Math 22B: Differential Equations
Course Syllabus
UC Davis, Spring 2021

Instructor: Dan Romik

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1 Contact information

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Please email your TA for all inquiries except when common sense suggests that your question can only be handled by the instructor.

2 Summary

- **Course lectures:** MWF 3:10-4:00 (online via Zoom)
- **Course personnel**
  - **Instructor:** Dan Romik
  - **TAs:** Abhishek Mallela, Qi Yu
  - **Reader:** Shiming Tan
- **Instructor office hours:** Tue 9:30-10:20 (online via Zoom)
- **TA office hours:** Abhishek Mallela: Tue 1:10-2 and Thu 1:10-2 (online via Zoom)
  Qi Yu: Wed 1:10-2 and Fri 1:10-2 (online via Zoom)
- **Course assignments:** Weekly homework (25%), 3 midterm exams and a final exam (75%), a syllabus quiz (optional 2% bonus credit). See the grading policy in Section 6 below for exam dates and other important details.
- **Course prerequisites:** C− or better in either MAT22A or MAT067

3 Course textbook

- The course will be based on the free online textbook *Lectures in Differential Equations* by Craig Tracy, available to download from the course Canvas page.

4 Course topics

- Ordinary differential equations: linear and nonlinear; first-order and second-order. Integrating factors. Conservation laws. Solution methods; exact versus numerical solutions.
- Applications and examples from physics, engineering, economics and other areas
- Vector differential equations
- Difference equations
- The existence and uniqueness problem
- Introduction to partial differential equations. Examples: waves, vibrating string, heat flow, energy levels in the hydrogen atom
- If time permits: Laplace transform and other advanced techniques

5 Learning objectives

Primary objective. By the end of the course, you should have a good understanding of the answers to the following questions:

- What is a differential equation?
- What is the difference between an ordinary differential equation and a partial differential equation?
- What are some of the most important differential equations and families of differential equations?
- What are some of the most important techniques for solving differential equations?
- What are some real-life problems and practical applications that differential equations help us understand?
- What are some of the ways in which computers are used to analyze differential equations?

- Is the statement "*Differential equations are fun!*" a statement that you personally agree with?

Secondary objectives. The course will improve your general problem-solving abilities, analytical skills, writing and communication skills, self-studying skills, time management skills, and self-confidence in your abilities to master complex topics. You should also aim to get a good grade; it's not the most important thing, but it is important (though, just like you, I wish it wasn't).

6 Grading structure and policy

Your final grade in the course will be computed based on the following components:

- **Homework (25% of the grade).** Homework will be assigned weekly and will be due every Wednesday starting on the second week of the quarter and ending on the ninth week of the quarter. There will be eight homework assignments in total.

  In calculating the homework grade, the lowest three assignment scores will be dropped. In other words, the homework component of your grade will be a number, normalized to a scale of 0 to 100, computed as the average of the top five homework assignment scores.

- **Midterms and final exam (75% of the grade).** There will be three midterm exams. They will take place during the regular lecture time (3:10-4:00 p.m.) on the following dates: **Friday April 16, Friday May 7, Wednesday May 26**.

  The final exam will take place on the time scheduled on the UC Davis Final Examinations Schedule: **Tuesday June 8, 10:30 a.m.–12:30 p.m.**

  In calculating the midterm and final component of the grade, the lowest grade among the four exams will be dropped. That is, the exam component of your grade will be a number, normalized to a scale of 0 to 100, computed as the average of the top three exam scores.

- **Syllabus quiz (optional: 2% bonus credit).** Sometime during the first two weeks of the quarter, you will be given the option to take an online quiz to test that you read this syllabus. Credit from the quiz can help further boost your grade by a small amount.

Example. A student named Darya received the scores $55, 77, 100, 95, 0, 35, 80, 0$ out of 100 on the homework assignments. She got the scores 96, 91, 100 on the midterm exams and a score of 79 on the final exam. She also received the bonus 2% credit from the quiz. (All scores are out of 100.)

