Math 2250-010 (Fall 2019)

Differential Equations and Linear Algebra

Lectures: MTWF 10:45-11:35 am, CSC 208

Section 011 Lab: H 09:40-10:30 am WBB 207
Section 012 Lab: H 10:45-11:35 am LCB 219

Course Information

- Instructor: Samantha Hill
  Pronouns: She/her/hers
- Office: LCB (LeRoy Cowles building) 311
- Email Address: hill@math.utah.edu
- Office Hours: TBD and by appointment
- Textbook: For information on purchasing the textbook, see https://www.math.utah.edu/schedule/bookInfo/M2250TextInclusiveAccess-1.pdf.

Title :	Differential Equations & Linear Algebra, 4th edition
Authors :	C. Henry Edwards, David E. Penney, & David Calvis
ISBN-13 :	978 − 0134497181

  We will be using the textbook for homework. There is an inclusive access e-book option, which is the cheapest option (see link above). You can also purchase the textbook at the bookstore or online. There is a 3rd edition of this textbook which *may* or may not suffice for this course. However, it is the student's responsibility to ensure that the problem numbers are the same.
- Class website: **Canvas** will be used regularly (posting homework, grades, etc.). You can access the Canvas page through CIS or by logging in at utah.instructure.com. Email notifications and correspondence will be sent to the student's UMail address ([u-number]@utah.edu).
- Prerequisites: C or better in (MATH 2210 OR MATH 1260 OR MATH 1280 OR MATH 1321 OR MATH 1320 OR ((MATH 1220 OR MATH 1250 OR MATH 1270 OR MATH 1311 OR AP Calculus BC score of 5) AND PHYS 2210 OR PHYS 3210)).

Technology: Calculators will not be allowed on quizzes or exams. Students are not expected to have prior programming experience, but will be required to run portions of code that will be provided in lecture and lab.

Grading Policy:

- Homework (10%):
  - There will be weekly homework assignments. The assignments will be posted on **Canvas** and will be **due on Wednesdays at the beginning of class**. Be sure to show all work. Optional problems will also be posted, and while they will not be graded, they are fair game for exams and quizzes.
  - **Late homework will not be accepted.** This includes homework turned in more than ten minutes after class starts. Solutions to the homework will be posted online the day they are due.
- Quizzes (15%):

  - **Each Friday there will be a ∼15-20 minute quiz** on that week's homework, unless it is an exam week.
  - **There will be no make-up quizzes.** Students who miss a quiz will receive a "0" on the missed quiz. Students will be allowed to drop your lowest two quiz grades.

- Weekly Lab (5+15 = 20%):
  - Attendance to the lab section is required, and will count for 5% of a student's total grade.
  - The remaining 15% of the lab grade will be determined by the lab submissions that will be graded.
  - The policies, grading criteria, and expectations of the lab will be communicated by the lab instructor during the first week. Questions about the content or grading of the lab should be directed toward the lab instructor.

- Two In-class Exams (2×15 = 30% total):
  - Students will have two in-class exams, fifty minutes in length, which will make up a total of 30% of your course grade.
  - The dates of the exams are Fridays **September 27 and November 8**.
  - In general, there are no make-up midterms. There may be exceptions in extenuating circumstances if the student notifies me before the day of the exam that they will be unable to attend and provides verifiable evidence of significant illness, serious family crisis, etc. The dates for these exams are fixed, and will be during normal class time in our normal classroom.

- Final Exam (25%)
  - The final exam will be given on **Monday, December 9, 10:30 a.m.-12:30 p.m.** in CSC 208.
  - You will not be allowed to make-up the final exam with the exception of truly extreme circumstances.

