MATH 2250-007 Differential Equations and Linear Algebra, Spring 2020

Class Meetings: Lecture: MWF at 1:25am-2:45pm in JW 335
Lab Meetings: Section 008: H at 12:55pm-1:45pm in WBB 207, Section 009: H at 2:00pm-2:50pm in WBB 207.
Instructor: Conor Tillinghast
Email: ctilling@math.utah.edu
Office Hours: TBA
Lab Instructor: Justin Baker
LA Office Hours: TBA.


More information can be found at the link below:

Course Information: Math 2250 Differential Equations and Linear Algebra is a 4 credit course.
Prerequisite Information: "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)).
Course Description: This is a hybrid course which teaches the allied subjects of linear algebra and differential equations. These topics underpin the mathematics required for most students in the Colleges of Science, Engineering, Mines and Earth Science.

Canvas: Canvas will be used for posting course announcements, homework assignments, grades, files and any relevant supplementary material. You can access the Canvas page through CIS or by logging in at utah.instructure.com. Students should check the Canvas page regularly for course information and resources. Email notifications and correspondence will be sent to the student’s UMail address ([ju-number]@utah.edu); this email account must be checked regularly.

Grading: The following are the grade components and the percentage each contributes to a student’s final grade:

- Homework Assignments (15%) - Roughly three textbook sections are due most Wednesdays at the beginning of class. The homework will typically cover material covered up to and including the preceding Friday. The homework problems each week will be assigned in the announcements section of canvas. Three of the problems will be selected for grading by the grader, each graded out of 5 points. There will also be 5 points given for completion. The lowest homework score will be dropped. Homework will only be accepted in class, no electronic copies. No late homework will be accepted, unless accompanied by a doctor’s note or other verification of extenuating circumstance.

- Quizzes (5%) - Short quizzes will be given most Fridays when there is not an exam at the end of class. The quizzes will be composed of 1-2 questions covering the material since the previous Friday’s class. Note you may not have completed homework on this material yet. The lowest quiz score will be dropped.

- Labs (20%) - Every Thursday a directed lab section will be held. These lab sections will have smaller class sizes, consisting of working on lab worksheets in groups. The lab instructor will be there to help guide students through the problems. The worksheets will be due at the beginning of the following week lab. You will be expected to complete the worksheet outside of lab. One fourth of the lab grade (about 5% of the total course grade) will be given for attendance, the remaining grade (about 15% of the total course grade) will be based on the quality of the lab reports. The lowest lab score will be dropped.
• Midterm Exams (35%, 17.5% each)- Two midterm exams will be given on select Fridays. Dates of the midterm exams will be Friday Feb. 14th and Friday Mar. 27th. Midterms may not be rescheduled except for the most extenuating of circumstances.

• Final Exam (25%)- A two-hour comprehensive exam will be given. Our final exam is scheduled for Wednesday Apr. 29th from 1:00-3:00 pm in JWB 335. The final may not be rescheduled.

Students with university excused absences (band, debate, student government, intercollegiate athletics) should make alternate arrangements with me as soon as possible if the absence interferes with any course components.

Final course letter grades will be determined as follows: If X is your course percentage weighted according to the above, then \( \{X \geq 93\% \Rightarrow A, X \geq 90\% \Rightarrow A-, X \geq 87\% \Rightarrow B+, X \geq 83\% \Rightarrow B , X \geq 80\% \Rightarrow B-, X \geq 77\% \Rightarrow C+, X \geq 73\% \Rightarrow C, X \geq 70\% \Rightarrow C-, X \geq 67\% \Rightarrow D+, X \geq 63\% \Rightarrow D , X \geq 60\% \Rightarrow D-, X < 59\% \Rightarrow E\} \).

The instructor retains the right to modify this grading scheme during the course of the semester; students will, of course, be well notified of any adjustments.

Additional Resources

• Tutoring Center & Computer Lab- There is free tutoring in the T. Benny Rushing Mathematics Student Center (room 155, the lower level between JWB and LCB), as well as a computer lab. For more information see http://www.math.utah.edu/undergrad/mathcenter.php

• Private Tutoring- ASUU Tutoring Center, 330 SSB. There is also a list of tutors at the math department office JWB 233.

• Departmental Videos- The math department has a full set of lecture videos which you are welcome to use to supplement our course material. These can be found at http://www.math.utah.edu/lectures/

Calculators: Calculators will not be allowed on exams. They may be used on homework, but you should still write out the details of your computation. It is in your best interest not to become too dependent on your calculator since they will not be allowed on exams.

Expected Learning Outcomes: Upon successful completion of this course, a student should be able to:

1. 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

2. 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.

3. 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.

4. Use differentiation to find critical points and inflection points, the signs of the first and second derivatives, and domain and limit information to determine vertical and horizontal asymptotes. Then use all of that information to sketch the graph of \( y = f(x) \).

5. Be able to utilize the basic concepts of linear algebra such as linear combinations, span, indepen- dence, basis and dimension, to understand the solution space to linear equations, linear differential equations, and linear systems of differential equations.
6. 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.

7. 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.

8. 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.

9. 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.

10. Understand and be able to use linearization as a technique to understand the behavior of non-linear 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.

11. 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.

12. 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.

13. 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.

**Student Responsibilities:** All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, and I will do so, beginning with verbal warnings and progressing to dismissal from and 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

**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 & Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

**Addressing Sexual Misconduct:** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to
the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veterans status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677 (COPS).

**Student Names and Personal Pronouns:** Class rosters are provided to the instructor with the students legal name as well as Preferred first name (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class, on papers, exams, group projects, etc. Please advise me of any name or pronoun changes (and update CIS) so I can help create a learning environment in which you, your name, and your pronoun will be respected. If you need assistance getting your preferred name on your UIDcard, please visit the LGBT Resource Center Room 409 in the Olpin Union Building, or email bpeacock@sa.utah.edu to schedule a time to drop by. The LGBT Resource Center hours are M-F 8am-5pm, and 8am-6pm on Tuesdays.

**Wellness Statement:** 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 or 801-581-7776.

**Safety Statement:** 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.

**Course Roadmap Week-by-Week:** Below is an outline of the sections and topic covered in this course. Schedule subject to change

**Week 1** Introduction, Chapters 1.1-1.4

**Week 2** Chapters 1.4, 1.5, 2.1, 2.2, Note, Friday Jan. 17th is the last day to drop

**Week 3** Chapters 2.2, 2.3, 2.4

**Week 4** Chapters 2.5, 2.6, 3.1

**Week 5** Chapters 3.1-3.4

**Week 6** Chapters 3.5, 3.6, Exam 1 on Friday Feb. 14th

**Week 7** Chapters 4.1, 4.2, 4.3, 4.4

**Week 8** Chapters 5.1, 5.2, 5.3

**Week 9** Chapters 5.4, 5.5, 5.6, Note, Friday Mar. 6th is the last day to withdraw

**Week 10** Spring Break

**Week 11** Chapters 10.1, 10.2, 10.3

**Week 12** Chapters 10.4, 10.5

**Week 13** Chapters 6.1, 6.2, 7.1

**Week 14** Chapters 7.2, 7.3, 7.4

**Week 15** Chapters 9.1, 9.2, 9.3

**Week 16** Chapter 9.4