Math 54: Linear Algebra and Differential Equations

Jeffrey Kuan

Summer 2019

Instructor: Jeffrey Kuan
Lecture/Discussion: MTuWThF, 4-6 PM in 3111 Etcheverry Hall
Office Hours: MTuWTh, 2:30-3:45 PM in Evans 860 for now, Evans 848 later
(My original office Evans 848 is being renovated)
Course Website: `https://math.berkeley.edu/~jkuan/mathn54.html`
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Hello, and welcome to Math 54: Linear Algebra and Differential Equations! Linear algebra is an extremely versatile and powerful mathematical tool that has applications everywhere, from physics to economics to engineering, and more! It is a very rewarding subject to learn, and I am very excited to teach it this summer. In this syllabus, I briefly outline some course policy, but feel free to email me if you have any questions during the semester!

Textbook

We will use *Linear Algebra and Differential Equations (UC Berkeley Custom Edition)*, 3rd Edition, ISBN: 9781323720868. This combines sections of the following two books:

- Linear Algebra and its Applications, Lay-Lay-Macdonald, 5th Edition
- Fundamentals of Differential Equations, Nagle-Saff-Snider, 9th Edition

However, I recommend that you just buy the custom edition.

Grading

The final grade will be determined as follows:

- Problem Sets: 17.5%
- Midterm 1: 17.5%
- Midterm 2: 17.5%
- Midterm 3: 17.5%
- Final Exam: 30%

The final exam will replace the lowest midterm grade, if it is higher. There are no quizzes! In lieu of quizzes, I am instead giving three midterm exams that will each cover less material. I want to emphasize that I am giving three midterms to make each exam more manageable: by having each exam cover less material and by having each exam matter less in the final grade. The (cumulative) final exam will be held on Thursday, August 15, 2019 in class.

Exams will be curved, but they will not be curved down. In particular, getting a 90% or above guarantees an A-/A/A+ grade, getting between 80%-90% guarantees a B-/B/B+ grade, getting between 70%-80% guarantees a C-/C/C+ grade, etc. However, likely, the grade cutoffs will be better than this because of the curve on the exams (which is approximately 30-40% A's, 35-45% B's, etc.).

Incompletes are rarely given, unless you are currently passing the class, and there are extenuating circumstances that prevent you from completing the class.

Problem Sets

There will be 14 problem sets in this class. Your lowest two grades will be dropped. Problem sets will typically be due on Tuesday and Friday at **the start of class by 4 PM** on Gradescope (though see the detailed schedule, as there are some exceptions to this rule). **Unfortunately, no late homework can be accepted.**

Problem sets are a sizable part of your grade, worth as much as a midterm. They can at times be long. That being said, start early, and seek out help when you need it.

You are highly encouraged to work with your peers on the problem sets; **however, your solutions must be your own!** It is important to try each question by yourself before talking to others. While I cannot enforce this, putting effort into problem sets is important for succeeding on the exams. If you collaborate with others (which again, is encouraged!), you should write up your final solution individually, on your own, to make sure you fully understand the material!

Each problem set will be graded out of 5 points, 2 points for completeness and 3 points for correctness, based on a spot check of a portion of the questions on the homework.

Entry code for Gradescope: MGVXYN

Email and Piazza Policy

Please do not hesitate to ask any questions or reach out by email if you feel like you need extra help, or if there is anything you would like to talk about! I am always happy to help, and generally respond quickly.

However, **please direct all questions about homework and conceptual questions that may be of general interest to the Piazza!** This is because many questions I usually get by email tend to be of general interest, so if you post the question on Piazza, I can answer it for everyone in the class to see! If you do not want your name on the post, you are welcome to post anonymously.

As a note, students can also answer each other's questions, and I strongly recommend doing this, as it will help you learn the material to explain it to someone else!

Some ground rules about using Piazza:

- Before posting, check previous posts to see if your question has already been answered.
- Be respectful of others.
- Never be afraid to ask questions! Asking questions is the best way to learn math. If it helps, you are free to post anonymously.
- It is okay to ask for help on Piazza if you are completely stuck on a question or do not know how to approach a question at all. However, to stimulate productive conversation, mention what you have tried and why that hasn't worked also in your post.