- Grading Scale

A	$93\% \leq N \leq 100\%$	B-	$80\% \leq N < 83\%$	D+	$67\% \leq N < 70\%$
A-	$90\% \leq N < 93\%$	C+	$77\% \leq N < 80\%$	D	$63\% \leq N < 67\%$
B+	$87\% \leq N < 90\%$	C	$73\% \leq N < 77\%$	D-	$60\% \leq N < 63\%$
B	$83\% \leq N < 87\%$	C-	$70\% \leq N < 73\%$	E	$N < 60\%$

  - This scale may be adjusted to benefit all students of the class.

Important Dates:

Classes begin	Monday, August 19
Last day to add without a permission code	Friday, August 23
Last day to drop (delete) classes	Friday, August 30
Last day to add, elect CR/NC, or audit classes	Friday, August 30
Labor Day Holiday	Monday, September 2
Midterm 1	Friday, September 27
Fall Break	Sunday-Sunday, October 6-13
Last day to withdraw from classes	Friday, October 18
Midterm 2	Friday, November 8
Last day to reverse CR/NC option	Wednesday, November 27
Thanksgiving Break	Thursday, November 28-Sunday, December 1
Classes end	Thursday, December 5
Final Exam	Monday, December 9

Course Goals and Description:
Math 2250 is a 4-credit semester course where students will master the basic tools and problem solving techniques important in differential equations and linear algebra. Techniques and tools learned in class will be demonstrated in the weekly lab sections. Upon successful completion of this course, a student should be able to:

Tools and skills:

- Be able to model dynamical systems that arise in science and engineering, by using general principles to derive the governing differential equations or systems of differential equations. These principles include linearization, compartmental analysis, Newton's laws, conservation of energy, and Kirchoff's law.
- Learn solution techniques for first order separable and linear differential equations. Solve initial value problems in these cases, with applications to problems in science and engineering. Understand how to approximate solutions even when exact formulas do not exist. Visualize solution graphs and numerical approximations to initial value problems via slope fields.
- Become fluent in matrix algebra techniques, in order to be able to compute the solution space to linear systems and understand its structure; by hand for small problems, and with technology for large problems.
- Be able to use the basic concepts of linear algebra such as linear combinations, span, independence, basis and dimension, to understand the solution space to linear equations, linear differential equations, and linear systems of differential equations.
- Understand the natural initial value problems for first order systems of differential equations, how they encompass the natural initial value problems for higher order differential equations, and general systems of differential equations.
- Learn how to solve constant coefficient linear differential equations via superposition, particular solutions, and homogeneous solutions found via characteristic equation analysis. Apply these techniques to understand the solutions to the basic unforced and forced mechanical and electrical oscillation problems.
- Learn how to utilize Laplace transform techniques to solve linear differential equations, with an emphasis on the initial value problems of mechanical systems, electrical circuits, and related problems.
- Be able to find eigenvalues and eigenvectors for square matrices. Apply these matrix algebra concepts to find the general solution space to first and second order constant coefficient homogeneous linear systems of differential equations, especially those arising from compartmental analysis and mechanical systems.
- Understand and be able to use linearization as a technique to understand the behavior of nonlinear autonomous dynamical systems near equilibrium solutions. Apply these techniques to non-linear mechanical oscillation problems and other systems of two first order differential equations, including interacting populations. Relate the phase portraits of non-linear systems near equilibria to the linearized data, in particular to understand stability.
- Develop your ability to communicate modeling and mathematical explanations and solutions, using technology and software such as Maple, MATLAB or internet-based tools as appropriate.

Problem solving fluency

- Students will be able to read and understand problem descriptions, then be able to formulate equations modeling the problem usually by applying geometric or physical principles. Solving a problem often requires a series of transformations that include utilizing the methods of calculus. Students will be able to select the appropriate calculus operations to apply to a given problem, execute them accurately, and interpret the results using numerical and graphical computational aids.
- Students will gain experience with problem solving in groups. Students should be able to effectively transform problem objectives into appropriate problem solving methods through collaborative discussion. Students will also learn how to articulate questions effectively with both the instructor and TA, and be able to effectively articulate how problem solutions meet the problem objectives.

