478, `dejulis@math.utah.edu` . Details, when available, appear at the tutoring web address `www.math.utah.edu/ugrad/tutoring.html`.

Grading. Final grades will be based on weighted components, as follows.

Weight	Graded Component
30%	Written midterm examinations.
30%	Written final examination.
20%	Textbook problems and computer problems.
20%	Take-Home quizzes.

Written In-Class Exams. There are three (3) midterm in-class written exams and a 2-hour written in-class final exam. Exams are graded by G. B. Gustafson and one assistant.

Exams have different presentation requirements, and none of the textbook problem exposition ideas apply. Basically, in-class exam solutions are expected to be a first draft.

A sample exam is supplied a few days before an in-class exam. Exam problems are modeled after the assigned textbook exercises. Computer problems do not appear on in-class exams.

Please bring pencils and eraser. Paper will be supplied. No books, tables, notes, phones or calculators on exam day.

Midterm Exams. Each of the three (3) midterm exams has equal weight, 10% of the semester total, which total to the final exam weight of 30%. The official time allowed for a class meeting is 50 minutes. To get extra time on exam day, the exam papers are distributed 5 minutes early and collected 5 minutes late, for a total exam period of 60 minutes.

An actual midterm exam has the same topics and number of problems as the sample midterm exam.

Final Exam. Two hours are reserved by the university for the written final exam, which is weighted as three midterm exams, representing 30% of the semester total.

The university published final exam time for a 12:55 MTWF class is Friday April 28, 1-3 PM in the regular classroom. Effort is made to provide 30 more minutes of exam time, 12:45 to 3:15 PM.

The final exam is comprehensive. About 40% of the exam covers the last three chapters in the course. The remaining 60% covers all other chapters. The actual final exam has the same topics and number of problems as the sample final exam.

Oral Exam. There is no oral exam.

Take-Home Quiz. Ten quizzes will be due, with at least 6 days to work on each quiz. The weight of the quizzes is 10% of the semester total. The lowest quiz score is dropped. The policy is no makeup, like exams.[2]

Hand-written Problems and Computer Labs. There will be 158 items due during the semester, including textbook problems and computer labs. They will be graded by an external assistant employed by Aryn DeJulius. Just 150 items are used. The weight of the 150 items is 20% of the semester total. In practical terms, fifteen (15) problems account for 2% of the semester final grade.

Textbook problems to be submitted for grading are listed at the end of this document. Collaboration is encouraged. Please submit your own handwritten solutions.

Study guide problems are not collected for grading.

Exposition suggestions exist for written presentation of textbook problems. A full accounting of *format ideas* contributed by Utah students appears on the internet course page as *format ideas for submitted work*. Kindly steal ideas and implement them, as they apply to your written work, both textbook problems and computer labs.

Computer Projects. The projects will be written by hand. Assist is expected from a computer algebra software package, such as `Matlab with Maxima`, `Mathematica` or `Maple`. Course examples will use `Maple`. There is a Math Center Computer Lab in the lowest floor of building LCB at which registered students automatically own accounts. Math accounts can login from other hosts, the Math Center Lab being only one possibility. Drop-in mathematics tutoring in the Math Center starts the first week of the semester. Drop-in computer help in the Math Center Computer Lab starts in the second week.

Withdrawal. It is the Math Department policy, and mine as well, to grant any withdrawal request until the University deadline. Registered students may initiate a withdrawal by starting the registrar's paperwork that is required. I promise that withdrawal requires no explanation, no confrontation and no appearance. My job is to provide the signature, from a paper left at the math department front desk, or a paper slipped under my office door.

ADA Statement. The American with Disabilities Act (ADA) requires that reasonable accommodations be provided for students with physical, sensory, cognitive, systemic, learning, and psychiatric disabilities. Please contact me during the semester (it is never too late) to discuss accommodation (113 JWB or 801-581-6879 or email), which is to say, accommodation shall be made.

Grading Scale.

```
A  = 95-100, A- = 90-94,
B+ = 85-89,  B  = 80-84, B- = 75-79,
C+ = 70-74,  C  = 65-69, C- = 60-64,
D+ = 55-59,  D  = 50-54, D- = 45-49,
E  = 0-44.
```

Exam Grading Practices. The scale is used religiously for the grading of exams. Graders mark

[2] A quiz is take-home exam with one week to complete it. There is one extra credit quiz. Missed a quiz? Please read the syllabus remarks about recovery from a missed exam.

a problem with a letter grade and then they convert the letter grade into a numerical credit from a table of credits.

