Syllabus for Math 2250-010
Differential Equations and Linear Algebra
Spring 2020

General Course Information:

Course: Differential Equations and Linear Algebra (Math 2250-010).
Instructor: Keyvan Yaghmayi.
Office: JWB 121.
Phone: 801-581-6208.
Email: yaghmayi@math.utah.edu.
Class Location: WEB 1230.
Class Time: Mondays, Wednesdays, and Fridays 8:05am - 9:25am.
Office Hours: Mondays 9:40am - 10:30am, Thursdays 2:40pm - 3:30pm, or by appointment.
Course Website: I will use the Canvas: [https://gate.acs.utah.edu/](https://gate.acs.utah.edu/) You can get there easily from the main University of Utah website [www.utah.edu](http://www.utah.edu) To log in, you use the same student ID and password that you use for Campus Information System.
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)).
Important Dates: The last day to add, drop (delete), elect CR/NC, or audit the class is Friday, January 17. The last day to withdraw is Friday, March 6.
Final Exam: Wednesday, April 29, 8:00am - 10:00am, in our classroom WEB 1230.

Catalog Description:

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 & Earth Science.

Expected Learning Outcomes: 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:

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. Understand phase diagram analysis for autonomous first order differential equations.

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. 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.

5. 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.

6. 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.

7. 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.

8. 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.

9. Understand and be able to use linearization as a technique to understand the behavior of nonlinear dynamical systems near equilibrium solutions. Apply these techniques to non-linear mechanical oscillation problems. (Additional material, subject to time availability: Apply linearization to autonomous 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.)

10. 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.

11. 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.

12. 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.
13. 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.

Here is the week-by-week outline that we will follow (subject to circumstances there might be little changes):

Week 1: 1.1 Differential Equations and Mathematical Models; 1.2 Integrals as General and Particular Solutions; 1.3 Slope Fields and Solution Curves; 1.4 Separable Differential Equations and Applications.

Week 2: 1.4 (Continued); 1.5 First-Order Linear Differential Equations; 2.1 Population Models; 2.2 Equilibrium Solutions and Stability.

Week 3: 2.2 (Continued); 2.3 Acceleration-Velocity Models; 2.4 Numerical Approximation: Euler’s Method. **Monday, January 20 is Martin Luther King Jr. Day Holiday.**

Week 4: 2.5 Improved Euler’s Method; 2.6 The Runge-Kutta Method. 3.1 Introduction to Linear Systems.

Week 5: 3.1 (Continued); 3.2 Matrices and Gaussian Elimination; 3.3 Reduced Row-Echelon Matrices; 3.4 Matrix Operations.

Week 6: 3.5 Inverses of Matrices; 3.6 Determinants; Midterm 1 (Friday, February 14) on Material from Weeks 1-5.

Week 7: 4.1 The Vector Space \( \mathbb{R}^3 \); 4.2 The Vector Space \( \mathbb{R}^n \) and Subspaces; 4.3 Linear Combinations and Independence. **Monday, February 17 is Presidents’ Day Holiday.**

Week 8: 4.3 (Continued); 4.4 Bases and Dimension for Vector Spaces; 5.1 Second-Order Linear Equations.

Week 9: 5.2 General Solutions of Linear Equations; 5.3 Homogeneous Equations with Constant Coefficients; 5.4 Mechanical Vibrations.

Week 10: Spring Break 🌻

Week 11: 5.4 (Continued); 5.5 Non-homogeneous Equations and Undetermined Coefficients; 5.6 Forced Oscillations and Resonance.

Week 12: 10.1 Laplace Transforms and Inverse Laplace Transforms; 10.2 Transformation of Initial Valued Problems; 10.3 Translation and Partial Fractions. Midterm 2 (Friday, March 27) on Material from Weeks 6-11.

Week 13: 10.3 (Continued); 10.4 Derivatives, Integrals, and Products of Laplace Transforms; 10.5 Periodic and Piecewise Continuous Input Functions.

Week 14: 6.1 Introduction to Eigenvalues and Eigenvectors; 6.2 Diagonalization of Matrices; 7.1 First-Order Systems and Applications.

Week 15: 7.2 Matrices and Linear Systems; 7.3 The Eigenvalue Method for Linear Systems; 7.4 Second-Order Systems and Mechanical Applications.

Week 16: On Monday We Make Review for the Final Exam. Final Exam is on Wednesday, April 29 (Comprehensive).
Homework:

There will be weekly homework assignments from the textbook. Homework problems and due dates will be posted on Canvas regularly. I encourage you to discuss your homework problems with one another, ask help from instructors in the tutoring center, or stop by at office hours. Be sure that the final copy you hand in is written entirely with your words as you understand the solution.

Late assignments will not be accepted and if you will be absent the day that an assignment is due you must turn it in to me before the class in which it is due. Your lowest homework score will be dropped and will not count toward your overall grade. Homework assignments will be graded and returned to you.

Please staple your homework and cut off any raggedy edges (from being torn out of a spiral binder). Please write your name and the homework set number at the top of the first page.

Lab Session:

You are required to register and attend one of the lab sessions:

- Lab Section 2250-011: Thursdays 8:35am - 9:25am JFB B-1
- Lab Section 2250-012: Thursdays 9:40am - 10:30am BEH S 104

In the lab session Trung C Chau, the lab instructor, gives you 3-4 challenging and more involved “story” problems usually over material you’ve recently turned in homework on. In fact, these problems often revolve around engineering and physics applications and are a little harder but as a bonus you get to do it in class with the lab instructor.