Tentative Schedule
Week 1: §1.1-1.4 — math models, general/particular solutions, slope fields, separable equations.
Week 2: §1.4-1.5, §2.1-2.2 — linear equations, circuits, mixture models, population models.
Week 3: §2.2-2.4 — equilibria, stability, acceleration-velocity models, numerical solutions.
Week 4: §2.5-2.6, §3.1 — numerical schemes, linear systems;
Week 5: §3.1-3.4 — linear systems, matrices, Gaussian elimination, reduced row echelon form
Week 6: §3.5-3.6 — matrix inverses, determinants. **midterm exam 1 on material from weeks 1-5**
Week 7: §4.1-4.4 — vector spaces, linear dependence, span, subspaces, bases and dimension.
Week 8: §5.1-5.3 — 2nd order DEs, general solutions, superposition, homogeneity, constant coefficients.
Week 9: §5.4-5.6 — mechanical vibrations, pendulums, solutions to non-homogeneous problems.
Week 10: §10.1-10.4 — Laplace transforms, solving IVPs with transforms, partial fractions and translations
Week 11: §10.4-5 — unit steps, convolutions. **midterm exam 2 on material from weeks 6-10**
Week 12: §6.1-6.2, §7.1 — eigenvalues and eigenvectors, diagonalization, first-order systems of ODEs
Week 13: §7.2-7.5 — matrix systems, eigen-analysis, spring systems, forced undamped systems, resonance
Week 14: §9.1-9.2 — equilibria, stability, phase portraits for non-linear systems
Week 15: Review
Week 16: Finals week. **final exam on material from weeks 1-15**

Responsibilities: All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, indicated in the Student Handbook. You have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies prescribed conduct (Article XI) that involves cheating on tests, collusion, fraud, theft, etc. Students should read the Code carefully and understand you are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee. http://regulations.utah.edu/academics/6-400.php

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Tutoring: You may find that you need some extra help beyond what the class can provide. There are several tutoring services available. The Math Department has a free drop-in tutoring center located in the T. Benny Rushing Mathematics Center. Information about the center can be found at http://www.math.utah.edu/ugrad/tutoring.html.

ADA Statement: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability and Access, 200 S. Central Campus Dr., Rm. 162, Olin Union Building, 581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All information in this course can be made available in alternative format with prior notification to the Center for Disability and Access.

Veterans' Center: If you are a student veteran, the U of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: http://veteranscenter.utah.edu/. Please also let me know if you need any additional support in this class for any reason.

Nondiscrimination & Accessibility Statement: The University of Utah does not discriminate on the basis of race, color, religion, national origin, sex, age, status as a disabled individual, sexual orientation, gender identity/expression, genetic information or protected veteran's status, in employment, treatment, admission, access to educational programs and activities, or other University benefits or services. Additionally, the University endeavors to provide reasonable accommodations and to ensure equal access to qualified persons with disabilities. Inquiries concerning perceived discrimination or requests for disability accommodations may be referred to the University's Title IX/ADA/Section 504 Coordinator at the Office of Equal Opportunity and Affirmative Action, 801-581-8365

Safety: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

Student Wellness: Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences etc., can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu

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Classroom Social Equity: I strive to be kind, ethical, fair, inclusive and respectful in my classroom and expect students to behave likewise. In this regard, I have these requests of you, as my students:

- Please inform me of whichever pronouns you prefer me to use for you. I will put great effort into honoring your request and ask that you correct me if I happen to make a mistake.
- Please tell me, discreetly, if you have any sort of anxiety disorder, TBI, PTSD, or any other challenge that would cause psychological harm to you by me calling on you in class. I want students to feel stretched and challenged during class, while working on problems as a large group, but I do not want to cause harm to any human being. Please let me know if that is the case for you and I will confidentially accommodate your request.
- If your preferred name is different than your legal first name (the preferred name you chose does indeed show up in CIS on my roll sheet, but not yet in Canvas), please log into Canvas and go to Account (on far left) Settings and change your Display Name to be the name you prefer to be addressed by. This will help me to address you correctly.