For example, if part (b) of problem 3 is marked as 30 percent of the problem, then the grader will convert a letter grade of `C+` for problem 3(b) into a credit of between 70 and 74 percent of 30 points towards the total of 100 for problem 3. Possible credits for a `C+` on problem 3(b) would be either 21 or 22 out of 30, at the option of the grader.

Final Letter Grade. Final grades are computed from the grading scale to a letter, using the following components and credits. The basic formula driving the choice of percentages is 80 percent exams and 20 percent homework and labs.

Component	**Percent Credit**	**Problem Count**	**Grading Total Score**
Exam 1	10	Five	500
Exam 2	10	Five	500
Exam 3	10	Five	500
Final Exam	30	Nine	900
Take-Home Quizzes	20	Nine	900
Homework and Computer Labs	20	One Hundred Fifty	15000

Scoring on homework, labs, quizzes and exams uses a scale of 0 to 100, per problem, the same as the grading scale. The following examples illustrate how the grades on papers are converted to a final grade.

Example 1. A score on Exam 1 of 94 is a letter grade of `A-`. The credit earned towards the final grade is 94 percent of 10, which equals 9.4.

Example 2. A score on the Final Exam of 91 is a letter grade of `A-`. The credit earned towards the final grade is 91 percent of 30, which equals 27.3.

Example 3. Homework and labs earned 100 each on 130 items and 50 each on 4 items for a total of 13200 out of 15000 possible. This is an average of 88 percent which is a letter grade of `B+`. The credit earned towards the final grade is 88 percent of 20, which equals 17.6.

Example 4. A take-home quiz has three (3) problems earning scores 90, 85, 60. The average is $(90+85+60)/3 = 78$ percent. The lowest of 10 quizzes is dropped, only 9 counted. The semester score is increased by 78 percent of 20 divided by 9, or 1.73.

Example 5. Assume midterm scores of 94, 90, 88 percent, final exam 91 percent, quizzes 85 percent and homework/labs 88 percent. The total credits toward the final grade are

$$9.4 + 9 + 8.8 + 27.3 + 17 + 17.6 = 89.1$$

which rounds down to 89, for a final letter grade of $B+$.

If the score had rounded up to 90 instead, then the final letter grade is $A-$. In such a borderline case, a final grade of $B+$ or $A-$ is decided by considering exam performance first and effort expended second. Borderline cases can require phone, office or email communication to resolve. Please act immediately, if your semester record is a borderline case. Rest assured that *you will be treated fairly*, even after the Registrar posts final grades, with a grade change if your record supports it.

Purpose of the textbook problems. The *reason* for exercises is to practice doing mathematics, that is, to write solution details for the 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 textbook and the *problem notes*. 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 gum eraser, lots of paper, and flesh out a first draft at full speed. This is not the paper you will submit.

- **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 expected.

- **Final Copy Format**. The most successful format ideas to date were invented by engineering mathematics students over the years 1990–2017. The ideas are described in some detail below and also in the internet document *format ideas for submitted work*.

Some Exposition Ideas

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, such as long calculations, graphics, answer checks.

5. Any of items 1-4 can be broken. Develop your own style. Freely commit theft of these ideas and reject ideas 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 *back of book* (abbreviated *B.O.B*). For problems without textbook answers, a full answer check is expected.

Cooperative efforts are encouraged. The uniform requirement is that you write in your own handwriting and submit your work 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 detailed citations. A statement like "References as earlier" is enough.

Brevity is encouraged. Readers don't appreciate sloughing in hip boots through a neck-high swamp of boring, over-explained details.

Answer Check. Every problem is expected 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 please construct one, using computer assist when possible. Proofs in particular are already *answer checks*, a special case when the answer check requirement is relaxed.

Due Dates. Due dates may be extended, due to snow days or unexpected events. Email communication about extended due dates and changed exam dates will use your email address recorded at the registrar's web site.

Missed Deadlines. Quizzes, homework and labs have a deadline, which is missed when the stack leaves office 113 JWB for delivery to the grading assistant. Unfortunately, late work has no grader, which causes a zero score to be recorded.