Sign up here: `piazza.com/berkeley/summer2019/mathn54`

Academic Integrity

Cheating on exams and plagiarism on problem sets (copying from a solution manual, from another student, or from online) is unacceptable, and will be dealt with accordingly. Please do not cheat! It is a huge mess for everyone involved. **If you ever feel like you are in a difficult position or if you ever feel overwhelmed in this class, please reach out to me by email or in person, and I will always be willing to help you!**

Prerequisites

It helps to have taken Math 1A/1B or an equivalent, covering calculus. In particular, we will need integration (including integration by parts) and differentiation throughout the course. As a note, multivariable calculus is not needed. We will learn the appropriate notion of partial derivative in class before starting partial differential equations. Familiarity with complex numbers is needed, but complex numbers will be reviewed briefly during lecture.

Accommodation

If you believe that you need any accommodations, please do not hesitate to reach out to me! Let me know about any necessary accommodations as soon as possible.

Scheduling Conflicts

By the end of the first week of class, please let me know if you have any scheduling conflicts.

In Conclusion...

I hope you enjoy this summer, and I look forward to getting to know you! If you ever have any questions, or if you ever have any feedback on how the class is going, feel free to let me know! Looking forward to a great summer! ☺ ☺ ☺

Part 1: Simultaneous Equations and the Basic Tools of Linear Algebra				
1	6/24	Introduction, Systems of Linear Equations	LLM 1.1	
2	6/25	Gaussian Elimination and Vectors	LLM 1.2-1.3	
3	6/26	Vector equations, A**x** = **b**, Solution Sets	LLM 1.3-1.5	
4	6/27	Linear Independence, Matrix Operations	LLM 1.7, 2.1	
5	6/28	Matrix Inverse, Invertible Matrix Theorem	LLM 2.2, 2.3	**PS 1 due**
6	7/1	Determinants	LLM 3.1-3.3	
7	7/2	Vector Spaces, Linear Transformations	LLM 4.1, 4.2	**PS 2 due**
8	7/3	Subspaces of Vector Spaces, Kernel and Range of Linear Transformations	LLM 4.1, 4.2	
9	7/4	**Fourth of July! No class!**		Have fun!
10	7/5	Buffer, Review for Midterm 1		**PS 3 due**
Part 2: Vector Spaces, Linear Transformations, and Diagonalization				
11	7/8	**Midterm 1**		
12	7/9	Linear Independence, Span, Basis, Dimension	LLM 4.1, 4.3, 4.5	
13	7/10	Rank, Nullity, Rank-Nullity Theorem	LLM 4.3, 4.5, 4.6	**PS 4 due**
14	7/11	More on Linear Transformations, Coordinates	LLM 4.4, 4.7	
15	7/12	Change of Basis	LLM 4.7	**PS 5 due**
16	7/15	Eigenvectors and Eigenvalues	LLM 5.1, 5.2	
17	7/16	Diagonalization	LLM 5.3	**PS 6 due**
18	7/17	Inner Products, Orthogonality	LLM 6.1, 6.2	
19	7/18	Buffer, Review for Midterm 2		
20	7/19	**Midterm 2**		**PS 7 due**
Part 3: Inner Product Spaces and Symmetric Matrices				
21	7/22	Orthogonal Projection	LLM 6.3	
22	7/23	Gram-Schmidt Process	LLM 6.4	**PS 8 due**
23	7/24	Least Squares	LLM 6.5	
24	7/25	Inner Product Spaces	LLM 6.7	
25	7/26	Diagonalization of Symmetric Matrices	LLM 7.1	**PS 9 due**
26	7/29	Singular Value Decomposition	LLM 7.4	
27	7/30	Homogeneous Second-Order ODE	NSS 4.2, 4.3	**PS 10 due**
28	7/31	Nonhomogeneous Second-Order ODE	NSS 4.4, 4.5	
29	8/1	Buffer, Review for Midterm 3		
30	8/2	**Midterm 3**		**PS 11 due**
Part 4: Differential Equations and Partial Differential Equations				
31	8/5	Systems of Differential Equations	NSS 9.1, 9.4	
32	8/6	More Systems of Differential Equations	NSS 9.5, 9.6	**PS 12 due**
33	8/7	Fourier Series	NSS 10.3, 10.4	
34	8/8	Introduction to Partial Differential Equations	NSS 10.2	
35	8/9	Heat Equation	NSS 10.5	**PS 13 due**
36	8/12	Buffer, or Wave Equation (if there is time)	NSS 10.6	
37	8/13	Buffer, Review for Final Exam		
38	8/14	Review for Final Exam		**PS 14 due**
39	8/15	**Final Exam**		
40	8/16	Conclusion: Why Is Linear Algebra So Important?		