Math 54: Linear Algebra and Differential Equations. Fall 2016.

--N. Kotwani

Course description: Basic linear algebra; matrix arithmetic and determinants. Vector spaces; inner product spaces. Eigenvalues and eigenvectors; linear transformations. Homogeneous ordinary differential equations; first-order differential equations with constant coefficients. Fourier series and partial differential equations.

Instructor: Nikhil Srivastava, email: *firstname at math.obvious.edu*

Please come to office hours or consult with your GSI **before** sending me email about logistical concerns. As far as possible, please use Piazza for mathematical questions.

Lectures: MWF 4:00-5:00pm, 155 Dwinelle.

Office Hours: Monday 5:15-6:30pm (1035 Evans) and Tuesday 2:00-3:45pm (Student Learning Center)

Course Control Number: 31371

Enrollment Issues: Unfortunately, I have no control over enrollment issues. If you have any concerns about the waitlist, switching sections, and so on, please contact the registrar or one of the Mathematics undergraduate advisors:

- Thomas Brown, 965 Evans, *brown@math.obvious.edu*
- Jennifer Sixt Pinney, 964 Evans, *jensixt@math.obvious.edu*

Graduate Student Instructors

- Nick Ryder (nick.ryder@b.edu) TTh 2-3pm, 1060 Evans.
- Yingdi Qin (qinyd@b.edu), TTh 8-9am, 818 Evans.
- Patrick Lutz (pglutz@b.edu), M 10-11am, F 9-11am, 840 Evans.
- Aaron Brookner (brookner@b.edu), MW 9-10am, 854 Evans.
- Satyaki Mukherjee (satyaki@b.edu), Tu 3:30-4:30 and Th 4-5pm, 1058 Evans.
- Benjamin Siskind (bsiskind@b.edu) M 11:15-12:15 Th 12:15-1:15, 1062 Evans.
- Bryan C. Brown (bryan.brown@b.edu) (email)

Textbook:Linear Algebra and Differential Equations, Second Custom Edition for UC Berkeley, by Lay, Nagle, Saff and Snider.

Grading: 5% HW, 15% quizzes, 20% x 2 midterms, 40% final. The bottom two HW and Quiz grades will be dropped, and the lower midterm score will be replaced by the final, if it helps. All exams will be curved. The median grade will be **at least** a B-. This is not an upperbound; if everyone does extremely well, I will be happy to give everyone an A+.

Exams: There will be two in-class midterm exams on **Friday, 9/23**, and **Monday, 10/31**. There will be no makeup exams, except for documented medical emergencies.

Quizzes will be held in section every **Friday**. They will cover material up to the preceding Wednesday. There will be no quiz on midterm days. The quizzes will be substantially easier than the exams, are and designed to regularly check basic understanding of the material, so that you know in case you are falling behind.

Homework will be assigned daily (problems from the textbook) on this webpage, and each week's homework will be collected the following **Wednesday** in section.

1. Homework 1 (problems assigned 8/24 and 8/26) due Wednesday, 8/31. solutions.
2. Homework 2 (problems assigned 8/29--9/2) due Wednesday, 9/7. solutions.
3. Homework 3 (problems assigned 9/7--9/12) due Wednesday, 9/14. solutions.
4. Homework 4 (problems assigned 9/14--9/19) due Wednesday, 9/21. solutions.
5. Homework 5 (problems assigned 9/26) due Wednesday, 9/28. solutions.
6. Homework 6 (problems assigned 9/26--10/3) due Wednesday, 10/5. solutions.
7. Homework 7 (problems assigned 10/5--10/10) due Wednesday, 10/12. solutions.
8. Homework 8 (problems assigned 10/12--10/17) due Wednesday, 10/19. solutions.
9. Homework 9 (problems assigned 10/19--10/24) due Wednesday, 10/26. solutions.

10. Homework 10 (problems assigned 10/26) due Wednesday, 11/2. solutions.
11. Homework 11 (problems assigned 11/2--11/7) due Wednesday, 11/9. solutions.
12. Homework 12 (problems assigned 11/9--11/15) due Wednesday, 11/16. solutions.
13. Homework 13 (problems assigned 11/16--11/22) due **Wednesday, 11/30**. solutions.
14. Homework 14 (problems assigned 11/28--11/30) due **Friday, 12/2.** solutions.

Announcements

- (8/24). Welcome to the class! There will be a short quiz in your first section on Friday, covering basic complex number arithmetic as detailed in Appendix B (pages 664-668) of the textbook. You need to know how to add, multiply, and conjugate complex numbers in both Cartesian and polar form.
- (9/18) Here is practice midterm 1 and solutions, as well as a list of topics for Midterm 1.
- (9/25) Midterm 1 and solutions.
- (10/6) Midterm 1 stats.
- (10/26) Practice Midterm 2.
- (10/27) Practice Midterm 2 solutions.
- (10/28) List of topics for Midterm 2.
- (11/5) Midterm 2 and solutions.
- (11/5) Midterm 2 statistics.
- (12/7) Practice final and list of topics.
- (12/9) Practice midterm solutions.
- (12/31) Final exam solutions and a statistics.

Class Schedule

This course covers a lot of material very quickly, and in order to digest it you will have to read the assigned sections **before** lecture.

