MATHEMATICS 2280
Introduction to Differential Equations
Spring Semester 2019

Time: Meet in LCB 215 8:00-9:20am MWF, in JTB 120 8:35-9:25am on Tuesday. Maple Lab in LCB 115 at 8:35am on select Fridays.

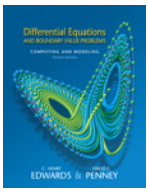
Instructor: Professor Grant B. Gustafson[1]

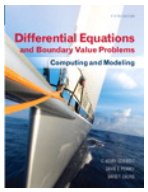
Office Hours: JWB 113, MWF after class and other times by appointment. Office hour changes will appear on my office door card and on the duplicate internet door card http://www.math.utah.edu/ gustafso/doorcardS2019.pdf

Telephone: 801-581-6879, office 113 JWB, no text or voicemail. 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 `www.math.utah.edu/~gustafso/`. All pdf and text documents can be viewed or printed from commonly used web browsers: `Safari`, `Mozilla Firefox`, `Google Chrome`, `Microsoft Internet Explorer`, Windows 10 `EDGE`.

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 PDF web notes will make up the course material.

Tutoring. The Math Department Tutoring Center or **Math Center** is located in the basement of building LCB. 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 tutoring times and specialities of available free 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,

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

velocity and acceleration, vectors, the Divergence Theorem, from Physics 2210 or Calculus III (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 `Symbolic Math Toolbox`, `Mathematica`. The computer code examples are supplied in `Maple`. Use of `Matlab` on assignments is equivalent, however no sample matlab code nor direct matlab 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. Basic information about `Maple` and the Math Center is here:

`http://www.math.utah.edu/~gustafso/s2019/maple-web-help/indexMaple-Web-Help.html`

A `Maple` tutorial and sample first lab can be found here:

`http://www.math.utah.edu/~gustafso/s2019/maple-web-help/troubleShooting.html`

The Math Center director is Lisa Penfold, `penfold@math.utah.edu`, 801-585-9478. 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.
25%	Textbook problems and computer problems.
15%	Semester Project.

Written In-Class Exams. There are two (2) 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 two (2) midterm exams has equal weight, 15% of the semester total, which total to the final exam weight of 30%. The official time allowed for a class meeting is 80 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 90 minutes. In addition, a midterm exam can be started as early as 7:30am, if you need the extra time.

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 8:05am MTWF class is Tuesday April 30, 8-10 am in the regular classroom. Effort is made to provide 30 more minutes of exam time, 7:30 to 10:00

am.

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.

Semester Project. The weight of the semester project is 15% of the semester total. The project is considered 100% complete if all three (3) parts are submitted. The due dates for Parts 1,2,3 are March 1, April 12, May 7. Grading of the project parallels exam grading. All project problems and sample project problems with solutions are available online at the start of the semester. Edits are limited to corrections, e.g., a typo. Browse the course web page for links to the PDF sources: `http://www.math.utah.edu/~gustafso/s2019/2280/index2280S2019.html`

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 Lisa Penfold. Just 150 items are used. The weight of the 150 items is 25% of the semester total. In practical terms, twelve (12) problems account for 2% of the semester final grade.[2]

Textbook problems to be submitted for grading are listed at the end of this document. Collaboration is encouraged. Please submit your own handwritten solutions on paper in class or under the door 113 JWB. PDF copies in email are not acceptable.

Study guide problems are not collected for grading. These are the unboxed problems in the bookmark list. You should read the unboxed problems problems cited, but don't solve them, as a rule.

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 Labs. The labs will be written by hand. Assist is expected from a computer algebra software package, such as `Maple`, `Matlab with Maxima or Symbolic Math Toolbox` or `Mathematica`. 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. The **five computer labs** and Friday due dates:

Week 4: 1 Feb. Maple Lab 0, typing lesson.
Week 5: 8 Feb. Maple Lab 1, quadratics, plots, derivatives, Jacobian.
Week 7: 1 Mar. Maple Lab 2: Swamp cooler or freezing pipes.

[2] Does Homework make a difference? A single problem contributes $(25/100)(100/15000)(100) = 0.167$ to the final grade in the course. Skipping 12 homework problems or computer lab problems will reduce the semester total by 2 percentage points. In letter grade terms, 12 problems skipped can change the final letter grade to `A-` (94%) from a potential `A` (96%).

May 7: Maple Lab 3: Laplace.
May 7: Maple Lab 4: Resonance.
May 7: Maple Lab 5: Brine Tank.
May 7: Extra Credit Maple Lab 6: Tacoma Narrows.
May 7: Extra Credit Maple Lab 7: Earthquake.

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 and the semester project. Graders mark 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. Note: this practice is for exams and the semester project only (HW problems are graded differently).

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	15	Eight	800
Exam 2	15	Eight	800
Final Exam	30	Nine	900
Semester Project	15	Eight	800
Homework and Computer Labs	25	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 15, which equals 14.1.

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 25, which equals 22.