Darya's final numerical score will be

$$0.25 \times \left(\overbrace{\frac{55+77+100+95+80}{5}}^{\text{homework}} \right) + 0.75 \times \left(\overbrace{\frac{96+91+100}{3}}^{\text{exams}} \right) + \overbrace{0.02}^{\text{syllabus quiz}} = 94.1$$

Letter grades. At the end of the quarter I will decide on cut-offs translating the final numerical scores to letter grades, in order to aim for a fair grade distribution that rewards your efforts (and to make allowance for the possibility of unexpectedly difficult exams, challenging circumstances, etc). The following minimum letter grade cut-offs are guaranteed to apply:

- A final numerical score of 90 or higher guarantees a final letter grade of A− or better.
- A final numerical score of 80 or higher guarantees a final letter grade of B− or better.
- A final numerical score of 70 or higher guarantees a final letter grade of C− or better.

In the example above, Darya will be able to know even before taking the final exam that she will be getting a final grade of A− or better.

IMPORTANT NOTE: No make-up exams or assignments will be given for any reason.

Please contact me as soon as possible if you missed an exam or assignment due to an excused medical absence or similar emergency, and I will determine (at my discretion) if an adjustment to the grading formula above is appropriate.

For other reasons for missed assignments or exams, please note that the grading policy already makes allowance for the possibility of missing the occasional assignment by dropping the lowest assignment scores, so no additional allowance or adjustments to the grading scheme will be made.

7 Required software and hardware

- Course lectures will take place via Zoom, and will be recorded and hosted on the course Canvas site. The recordings will be deleted from the site after the end of the quarter (see privacy policy below).
- In order to take the midterm and final exams you are required to be able to log on to Zoom for the scheduled Zoom meeting, to have a stable home internet connection, and for your Zoom device to have a microphone and camera. At the end of the exam you will be required to scan your exam pages using a camera and upload them to Gradescope.

  Please make sure you have the required hardware in advance of the exam dates. In case of any problems, contact me as soon as possible to discuss the situation.
- A mock exam Zoom meeting will be arranged ahead of the first midterm exam to allow you to test your hardware setup, including rehearsing the exam scanning and uploading part.

8 Privacy policy

- The recordings of Zoom lectures will be deleted from the course Canvas site after the end of the quarter.
- I reserve the right to retain personal copies of lecture video that does not include student audio or other identifiable student information. Video containing identifiable student information will be deleted.
- Please respect the privacy of your fellow students and do not distribute video links or files of course lectures to anyone, including friends wishing to audit the course. If anyone asks you for access to course recordings, please refer them to me (I will be happy to provide access to anyone making a reasonable request).
- Office hours will not be recorded.

9 Ethics policy

- Any work submitted as part of the homework assignments must: (i) be physically written/typed by you; (ii) be written in your own words; and (iii) represent that you have taken an intellectual part in its creation and understand what you have written. In other words, it is okay to work collaboratively with other people, but you cannot just copy someone else's solution and submit it.
- Exams must be your independent work. You may not receive assistance from anyone, including search engines and other online sources, while taking exams. Guidelines on materials allowed for use during exams will be given ahead of time.
- Failure to adhere to these guidelines would be considered by me as a violation of the UC Davis Code of Academic Conduct and warrant, at minimum, a failing grade in the assignment in question and a referral to Student Judicial Affairs.
- To put the above in more human terms: don't cheat; treat me and your fellow students as you would like to be treated, and you will win at least 25 points of good karma.

10 Students with disabilities

If you are entitled to some form of accommodation or would like to receive an accommodation, e.g., based on a disability, please let me know as soon as possible so that we can discuss any relevant details. Please refer to the Student Disability Center with questions about accommodations.

11 Just for fun: a few inspirational quotes

"*In order to solve this differential equation you look at it until a solution occurs to you.*"

—George Pólya

"*Among all of the mathematical disciplines the theory of differential equations is the most important... It furnishes the explanation of all those elementary manifestations of nature which involve time.*"

—Sophus Lie

"*Where did we get that from? Nowhere. It's not possible to derive it from anything you know. It came out of the mind of Schrödinger, invented in his struggle to find an understanding of the experimental observations of the real world.*"

—Richard Feynman