APMA 0350 – SYLLABUS

Welcome to APMA 0350 – an exciting dif-fun-rential adventure awaits you! This is the survival manual for this course, where you can find all the administrative info you need to know, such as office hours, grading, and other goodies. Feel free to e-mail me if you have any other questions.

Disclaimer: Any item on this syllabus is subject to change. Any in-class or online announcement, verbal or written, is considered official addendum to this syllabus.

1. At a glance

Course Name	Applied Ordinary Differential Equations
Term	Spring 2023
Class Times and Location	MWF 12–12:50 pm in 85 Waterman St. 130
Instructor Name	Peyam (π-m) Tabrizian
E-mail	drpeyam@brown.edu
Course Website	APMA 0350 Website
Office	Room 316, 182 George Street
Office Hours	MWF 10:30 – 11:30 am

Date: Wednesday, January 25, 2023.

2. Logistics

Course Description: This course provides a comprehensive introduction to ordinary differential equations and their applications. We will see how applied mathematicians use ordinary differential equations to solve practical applications, from understanding the underlying problem, creating a differential-equations model, solving the model using analytical, numerical, or qualitative methods, and interpreting the findings in terms of the original problem. While this course is more geared towards the techniques for solving ODE, I will try my best to mention some rigorous theoretical foundations of differential equations. To learn even more about the theory, I suggest taking MATH 1110

Prerequisites: Calculus II (MATH 0100) or equivalent; knowledge of matrix-vector operations, determinants, and linear systems.

Warning: I *highly* recommend you to take Linear Algebra (MATH 0520) beforehand, since about a third of the lectures require it. In addition, about three lectures require Multivariable Calculus knowledge (MATH 0180)

Learning Outcomes: By the end of the course, you will be able to

- Formulate questions about real-world problems and create ordinary differential equations models to answer them
- Determine when an ordinary differential equation has a solution and when the solution is unique
- Analyze and solve ordinary differential equations using qualitative, analytical, and numerical techniques
- Draw conclusions about real-world problems from ordinary differential equations models

Calculator Policy: Calculators are **NOT** allowed on the exams. That said, you **ARE** allowed to use them on the Homework.

What this course is really about: I highly doubt that you'll forget the techniques you'll learn in this course because they are essential to human survival. That said, as Steve Krantz puts it in his book How to teach Mathematics, there is another goal of teaching this course. Namely, real purpose of this course is to teach you about mathematical discourse and critical thought. Just like in rhetoric, philosophy or politics, mathematics has its own language and way of thinking. How do mathematicians deal with an unknown problem? What methods do they use? What do they do when a given method doesn't work? Getting acquainted with all those different types of discourses is what your college education is really about.

Textbook: None; I will post self-contained lecture notes

Recommended:

- For more practice problems: Elementary Differential Equations and Boundary Value Problems by Boyce, DiPrima, Meade
- Super clear book: Notes on DiffyQs by Jiri Lebl
- Personal favorite of mine: Differential Equations, Dynamical Systems, and an Introduction to Chaos by Hirsch, Smale, Devaney

Online resources you can use:

- Course Website: This is the main course website, where you can find the lecture notes, homework, and study material
- Canvas: Where I'll post announcements and you check your grades

- Gradescope: Here is where you upload your homework
- Ed Discussion: Post questions that your classmates, the TAs, or I will answer
- Dr Peyam: My YouTube channel, where you'll find useful videos related to this course

3. Grading

Assignment	**Date**	**Percentage**
Homework	Weekly on Fridays	20 %
Programming Assignments	Three in total	5 %
Mini-Project	Friday, May 5	5 %
Midterm 1	Friday, March 3	20 %
Midterm 2	Friday, April 7	20 %
Final Exam	Friday, May 19, 9 am – 12 pm	30 %

Range	Grade
$[90, 100]$	A
$[80, 90)$	B
$[65, 80)$	C
$[0, 65)$	NC

Note: The scales above are a *guarantee*. For example, if you get 80, you are guaranteed at least a B. The final grade calculation is up to

my discretion. For students taking this course S/NC, a min grade of 65% is required to guarantee a grade of S.

For your information, in Fall 2022 there were 269 students enrolled, and the grade distribution was: 202 A, 47 B, 14 C, and 6 NC. There was no curve, but I rounded up things like 89.9 % to an A.

Exams: There will be a two midterms and a final exam, the dates are are above. Bring your student ID and a pencil to all exams. The midterms will be administered in the usual lecture room, but the final will be in a different room. The exams are closed book/notes and no calculators are allowed. For second midterm and the final, you are allowed to bring a standard 8.5×11 cheat sheet. The final exam is cumulative. **The final replaces your lowest midterm score if that's in your favor**

Graded Homework: Homework will be due on Fridays by 3 pm and will be posted on the course website. You will upload your assignments on Gradescope. **Make sure to check your submission, we will NOT accept any incomplete or corrupt files.** You are encouraged to work together but all students must independently write up their own solutions. There is no 'make up' homework, but **the lowest 2 assignments are dropped**

Programming Assignments: There will be three short programming assignments in total, done in Python, and also due on Fridays by 3 pm. The rules are the same as the homework and the lowest programming assignment gets dropped.

Mini-Project: There will be a small fun project due at the end of the semester, where you pick your favorite ODE and write a $1-2$ page

describing it. It won't be too time-consuming.