Class policies:

- I reserve the right to make reasonable changes to the class structure and syllabus at any time. I will notify you if and when any changes are made.
- Please silence your technology at the start of class. If you are repeatedly disrupting the learning environment, you will be asked to leave.

- If an emergency arises that prevents you from making it to an exam or turning in a homework, it is your responsibility to communicate that information to me as soon as possible, so that accommodation might be possible. In some extenuating circumstances, exams may be taken early, but not late.
- I encourage you to work with others on the homework, but anything that you turn in must be your own work. Again, cheating is student misconduct and will be dealt with seriously. If you cheat on any homework, quiz, lab, or exam, I will automatically give you a zero for that grade. Depending on the severity of the cheating, I may decide to fail you from the class. Please note that the use (or even just pulling it out of your pocket) of a cell phone or any other electronic device during any in-class exam is considered cheating and cause for receiving an automatic zero.

Dierential Equations and Linear Algebra Lecture Notes. Simon J.A. Malham. Department of Mathematics, Heriot-Watt University.Â Chapter 5. Linear algebraic equations 5.1. Physical and engineering applications 5.2. Systems of linear algebraic equations 5.3. Gaussian elimination 5.4. Solution of general rectangular systems. Handbook of Differential Equations: Ordinary Differential Equations, Volume 1 (Handbook Differential Equations with Linear Algebra. 572 PagesÂ·2009Â·3.42 MBÂ·1,748 DownloadsÂ·New! differential equations, especially systems thereof, demonstrate a fundamental application of linear Calculus, Vol. 2: Multi-Variable Calculus and Linear Algebra with Applications to Differential. 673 PagesÂ·1969Â·9.67 MBÂ·1,163 DownloadsÂ·New!Â Fourth Edition Gilbert Strang y x y z z Ax b b 0 Ay b Az 0 0. Contents Preface iv Linear algebra Schaum's Easy Outlines of Differential Equations. 143 PagesÂ·2003Â·1.73 MBÂ·66,002 Downloads. Easy Outline: College Algebra. Schaum's Easy Outline: Schaum's Easy Outlines of Differential Equatio Calculus and Linear Algebra. Written for undergraduate students, Differential Equations and Linear Algebra provides a complete course in differential equations. Topics include first order equations, second order equations, graphical and numerical methods, and linear equations and inverse matrices. See samples of the book and more at the author's web site. MATLAB examples are included throughout the book. Featured Video. 14:03. Differential Equations and Linear Algebra, 1.1: Overview of Differential Equations. Linear equations include dy/dt = y, dy/dt = â€“y, dy/dt = 2ty. The equation dy/dt = y*y is nonlinear. Watch Gil Systems of linear differential equations. Distinct real eigenvalues. Solution by diagonalization. Solution by the matrix exponential. Distinct complex-conjugate eigenvalues. Repeated eigenvalues with one eigenvector. Normal modes. Nonlinear differential equations. Fixed points and stability.Â Subcritical pitchfork bifurcation. Application: a mathematical model of a fishery. Applied Linear Algebra and Differential Equations. Lecture notes for MATH 2350. Jeffrey R. Chasnov. The Hong Kong University of Science and Technology Department of Mathematics Clear Water Bay, Kowloon Hong Kong. Copyright â—‹c 2017-2019 by Jeffrey Robert Chasnov This work is licensed under the Creative Commons Attribution 3.0 Hong Kong License. Linear Systems Of Differential Equations. 7.1. First-Order Systems and Applications.Â NOW is the time to make today the first day of the rest of your life. Unlock your Differential Equations & Linear Algebra PDF (Profound Dynamic Fulfillment) today. YOU are the protagonist of your own life. Let Slader cultivate you that you are meant to be!