

APMA 0350: Applied Ordinary Differential Equations (Spring 2017)

Lectures: M W F 1:00-1:50pm in B & H 168

Instructor: Ben Kunsberg

- Office: 182 George Street, room 222
- E-mail: benjamin_kunsberg@brown.edu
- Canvas Homepage: TBA
- Office Hours: Monday, Wednesday 2 - 3 p.m.

Teaching Assistants: TBA

Topics	
introduction	what are differential equations, what is a solution, sample models, ... (Ch. 1)
first-order equations	qualitative approach
	separable equations (Ch 2.2)
	applications: population growth, bathtub model, mixing, (Ch 2.3)
nonlinear systems	introduction: geometry, particle trajectories, definitions
	existence and uniqueness theorem and its proof (Ch 2.8)
	modelling: infectious diseases, stage-structured populations
numerical methods	Euler, Heyn, Runge-Kutta methods; introduction to Matlab (Ch 8.1)
Midterm 1	March 2nd, in class
linear systems of equations	matrices and $\exp(At)$, fundamental matrix solutions (Ch 7)
	computing $\exp(At)$: eigenvalues and eigenvectors (Ch 7)
	inhomogeneous equations (Ch 7)
	applications: forced linear pendulum, stage-structured populations
Midterm 2	April 13th, in class
nonlinear systems	phase-plane analysis: equilibria, stability, periodic orbits (Ch 9)
	applications: pendulum, SIR models, traffic flow (Ch 9)
Final examination	TBA

Recitation Sessions: (Time TBD, but probably Wednesday evenings. During recitations, you will work in groups of three on guided projects to review, deepen, and expand your understanding of the course material, and apply the techniques we learned about to models.

Participation in recitation sessions is not required but strongly recommended! Coming to the recitation will likely decrease the time needed for the homework.

Homework: Assignments will be available on Canvas on Friday afternoon; homework will be due at the beginning of Friday's class at 1:00 p.m. You can drop it off at class or in the APMA 350 homework box at 182 George St. The dropbox will be checked/emptied at 1:50 p.m. on Friday.

Grades for homework will usually be posted within a week on Canvas.

Goals: This course gives a comprehensive introduction to the qualitative and quantitative theory of ordinary differential equations and their applications. During the course, you 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 and/or numerical techniques, and interpreting the findings in terms of the original problem. We will also learn the underlying rigorous theoretical foundations of differential equations.

Approximate sections are listed in the Topics table.

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

Prerequisites: Intermediate Calculus: MATH 0100/0170/0180/0190/0200/0350;
Linear Algebra: MATH 0520/0540 (can be taken concurrently).

Assessment:

Graded work	Weight
Homework	25%
Midterm exam 1	20%
Midterm exam 2	20%
Final examination	35%

Provisional grading scale	
Grade	Percentages to aim
A	90-100%
B	80-89%
C	70-79%

The provisional grading scale may be subject to a "curve", if the class average score is low enough. The curve may set new thresholds for the grades, but the thresholds will always be lower than those above. That is, the curve will never lower your grade and can only raise it. For example, if you get above a 90%, you can be sure of an A.

I will not change your grade subjectively; it will be calculated exactly according to the above breakdown.

Policies:

- Lectures: Please come to all classes. The textbook is comprehensive; we will only be covering a portion. In addition, we will go in a different order. Thus, it is important to come to class so that you can learn the correct portion! In addition, it is a great opportunity to

ask questions! We will also have small group discussions during the middle of class. This is a good opportunity to practice explaining what you have learned.

- Homework:
 - Late homework assignments will not be accepted, as they cause considerable inconvenience for the TAs. No credit will be given for late work unless you have a legitimate excuse (illness/emergency), together with verification.
 - Students can, and are encouraged to, collaborate on homework assignments: however, assignments must be written up separately and individually.
 - If you believe you have been misgraded, please send me an email with e.g. "Misgrade APMA 350 {Your Last Name} HW 5" in the title. To save the TAs time, I will store all of these potential misgrades until the end of the semester and then consider and apply them all at once.
- Midterm exams will not be given for individuals at times other than the scheduled slots, except in cases of illness, emergency or some other crisis; documentation verifying the excuse will be required, such as a note from your doctor. You need to contact me as soon as you can, before the midterm exam whenever possible, if a serious conflict arises.
- Final exams: You must see a Dean in the Dean of the College's office for final exam excuses.

Time Required: Over 14 weeks, students will spend 3 hours per week in class (42 hours). The weekly homeworks are expected to take roughly 6-8 hours each (≈ 84 hours). It is strongly encouraged to read the appropriate sections of the book beforehand. This may take an additional 1-2 hours each week (≈ 20 hours).