Erasing Zero Scores. Kindly prepare and submit extra credit problems (also with deadlines), as a replacement for zero scores on homework and labs. Take-home quiz and exam scores cannot be altered with extra credit.

Missed Quiz. If you fail to submit a take-home quiz, which has 6 days of preparation time, then do your politics in JWB 113, or write email to the address **ggustaf@math.utah.edu** , or else call my office at 801-581-6879. Backup plan: Call 801-581-6851, weekdays 9 AM to 5 PM, to leave a message with a math department secretary.

Missed Midterm Exam. If you miss an exam, then use the contact information above. The last midterm is at the end of the semester, which creates a delicate situation due to travel plans and semester grade reporting deadlines.

Missed Final Exam. Use the contact information above. Accommodation is possible, but please communicate quickly.

Weekly Schedule

Questions: Office Phone: 801-581-6879, Email: **ggustaf@math.utah.edu** , Office: 113 JWB.

Items in Boldface

An external grading assistant is employed to examine the required items, which are in boldface. Each problem has score 100. The maximum credit is 15000 total, which includes both textbook and computer lab problems.

Selective Grading. The grading assistant examines only one or two problems, initially. If they are correct, then the score is 100 on all problems, even those not examined. If problems are missing, then they earn a zero score, and the entire work is graded. If the targeted problems have mistakes,

then the entire work is graded. Possible scores are 100, 50, 0 on each problem.

Does Homework make a difference? A single problem contributes $(20/100)(100/15000)(100) = 0.133$ to the final grade in the course. Skipping 15 homework problems or computer lab problems will reduce the semester total by 2 percentage points. In letter grade terms, 15 problems skipped can change the final letter grade to `A-` (94%) from a potential `A` (96%).

Homework and computer labs contribute 20 percent towards the final grade in the course. The final exam contributes 30 percent. Please take note of the relative importance of each grading component to the final letter grade in the course.

Items in Boldface

These are the problems you are to prepare for grading. An external grader will examine your work and mark credits. Each homework package is due on Friday, with 6 days or more of preparation time.

Items not in Boldface

The **study guide** for the course includes the non-boldfaced problems in the list below. Reading only the problems due for grading is a serious mistake. Reading all the problems identifies important topics in the text. It is the fastest way to identify a topic or detail you skipped or delayed.

Submission Dates

Homework and Labs are due on **Friday**, the week after they are assigned. Items in **boldface** are graded by an assistant, who assigns scores of 100 or 50 or 0 per problem. Items not in boldface are study guide problems, used as reading material to identify skipped or delayed topics. Only 150 scores are used to compute the homework and lab total, which is weighted 20% of the final grade.

Quizzes are due on Friday. Expect to work on a quiz for 7-10 days. Exceptions of 14 or 21 days exist, depending on midterm exams and holidays. The schedule is detailed earlier in the syllabus. The lowest quiz score is dropped, making 9 quiz scores weighted 20% of the final grade.

Exam Dates

Hour Midterms on Fridays, 17 Feb, 31 Mar, 14 Apr. Exam from 12:50 to 1:45.

Final Exam on Friday 28 April, $2\,\frac{1}{2}$ hours, 12:45 to 3:15.

Lectures Week 1, Jan 9-13
Read: Sections 1.1, 1.2, 1.3, 1.4.

`HW 1, Due Week 2`
1.1: `1, 4, 5, 6, 9, 15, 19, 27, 29, 30, 32, 33, 34`

Reading. Required background. Nothing graded from 1.1.

1.2: 1, **2**, **4**, 5, **6**, 7, 9, **10**, 13, 15, 16, 18, 21, 22, 24, 26, 29, 31, 32, 33, 35, 40, 41

1.3: 2, 3, 5, 6, **8**, 10, 11, 13, **14**, 23, 25, 26, 33

1.4: 2, 3, 4, **6**, 9, **12**, 13, **18**, 19, 20, 21, **22**, **26**, 36, 41, 42, 45, 46, 49, 51, 56, 59

Print Exercise 1.3-8 image at 200% from here:
http://www.math.utah.edu/ gustafso/exercise1.3-8-EdwardsPenney.jpg

Lectures Week 2, Jan 16-20
Read: Sections 1.5, 3.7, 2.1, 2.2, 2.3.
16 Jan, Holiday Monday.