Late Assignments: Please beware that late submissions of assignments can create unfair situations to others in the class and make it harder for the TAs to give timely feedback. If you encounter circumstances that make it hard for you to complete assignments in time or keep up with the course material, please reach out to me as soon as possible, so that we can work on a plan together. TAs cannot grant homework extensions. **We will not grant homework extensions later than the Sunday after homework is due.**

Grading Policy: If there is a mistake in the grading of your assignment or exam (points are added incorrectly, your score was mis-entered into the grade book) please let me know immediately. If you disagree with the grading of your assignment then you may submit a regrade request on Gradescope. **You only have 1 week after your score has been posted to request a regrade, otherwise we won't accept it.** Please note that small changes in homework points generally do not affect an overall grade. If your regrade was approved, please wait up to one week for your Gradescope score to be updated on Canvas.

Recitation Sessions: There will be **optional** recitation sessions led by the Graduate TA. What is covered in those sessions is up to the GTA. In Fall 2022 for example, it was mainly used to go over the homework problems.
Lecture Recordings: The lectures will be recorded, you can find the recordings on Canvas under Media Library ¿ Lecture Captures

4. Miscellaneous Information

Statement on Inclusivity: I strive to foster an inclusive, collaborative, and supportive learning environment where everybody is welcome

and feels they belong. I also aim to create an atmosphere where everyone is comfortable to add their voices and opinions. Being personally a member of the LGBT community, I acknowledge that there are many disparities in representation in the mathematical sciences and that we, as a community, need to work much harder and more persistently to become more diverse.

Accessibility and Accommodations Statement: Brown University is committed to full inclusion of all students. Please inform me early in the term (by email, office hours, after class, or by appointment) if you may require accommodations or modification of any of course procedures. If you need accommodations around online learning or in-classroom accommodations, please reach out to Student Accessibility Services (SAS) for their assistance (sas@brown.edu, 401-863-9588). Undergraduate students in need of short-term academic advice or support can contact an academic dean in the College by emailing college@brown.edu. Graduate students may contact one of the deans in the Graduate School by emailing graduate_school@brown.edu.

Books, Supplies, and Materials If your Brown undergraduate financial aid package includes the Book/Course Material Support Pilot Program (BCMS), concerns or questions about the cost of books and course materials for this or any other Brown course (including RISD courses via cross-registration) can be addressed to bcms@brown.edu. For all other concerns related to non-tuition course-related expenses, whether or not your Brown undergraduate financial aid package includes BCMS, please visit the Academic Emergency Fund in E-GAP (within the umbrella of "E-Gap Funds" in UFunds) to determine options for financing these costs, while ensuring your privacy.

Finally: Sit back, relax, and enjoy the show! On the next page, you can find *very tentative* schedule of the lectures.

#		**Date**	**Lecture Title**	
1	W	Jan 25	What is a differential equation?	
2	F	Jan 27	Direction Fields	
3	M	Jan 30	Qualitative Methods	
4	W	Feb 1	Existence and Uniqueness	
5	F	Feb 3	Separable Equations	HW 1 due
6	M	Feb 6	Integrating Factors	
7	W	Feb 8	Applications	
8	F	Feb 10	Exact Equations	HW 2 due
9	M	Feb 13	Numerical Methods (I)	
10	W	Feb 15	Numerical Methods (II)	
11	F	Feb 17	Second-Order ODE (I)	HW 3 due
	M	Feb 20	No class	
12	W	Feb 22	Second-Order ODE (II)	
13	F	Feb 24	Boundary-Value Problems	HW 4 due
				Coding 1 due
14	M	Feb 27	Undetermined Coefficients	
15	W	Mar 1	Variation of Parameters	
16	F	Mar 3	Midterm 1	

17	M	Mar 6	Laplace Transform	
18	W	Mar 8	Initial-Value Problems	
19	F	Mar 10	Step Functions (I)	HW 5 due
20	M	Mar 13	Step Functions (II)	
21	W	Mar 15	ODE with jumps	
22	F	Mar 17	Dirac Delta	HW 6 due
23	M	Mar 20	Convolution	
24	W	Mar 22	Systems of ODE (I)	
25	F	Mar 24	Linear Algebra Review	HW 7 due
				Coding 2 due
		Mar 27–31	No class (Spring Break)	
26	M	Apr 3	System of ODE (II)	
27	W	Apr 5	Midterm 2 – Review	
28	F	Apr 7	Midterm 2	

29	M	Apr 10	Complex Eigenvalues	
30	W	Apr 12	Repeated Eigenvalues	
31	F	Apr 14	Matrix Exponentials (I)	HW 8 due
32	M	Apr 17	Matrix Exponentials (II)	
33	W	Apr 19	Undetermined Coefficients	
34	F	Apr 21	Variation of Parameters	HW 9 due
35	M	Apr 24	Nonlinear Systems	
36	W	Apr 26	Ecology: Competing Species (I)	
37	F	Apr 28	Ecology: Competing Species (II)	HW 10 due
				Coding 3 due
38	M	May 1	Epidemiology: SIR Models (I)	
39	W	May 3	Epidemiology: SIR Models (II)	
40	F	May 5	Final Exam Review	Mini Project due
41	M	May 8	Catch-up	
	F	May 19	Final Exam	