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

$$14.1 + 13.2 + 27.3 + 12.75 + 22 = 89.35$$

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

If the total was 89.5, which rounds up to 90, then the final letter grade is $A-$. But what if the total was 89.44? 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 work gets completed on schedule. Problems are discussed in class in greater detail, especially when class members request details for a specific problem.

- **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 1990–2019. 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 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. 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 (deadline May 7), as a replacement for zero scores on homework and labs. The semester project score and exam scores cannot be altered with extra credit.

Missed Midterm Exam. If you miss an exam, then use the contact information found on the online DoorCard, located on the course web page. 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 found in the online DoorCard, course web site. 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: How to Read the Assignment List

An external grading assistant is employed to examine the required items, which are in boldface, eg., **4** in section 1.2 means exercise 1.2-4 is required.

The grader will not look at study-guide non-boldface problems. No, you are not supposed to write out solutions to study guide problems: read the study guide problem and think about how to solve it. Do not waste time writing up study guide problems. Use the time to improve submitted (boxed) problems and to prepare computer labs.

Each required 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.

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.

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.

Exam Dates

Midterms are nearly 2 hours on Friday 22 Feb and Friday 5 Apr. Midterm period is 7:30am to 9:25am. Arrive at 8:05am, the regular class time, if you will not need extra time.

Final Exam on Tuesday 30 April, $2\frac{1}{2}$ hours, 7:30am to 10:00am. The scheduled time by the university is 8:00am to 10:00pm. Arrive at 8:00am, if you will not need extra time.

Lectures Week 1, Jan 7-11
Read: Sections 1.1, 1.2, 1.3, 1.4.

HW 1, Due Week 3
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/s2019/2280/images/exercise1.3-8-EdwardsPenney.jpg

Lectures Week 2, Jan 14-18
Read: Sections 1.5, 3.7, 2.1, 2.2, 2.3.
15 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

Lectures Week 3, Jan 21-25
Read: Sections 2.4, 2.5, 2.6, 3.1.

HW 3, Due Week 6
Due is the computer Numerical DE Homework, PDF link below. The work uses as a reference the statements from textbook exercises 2.4-6, 2.5-6, 2.6-6. Please review all problems below, prior to starting the numerical homework. REPEAT: You are not expected to write solutions to review problems, or even to solve them. Review problems are for reading.
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

The PDF source and instructions for HW3 can be found here:
http://www.math.utah.edu/~gustafso/s2019/2280/homework/numericalDEproject/numericalDEproject-S2019.pdf
The due date for this numerical work is Week 6. Submit it with maple lab 1.

Lectures Week 4, Jan 28 to Feb 1

Read: Sections 3.2, 3.3, 3.4, some of 3.5

HW 4, Due Week 6
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**
Computer Lab 1, Due Week 5:

http://www.math.utah.edu/~gustafso/s2019/2280/maple/lab1/2280mapleL1-intro-S2019.pdf

Lectures Week 5, Feb 4-8
Read: 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]

Lectures Week 6, Feb 11-15
Read: Exam 1 Sample and Sections 7.1, 7.2, 7.3.
14 Feb, Midterm Exam 1 Review

HW 6, Due Week 9
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
Computer Lab 2, Newton Cooling, Due Week 7. Choose one project.

http://www.math.utah.edu/~gustafso/s2019/2280/maple/lab2/2280mapleL2-freezing-pipes-S2019.pdf
http://www.math.utah.edu/~gustafso/s2019/2280/maple/lab2/2280mapleL2-swamp-cooler-S2019.pdf

Lectures Week 7, Feb 18-22
Read: Sections 7.4, 7.5.
18 Feb, Holiday Monday.
22 Feb, Midterm Exam 1.

HW 7, Due Week 9
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
Computer Lab 3, Laplace. Due Week 8.:

http://www.math.utah.edu/~gustafso/s2019/2280/maple/lab3/2280mapleL3-laplace-S2019.pdf

Lectures Week 8, Feb 25 to Mar 1
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;
RK4 for systems is found here:

http://www.math.utah.edu/~gustafso/s2019/2280/lectureslides/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/s2019/2280/maple/maple-examples/

Lectures Week 9, Mar 4-8
Read: Sections 5.1, 5.2, 5.3.

HW 9, Due Week 12 after Week 10 Spring Break.
5.1: **16**, 17, **20**, **22**, **24**, 25, **28**

Lectures Week 10, Mar 9-17
Read: Spring Break

HW 10 does not exist. Spring Break in Week 10. No HW, no Quiz, no Lab.