HW 2, Due Week 3

1.5: 1, 7, **8**, **10**, 13, **18**, **20**, 21, 23, 24, 33, **34**, 36, 39

3.7: 1, 2, **4**, 7 [LC and RC circuits, LRC after 3.6]

2.1: 1, 3, 4, 6, **8**, 10, 12, **16**, 22, 23, 33, 37

2.2: 5, 7, 8, 9, **10**, 11, 15, 17, **18**

2.3: 2, 3, 9, **10**, 13, 14, 17, 18, 19, **20**, **22**, 24, 25

Computer Lab 1, Due Week 5:

http://www.math.utah.edu/ gustafso/s2017/2280/2280mapleL1-intro-S2017.pdf

Lectures Week 3, Jan 23-27
Read: Sections 2.4, 2.5, 2.6, 3.1.

HW 3, Due Week 4
No exercises due, only the computer Numerical DE Project (below), which uses the statements from exercises 2.4-6, 2.5-6, 2.6-6.

2.4: 2, 3, 4, **6**, 10, 12, 17 Euler's method

2.5: 3, 4, 5, **6**, 10, 12 Improved Euler or Heun

2.6: 3, 4, 5, **6**, 10, 12 Runge-Kutta, RK4

http://www.math.utah.edu/ gustafso/s2017/2280/numericalDEproject-S2017.pdf

Lectures Week 4, Jan 30 to Feb 3
Read: Sections 3.2, 3.3, 3.4, some of 3.5

HW 4, Due Week 5

3.1: 1, 6, 10, 27, 33, **34**, **36**, 37, **38**, 39, **40**, 41, **42**, 43, **46**, **48**, 53

3.2: 1, 2, 5, 8, 11,13, 16, **18**, 19, 20, 21, **22**, 23, 25, 26

3.3: 3, 7, **8**, 9, **10**, 11, **16**, 17, 23, 27, 31, **32**, 37, 40

3.4: 3, 4, 5, 6, 10, 11, 15, 17, 19, **20**, 21, 33, **34**

Lectures Week 5, Feb 6-10
Read: Exam 1 Sample and Sections 3.5, 2.6, 3.7.

HW 5, Due Week 6
3.5: 2, 3, 5, **6**, 10, 11, **12**, 19, 21, **22**, 25, 27, 29, 31, 34, 39, 43, 45, 47, 51, 52, **54**, 57, **58**, 59
3.6: 3, **4**, 5, 7, **8**, 9, **11**, 13, 15, 17, **18**, 20, 21, 22
3.7: 1, 2, 4, 7, **12**, 15, **18**, 19 [LRC circuits]

Computer Lab 2, Newton Cooling, Due Week 6. Choose one project.
http://www.math.utah.edu/ gustafso/s2017/2280/2280mapleL2-freezing-pipes-S2017.pdf
http://www.math.utah.edu/ gustafso/s2017/2280/2280mapleL2-swamp-cooler-S2017.pdf

Lectures Week 6, Feb 13-17
Read: Sections 7.1, 7.2, 7.3.
17 Feb, Midterm Exam 1

HW 6, Due Week 7
7.1: 1, 3, 7, 9, 11, 13, 17, **18**, 19, **22**, 23, 27, **28**, 29, 31, 40
7.2: 3, 7, 9, **10**, 15, **16**, 17, 19, **20**, 21, 23, **24**, 35, 37
7.3: 3, **6**, 7, 9, **12**, 13, 17, **18**, 20, 23, 27, 28, 29, 30, 32, 34, 37

Lectures Week 7, Feb 20-24
Read: Sections 7.4, 7.5.
20 Feb, Holiday Monday.

HW 7, Due Week 8
7.4: **2**, 3, 9, 13, 15, 17, **22**, 23, 26, 27, 29, 30, **36**, 37
7.5: 3, **4**, 7, 9, 11, 13, **14**, 21, **22**, 25, 27, **28**, 31, 33, 34, 37

Lectures Week 8, Feb 29 to Mar 4
Read: Sections 7.6, 4.1, 4.2, 4.3.

