APMA 350: Introduction to Applied Differential Equations

Meeting times: MWF 11-11:50 AM

Instructor: Amanda Howard
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Office Hours: Wednesday, 4-6pm or by appointment

Homework due: Thursdays, by 5pm, in 182 George Street

I. Course Description:
From population growth and decay to the speed at which coffee cools after you add milk, our world is modeled by ordinary differential equations. This course will introduce both numerical and theoretical techniques to solve such equations. Intended for students considering a concentration in applied mathematics, or for those who are interested in the rigorous development of the methods used, as well as the mathematical and historical context of these methods. The course will introduce programming in Matlab as a way to solve problems numerically. Students will practice skills weekly through ungraded problem sessions and graded problem sets. Three hours of lecture and one hour (mandatory) of recitation.

II. Course Goals and Outcomes:
Course Goals: Students will learn the foundations of solving ordinary differential equations both analytically and numerically to prepare them for future coursework in Applied Mathematics or other fields.

Learning Outcomes: After taking this course, students will be able to:
· Create a flow chart of the methods taught to solve first order ordinary differential equations and distinguish when each method is used.
· Explain the importance and role of numerical methods in solving differential equations.
· Explain the significance of solutions to differential equations in the context of physical applications.

III. Course Materials:
Textbook: *Elementary Differential Equations and Boundary Value Problems* [10th edition] W.E. Boyce and R.C. DiPrima, published by John Wiley & Sons Inc.

The textbook is recommended as a reference, although not mandatory. The homework problems will not come from the text. Previous editions of the textbook may be used.

IV. Grading Policy/Procedures:
The final grade will be based on:

Graded Work	Weight
Weekly problem sets	35%
Midterm I	15%
Midterm II	15%
Final exam	20%
Recitation Attendance	5%
Short project—ODEs in Matlab	5%
Short project—Writing in Math	5%

More information about the short project will be passed out in the coming weeks and available on the course Canvas site. The final will be cumulative exam covering all the material we covered this semester.

Late homework will not be accepted except in exceptional cases with prior approval. Instead, the lowest homework grade will be dropped. Homework is due on Thursday by 5pm in the bin for APMA 350 in the Applied Math building at 182 George Street.

V. Format, Policies, Procedures, and Expectations of Students:
Class will consist of three weekly lectures and a weekly recitation section. While I will post my lecture notes after each lecture, they are not guaranteed to cover all the material I put on the board, and therefore you should not see them as a substitute for attending lectures.

The weekly recitation section is mandatory. Recitations will consist of small group work, which has been shown to increase student scores on exams. 5% of your final grade is based on attendance at the recitation sections, so please be sure to sign in at each section.

VI. Accommodations for Students with Disabilities:
Please inform me if you have a disability or other condition that might require some modification of any of these course procedures. You may speak with me after class or during office hours. For more information, contact Students and Employee Accessibility Services at 401-863-9588 or SEAS@brown.edu.

VII. Academic Support:
The Math Resource Center is available for students in APMA 350, as well as other Applied Math and Math classes. It offers free tutoring by graduate students (including current and past APMA 350 TAs) Monday-Thursday, 8-10pm.

VIII. Diversity:
This course, along with the Department of Applied Mathematics, believes that a learning community is enriched by diversity, including race, gender, gender identity, sexual identity, age, class and race. I am committed to present materials that are respectful of all dimensions of diversity, and your suggestions and comments are welcomed through email or office hours. Participants who need accommodations, including but not limited to extensions due to religious

holidays, should contact me so that we can make arrangements, preferably with as much notice as possible.

IX. Academic Honesty:
You may work in groups to complete the homework, however you are expected to write up your solutions alone. Copying another student's write up is academic dishonesty.

All Brown University students are expected to adhere to Brown's Academic Code, which reads, in part, 'Academic achievement is evaluated on the basis of work that a student produces independently. A student who obtains credit for work, words, or ideas that are not the products of his or her own effort is dishonest and in violation of Brown's Academic Code. Such dishonesty undermines the integrity of academic standards of the University. Infringement of the Academic Code entails penalties ranging from reprimand to suspension, dismissal, or expulsion from the University.' Students are expected to familiarize themselves with the Academic Code, in full, located online at: https://www.brown.edu/academics/college/degree/sites/brown.edu.academics.college.degree/files/uploads/Academic-Code.pdf

X. How to Succeed in this Course:
Math is best learned by incremental review, instead of cramming for assignments and tests. I encourage you to start problem sets early, so you have time to think about difficult problems. I highly encourage you to attend office hours, even if you do not have specific questions. Hearing the questions other students ask can be equally helpful.
This course will involve two short projects. I am happy to provide feedback on drafts for these projects if they are given to me with at least a week to review.

XI. Tentative Course Schedule:

Week	**Chapters in Textbook**	**Assignments (due Thursday at 5pm unless noted)**
Week 1: Sept 7-11 Introduction to Course	7.1 -7.3	
Week 2: Sept 14-18 Basic theory of systems of first order linear equations	7.4	Problem set 1 due
Week 3: Sept 21-25 Homogeneous linear systems with constant coefficients	7.5 – 7.6	Problem set 2 due

Week 4: Sept 28-Oct 2 Fundamental matrices & repeated eigenvalues	7.7 - 7.8	Problem set 3 due
Week 5: Oct 5-9 Solving ODEs in Matlab & Midterm review		MIDTERM I ON WEDNESDAY
Week 6: Oct 12-16 Linear systems, autonomous systems & stability	9.1 – 9.2 Note: Fall Weekend Holiday—No Class on Monday	Problem set 4 due
Week 7: Oct 19-23 Locally linear systems	9.3	Problem set 5 due
Week 8: Oct 26-30 Competing species & predator-prey equations	9.4 -9.5	Problem set 6 due
Week 9: Nov 2-6 Liapunov's second method & the Lorenz equations	9.6-9.7	Problem set 7 due
Week 10: Nov 9-13 Writing in Math & Midterm review	10.1	MIDTERM II ON WEDNESDAY
Week 11: Nov 16-20 Two-point boundary value problems	10.2-10.5	Problem set 8 due
Week 12: Nov 23-27 Heat conduction	10.6 Note: Thanksgiving recess—No class on Wednesday or Friday	ODEs in Matlab due on **Wednesday at noon**

Week 13: Nov 30-Dec 4 The wave equation & Laplace's equation	10.7-10.8	Problem set 10 (due Thursday at 5pm) Writing in Math assignment draft **due Friday at noon**
Week 15: Dec 7-11 Review	Note: No class, optional review lecture Monday during normal class time	Writing in Math assignment **due Friday at noon**
Week 16: Dec 14-18 Exam week		FINAL EXAM