Lab session problems will be posted on Canvas under the name of “Lab Session Problems”. In class you should at least get a conceptual feel for all the problems on the sheet. You will have the rest of the week to finish them off. You do this every week except on exam weeks, when you will use that day for review.

The policies, grading criteria, and expectations of the lab will be communicated by Trung during the first week. Questions about the content or grading of the lab should also be directed toward Trung.

Quizzes:

There will be short “group quizzes” in almost every week. The dates and the sections that they cover will be posted on Canvas. It should take approximately 10-15 minutes to complete the quiz. I will upload the solutions and grades on canvas. Quizzes will not be excused due to absences or lateness so please be prompt and present. At the end of the semester, your lowest quiz score will be dropped and will not count toward your overall grade.

You are encouraged to work together on quizzes by making groups of 2, 3 or 4 with friends/neighbors in class and discussing problems and your possible solutions within the group. You should write your answer based on your own understanding and in your own words. It is totally fine if someone likes to work individually.
Tests:
There will be two midterms along with a comprehensive final exam. All of them are in the scheduled classroom (WEB 1230) and at the class time.

Midterm One: Friday, February 14 on material from weeks 1-5.
Midterm Two: Friday, March 27 on material from weeks 6-11.
Final Exam: Wednesday, April 29, Comprehensive.

It is essential that you show all your work. Credit won’t be given without proper work and partial credit will be awarded if you show correct steps even if you do not obtain the final correct number.

Grading:
The grades will be calculated as follows:

Homework 10%
Lab Session 10%
Quizzes 10%
Midterm One 20%
Midterm Two 20%
Final Exam 30%

The grade scale will be the usual: A (93-100), A- (90-92), B+ (87-89), B (83-86), B- (80-82), C+ (77-79), C (73-76), C- (70-72), D+ (67-69), D (63-66), D- (60-62), E (0-59). If I do need to curve the grades, I will simply shift your overall percentage up by a few points (whatever is necessary).

Some Policies/Comments:

- Electronic devices (including calculators, cell phones, and music players) are not allowed during the exam. I will make tests and quizzes to evaluate your mathematical skills and not your calculator skills. It is recommended that you complete your homework without calculator and then check your answer by calculator or other preferred technology.

- Cheating will not be tolerated at any time during this course. Any student found cheating will receive a zero for the assignment or test on which the cheating occurred.

- If there is something that I want to inform you, I will reach you by your email. That is usually your default UMail address (uNID@utah.edu) that you have in the CIS. If you are using other emails more frequently than your UMail, then you can set your UMail to forward to your preferred email address. Also the fastest way to reach me is my email: yaghmayi@math.utah.edu.

- 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) then “Settings” and change your “Display Name” to be the name you prefer to be addressed by. This will help me greatly to know students’ names, and to address you correctly when responding to Canvas comments.

- If you have any thoughts, ideas, or suggestion, please feel free to contact me. I promise to do everything in my power to help.
Tutoring and Extra Help:

- **Tutoring Lab:** The math tutoring center is available free of charge to all university students. It is located in room 155 of the T. Benny Rushing Mathematics Center (adjacent to the LCB and JWB). The tutoring center is open Monday-Thursday 8:00am-8:00pm, and Friday 8:00am-4:00pm. Please take advantage of the tutoring center as needed throughout the semester. They are also offering group tutoring sessions. If you’re interested, inquire at http://www.math.utah.edu/ugrad/tutoring.html

- **ASUU Tutoring Center:** University Tutoring Services, 330 SSB. They offer inexpensive tutoring, please see their website: http://tutoringcenter.utah.edu

- **Khan Academy:** It is a non-profit, free, educational organization for anyone, anywhere. They have some amazing videos in the Youtube. Check them out: https://www.khanacademy.org/

**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. You 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, collusion, fraud, theft, etc. Students should read the Code carefully and know 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

**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 U-ID card, 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 https://wellness.utah.edu/ or 801-581-7776.

Center for Disability & Access: is dedicated to students with disabilities by providing the opportunity for success and equal access at the University of Utah. They are committed to providing reasonable accommodations as outlined by Federal and State law. The Center for Disability & Access (CDA) also strive to create an inclusive, safe and respectful environment. By promoting awareness, knowledge and equity, they aspire to impact positive change within individuals and the campus community. Please visit http://disability.utah.edu/ for the latest information.

A.D.A. 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.

Veterans Support Center: The Center is staffed by student Veterans who are committed to providing their fellow Veterans with the most useful and current information available. The Mission of the Veteran Support Center is to improve and enhance the success of student Veterans; to help them receive the benefits they deserve; to serve as a liaison between the Veteran student community and the University; and to increase their academic success. Additionally to provide an opportunity to continue the relationships built through the service in civilian life. Please see http://veteranscenter.utah.edu/

Women’s Resource Center: The Women’s Resource Center (WRC) at the University of Utah serves as the central resource for educational and support services for women. Honoring the complexities of women’s identities, the WRC facilitates choices and changes through programs, counseling, and training grounded in a commitment to advance social justice and equality. http://womenscenter.utah.edu/

Disclaimer: All information on this syllabus is subject to change. If any changes on this syllabus, course policies or course outline arise throughout the semester, then I will announce it in class and send the change in email.

Good Luck!