Lectures Week 11, Mar 18-22
Read: Sections 5.4. 5.5, 5.6

HW 11, due Week 12
Edition 4:
5.2: **8**, 11, 13, **20**, 21, 27, 29, **30**, 31, 35, 39, 43, 45, 49
5.3: **6**, 9, 13, 19, **24**, 27
5.4: 1, 7, **11** , **29**
5.5: 1, 3, **4**, 11, **12**, 23, **38**
Edition 5:
5.2: **8**, 11, 13, **20**, 21, 27, 29, **30**, 31, 35, 39, 43, 45, 49
5.4: **6**, 9, 13, 19, **24**, 27
5.5: 1, 7, **11** , **29**
5.6: 1, 3, **4**, 11, **12**, 23, **38**
Section 5.3 of 5/E is a reference for Chapter 6. No problems due.
Computer Lab 4, Resonance. Due Week 12.:

http://www.math.utah.edu/~gustafso/s2019/2280/maple/lab4/2280mapleL4-resonance-S2019.pdf

Lectures Week 12, Mar 25-29
Read: Exam 2 Sample and Sections 6.3, 6.4, 6.5.
28 Mar, Midterm Exam 2 Review

HW 12, due Week 14
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 1-5
Read: Sections 9.1, 9.2.
5 Apr, Midterm Exam 2

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 5, Brine Tank, Due by May 7:

http://www.math.utah.edu/~gustafso/s2019/2280/maple/lab5/2280mapleL5-brineTank-S2019.pdf

Lectures Week 14, Apr 7-11
Read: Sections 9.3, 9.4.

HW 14, due by May 7 under door 113 JWB
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 15-19
Read: Sections 9.5, 9.6. Course Review.
20 Apr, Problem Session.

HW 15, due by May 7 under the door JWB 113
9.5: 1, 2, **3**, **7**, **9**
9.6: 1, **5**
Extra Credit Computer Labs 6 and 7, Due May 7:

http://www.math.utah.edu/~gustafso/s2019/2280/maple/lab6/2280mapleL6-narrows-S2019.pdf
http://www.math.utah.edu/~gustafso/s2019/2280/maple/lab7/2280mapleL7-earthquake-S2019.pdf

Lectures Week 16, Apr 22-23

Read: Sample Final Exam.

22 Apr, Final Exam Review.
23 Apr, Office hours and lectures end.
24 Apr, Reading day. Office hours only.

Final Exam Period, Apr 25 to May 1
Read: Chapters 1–7 and 9. Final exam period.
Final Exam on 30 April, 7:30am to 10:00am, regular classroom. Please bring pencils and eraser. Paper provided. No electronic devices, books or notes.

Brief Homework and Lab Summary with Due Dates

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HW 1, Due Week 3
 1.2: 2, 4, 6, 10; 1.3: 8, 14; 1.4: 6, 12, 18, 22, 26
HW 2, Due Week 3
 1.5:  8, 10, 18, 20, 34; 3.7: 4; 2.1: 8, 16; 2.2: 10, 18; 2.3: 10, 20, 22

HW 3, Due Week 6
 No exercises due, only the computer Numerical DE homework,
 which uses the statements from exercises 2.4-6, 2.5-6, 2.6-6.
HW 4, Due Week 6
 3.1: 34, 36, 38, 40, 42, 46, 48; 3.2: 18, 22
 3.3: 8, 10, 16, 32; 3.4: 20, 34
 Computer Lab 1, Due Week 5: 15 Feb
HW 5, Due Week 6
 3.5: 6, 12, 22, 54, 58; 3.6: 4, 8, 11, 18; 3.7: 12, 18

HW 6, Due Week 9
 7.1: 18, 22, 28; 7.2: 10, 16, 20, 24; 7.3: 6, 12, 18
 Computer Lab 2, Newton Cooling. Due Week 7: 7 Mar. Choose pipes or swamp.
HW 7, Due Week 9
 7.4: 2, 22, 36; 7.5: 4, 14, 22, 28
 Computer Lab 3, Laplace. Due May 7.
HW 8, Due Week 9
 7.6: 7, 8, 12, 22;  4.1: 8, 20;  4.2: 12;  4.3: 9

HW 9, Due Week 12 (Spring Break is Week 10, no classes)
 5.1: 16,  20, 22, 24, 28
HW 10 does not exist. Spring Break. No HW nor Lab due.
HW 11, due Week 12
 Edition 4: 5.2: 8, 20, 30;  5.3: 6, 24;  5.4: 11, 29;  5.5: 4, 12, 38
 Edition 5: 5.2: 8, 20, 30;  5.4: 6, 24;  5.5: 11, 29;  5.6: 4, 12, 38

HW 12, due Week 14
 Edition 4: 5.6: 15, 23; 6.1: 4, 8, 18; 6.2: 2, 12, 22; 6.3: 8, 9, 10
 Edition 5: 5.7: 15, 23; 6.1: 4, 8, 18; 6.2: 2, 12, 22; 6.3: 8, 9, 10
 Computer Lab 4, Resonance. Due May 7.
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HW 13, due Week 14
 6.4: 4, 8; 6.5: Not covered in class, nothing due.
 Computer Lab 5, Brine Tank, Due May 7.

HW 14, due May 7
 9.1: 6, 10, 13, 24; 9.2: 8, 20; 9.3: 4, 17, 20; 9.4: 1, 9
HW 15, due by 6pm on May 7 under the door JWB 113
 9.5: 3, 7, 9; 9.6: 5

Computer Lab 0 due Jan 25
Computer Lab 1 due Feb 15
Computer Lab 2 due Mar 1
Computer Labs 3, 4, 5 due May 7
Extra Credit Computer Labs 6 and 7 Due May 7