

Differential Equations and Linear Algebra - Math 2250
Spring 2015 - Section 7

Lectures: MWF 01:25pm-02:45pm - JWB 335
Laboratory: H 12:55pm-01:45pm - WBB 207 - Section 8
H 2:00pm-2:50pm - WBB 207 - Section 9
Course webpage: <http://www.math.utah.edu/~vshankar/teaching/2250.html>
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Office Hours: Open door or by appointment

Teaching Assistant: Edward Vernarsky (Vern)
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Office Hours: TBD

Textbook:

- If you are planning to take Math 3140 or Math 3150 after Math 2250, you should get *Linear Algebra and Differential Equations with Introductory Partial Differential Equations and Fourier Series*, ISBN-13:978-1-269-42557-5, by Edwards, Penny and Haberman.
- If you are not planning to take Math 3140 or Math 3150, you should get *Differential Equations and Linear Algebra* (3rd Edition), by Edwards and Penny.

Updates: Topics covered are listed in the week-by-week guide. Assignments will be added into the guide PDF every week. You are responsible for checking it regularly.

Mathematics Tutoring Center: Free tutoring is available in room 155 of the T. Benny Rushing Mathematics Center (adjacent to the LCB and JWB). Hours are 8am-8pm Monday-Thursday and 8am-6pm on Friday. For more information consult the website.

<http://www.math.utah.edu/ugrad/mathcenter.html>

You might find the videos and problems from the website of the Khan Academy helpful.

<https://www.khanacademy.org/>

Prerequisites: Math 1210-1220 or 1310-1320 (or 1250-1260 or 1311-1321, i.e. single-variable calculus.) You are expected to have learned about vectors and parametric curves in one of these courses, or in Math 2210 or Physics 2210 or 3210. Practically speaking, you are better prepared for this course if you've had elements of multivariable calculus in courses such as 1320, 1321, or 2210 and if your grades in the prerequisite courses were above the "C" level.

Expected Learning Outcomes for 2250:

The goal of Math 2250 is to master the basic tools and problem solving techniques important in differential equations and linear algebra. These basic tools and problem solving skills are described below.

The basic topics

- 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, and 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 use 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 specific solution methods listed above. Students will be able to select the appropriate operations, execute them accurately, and interpret the results using numerical and graphical computational aids.
- Students will also 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 convey how problem solutions meet the problem objectives.

Reading: You are expected to have read the corresponding section prior to each class. We will cover about three sections per week. Reading will make the discussion in class much clearer, and overall you will save time.

Attendance to the lab is mandatory and will be recorded. You should attend all the lectures as well; missing lectures will hamper your ability to pass this class. Remember that quizzes, and exams happen during lectures on Fridays.

Lab: Every Thursday a teaching assistant-directed lab section will be held. These lab sections will have smaller class sizes allowing the TA to more closely monitor student learning. The Thursday directed group work will help the students prepare for the homework, quizzes, and exams. Credit will be given for lab attendance and student presentations. Additionally, you will have until the beginning of the next lab to turn

in your completed lab worksheet for credit. These lab sections will be a helpful and supportive environment where everyone should feel able to present some of the time. Please attend the lab session you registered for. The lab accounts for a large portion of your grade.

Quizzes: At the end of every Friday class (except when an exam or super quiz is scheduled), a short 1-2 problem quiz will be given, taking roughly 10 minutes. The quiz will cover relevant topics covered in the week's lectures and in the lab section. Some quizzes may be much larger than others (super-quizzes), in which case more time will be allotted. No make-up quiz will be given. The quizzes account for a large portion of your grade.

Homework: Assigned problems are listed at the end of the syllabus and on the course web page. Only the highlighted problems will be collected and graded. Homework will be collected in lecture every Friday, from sections covered up to Wednesday of the same week. No late homework will be accepted. Homework will be collected on paper only.

You are encouraged to solve all the assigned problems as they are part of the quiz and exam material. To succeed in this class, you'll need to invest time in solving problems from very simple problems letting you practice just one specific technique to more sophisticated questions. Feel free to do as many problems as necessary and to ask us for help. Keep in mind that it is more useful to do a few involved exercises carefully and thoroughly than rushing through a large number of simple problems.

Midterm exam: There will be two in-class exams. No books, notes, formula sheets, calculators (scientific or not), computers, phones (smart or not) or electronic device will be allowed. Always consult the course web page to confirm those dates. The exams cannot be dropped.

Review and practice: A practice exam may be posted about a week prior to each midterm. The practice exam, if posted, will be similar in structure and format to the real exam and will be discussed in the lab session prior to the exam. Additionally, we will review important concepts in class on before each exam.

Final Exam: The final exam covers all the material presented during the semester.

Review: We will have a review session before the final (TBD).

Make-up and regrading: Any conflict leading to missed exams or quizzes are your responsibility and must be arranged ahead of time or within a week past the test. Failure to do so may result in a zero for the corresponding test. Regrading inquiries must be submitted in writing within a week of the test being returned.

Students with Disabilities: 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 Services, 162 Olpin Union Building, 581-5020. CDS will work with you and us to make arrangements for accommodations.

Grading: Grades are determined as a weighted average as follows

Lab	Quizzes	Super-Quizzes	Homework	Midterms	Final
20%	10%	5%	20%	20%	25%

Letter grades are determined as follows:

A	A-	B+	B	B-	C+	C	C-	D+
100-93	92-90	89-87	86-83	82-80	79-77	76-73	72-70	69-67
			D	D-	E			
			66-63	62-60	59-0			

However, I will most likely curve the class based on the highest letter grades. I reserve the right to change my mind or modify grades in special cases.

Honor Code: You are expected to abide by the University of Utah Honor Code and to avoid any instances of academic misconduct, including but not limited to: (1) possessing, using, or exchanging improperly acquired written or oral information during an exam, (2) substitution of material that is wholly or substantially identical to that created or published by another individual(s), and (3) false claims of performance or work.