HW 8, Due Week 9
7.6: 2, 5, 6, **7**, **8**, 11, **12**, 18, 21, **22** [impulses and Laplace]
4.1: 1, 3, 2, 5, 7, **8**, 11, 12, 15, 17, **20**, 21, 24, 26
4.2: 7, **12**, 27; A Laplace or Cayley-Hamilton-Ziebur solution is acceptable.
4.3: 7, **9**, 21;

See RK4 for systems http://www.math.utah.edu/ gustafso/s2017/2280/numericalVectorMethods.pdf
For Exercise 4.3-9 and similar computer problems, see all files numerical-4.3* in the directory
http://www.math.utah.edu/ gustafso/s2017/2280/maple/

Lectures Week 9, Mar 7-11
Read: Sections 5.1, 5.2, 5.3.

HW 9, Due Week 11 after Spring Break (Week 10, no classes)
5.1: **16**, 17, **20**, **22**, **24**, 25, **28**

Computer Lab 3, Laplace:
http://www.math.utah.edu/ gustafso/s2017/2280/2280mapleL3-laplace-S2017.pdf

Lectures Week 10, Mar 11-19
Read: Ch 1 to Ch 5 review. Spring Break

HW 10 does not exist. Spring Break.
No Quiz 10. No Lab 10.

Lectures Week 11, Mar 20-24
Read: Sections 5.4. 5.5, 5.6

HW 11, due Week 12
5.2: **8**, 11, 13, **20**, 21, 27, 29, **30**, 31, 35, 39, 43, 45, 49
5.3 [5.4 in edition 5/E]: **6**, 9, 13, 19, **24**, 27
5.4 [5.5 in edition 5/E]: 1, 7, **11** , **29**
5.5 [5.6 in edition 5/E]: 1, 3, **4**, 11, **12**, 23, **38**
Edition 5/E problems are identical in matching sections:

Edition 4/E	Edition 5/E
5.1	5.1
5.2	5.2
5.3	5.4 [a new 5.3 was inserted]
5.4	5.5
5.5	5.6
5.6	5.7

We don't do the 5/E section 5.3 problems.
The material in 5/E section 5.3 is a reference
for Chapter 6 in both 4/E and 5/E.

Lectures Week 12, Mar 27-31
Read: Exam 2 Sample and Sections 6.3, 6.4, 6.5.
31 Mar, Midterm Exam 2

HW 12, due Week 13
5.6 [5.7 in edition 5/E]: 1, 13, **15**, 19, **23**
6.1: 3, **4**, 5, 7, **8**, 11, 15, 17, **18**
6.2: **2**, 5, 7, 9, **12**, 13, 17, 19, 21, **22**, 23, 29
6.3: 5, 7, **8**, **9**, **10**, 11, 18, 19

Lectures Week 13, Apr 3-7
Read: Sections 9.1, 9.2.
6 Apr, Exam 3 Review.

HW 13, due Week 14
6.4: 1, 3, **4**, **8**, 9, 10, 11, 13, 14
6.5: Not covered in class, nothing due.
Computer Lab 4, Resonance:

http://www.math.utah.edu/ gustafso/s2017/2280/2280mapleL4-resonance-S2017.pdf

Lectures Week 14, Apr 10-14
Read: Exam 3 Sample and Sections 9.3, 9.4.
14 Apr, Midterm Exam 3

HW 14, due Week 15
9.1: **6**, 7, **10**, **13**, 15, 17, 20, **24**, 30
9.2: 2, **8**, 9, **20**
9.3: 1, **4**, 9, **17**, **20**
9.4: **1**, 7, **9**, 13

Lectures Week 15, Apr 17-21
Read: Sections 9.5, 9.6. Course Review.
20 Apr, Problem Session.

HW 15, due by 6pm on May 4 under the door JWB 113
9.5: 1, 2, **3**, **7**, **9**
9.6: 1, **5**

Lectures Week 16, Apr 24-25
Read: Sample Final Exam.

24 Apr, Final Exam Review.
25 Apr, Final Exam Review. Lectures end.
26 Apr, Reading day. Office hours only.

Final Exam Period, Apr 28 to May 3
Read: Chapters 1–7 and 9. Final exam period.
Final Exam on 28 April, 12:45 to 3:15 PM, regular classroom. Please bring pencils and eraser. Paper provided. No electronic devices, books or notes.