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#	Date	Topics	Readings	Homework problems	Remarks
1	W 8/24	Intro, linear equations	1.1	1,3,5,7,11,15,20,23,24,28.	
2	F 8/26	Row reduction	1.2	1,5,7,11,15,23,26,30.	Quiz on Complex numbers in section
3	M 8/29	The column picture	1.3	1,5,9,11,14,23,24,29	
4	W 8/31	Matrix equations and solution sets	1.4-1.5	1.4: 11, 13, 15, 24, 25, 29, 30, 31, 34. 1.5: 1, 5, 9, 24, 25**x**, 38, 39	**x** means optional, but recommended
5	F 9/2	Linear independence	1.7	1, 7, 9, 11, 22, 31, 32, 33, 34, 37, 38.	
*	M 9/5	*Labor Day*			
6	W 9/7	Linear Transformations	1.8	2, 8, 12, 14, 16, 17, 22, 30, 31, 32.	
7	F 9/9	The Matrix of a Linear Transformation	1.9	2, 4, 6, 9, 19, 22, 26, 33**x**, 35, 36.	
8	M 9/12	Matrix Algebra ~~and Inverses~~	2.1	2.1: 1,2,10,12,15,18,22,23,31,32.	
9	W 9/14	Inverses and how to compute them	2.2, 2.3	2.2: 10, 12, 13, 16, 20, 22, 24, 30, 32. 2.3: 2 , 5, 8, 12, 15, 21, 28, 36.	
10	F 9/16	Subspaces and Bases	2.6	2, 5, 7, 11, 13, 18, 22, 24, 27, 28, 34.	

11	M 9/19	Dimension and Rank	2.7	3,5,7,9,16,21,23,24.	
12	W 9/21	Review	Ch 1 and 2		
13	F 9/23	Midterm 1 (in class)		see Announcements for study materials	
14	M 9/26	Vector Spaces	4.1	1, 2, 5, 6, 8, 11, 20, 21, 22, 23, 31, 32.	
15	W 9/28	Span, Linear independence, Basis	4.3, 4.4	4.3: 26, 33, 34, 37x 4.4: 13, 14, 18, 19x, 20 Ch4 Supplementary: 4, 5, 6, 8.	
16	F 9/30	Coordinates, Linear Transformations, Kernel and Image	4.2end, 4.4	4.2: 30, 31, 33x, 35, 36x 4.3: 31, 32, 33 4.4: 22, 23, 24, 26, 28, 31, 32.	Only the last part of 4.2 is new the rest is a review of Null and Col.
17	M 10/3	The Matrix of a Linear Transformation	5.4, first 2 sec	4.5: 21, 23 5.4: 2, 6, 9.	
18	W 10/5	Change of Basis, Dimension	4.5, 4.7	4.7: 3, 7, 8, 13, 14, 20a. 4.5: 9, 11, 25, 26, 27, 30, 31x	
19	F 10/7	Determinants	3.1, 3.2	3.1: 4, 22, 25, 38, 43x 3.2: 6, 7, 16, 22, 27, 29, 32, 33x, 34.	
20	M 10/10	Eigenvalues and Eigenvectors	5.1, 5.2	5.1: 2, 7, 16, 20, 21, 24, 25, 29, 32. 5.2: 4, 10, 19.	
21	W 10/12	Diagonalization	5.3	5.3: 5, 8, 13, 14, 21, 27, 31, 32. 5.4: 11, 14, 17, 23.	
22	F 10/14	More Diagonalization, Applications	5.4	5.3: 2, 3, 4, 5, 22, 24, 25, 29. ~~5.6: 1~~ Supplementary: 2, 9, 10x.	American Scientist article
23	M 10/17	Complex Eigenvalues, Applications	5.5	5.5: 1, 4, 8, 12, 13, 22, 25.	
24	W 10/19	Geometry of R^n	6.1, 6.2	6.1: 2, 6, 7, 10, 14, 17, 19, 24, 27, 29. 6.2: 5, 9, 23abc, 32.	
25	F 10/21	Orthogonal Projections	6.3	6.1: 30 6.3: 1, 4, 8, 12, 14, 19, 22, 24.	
26	M 10/24	Gram-Schmidt and Least Squares	6.4, 6.5	6.4: 2, 6, 10, 17ab, 22 6.5: 3, 5, 7, 9, 17 , 19, 22.	
27	W 10/26	Inner Product Spaces	6.7	1, 7, 10, 14, 16, 18, 22, 26.	
28	F 10/28	Symmetric Matrices, review	7.1		

	M 10/31	Midterm 2 (in class)			
30	W 11/2	Intro to Diff Eq, First and Second Order Homogeneous DE	4.1, 4.2	7.1(Lay): 1, 17, 26, 27, 29 4.1: 1,2 4.2: 3, 5, 10, 13	
31	F 11/4	2nd order ODE with complex and repeated roots	4.2, 4.3	4.3: 3, 13, 22, 28, 30, 32, 36.	
32	M 11/7	Inhomogeneous equations, method of undetermined coeffs	4.4, 4.5	4.4: 1, 2, 3, 11, 12, 21, 29. 4.5: 2, 5, 18, 20.	
33	W 11/9	Systems of linear ODE	9.1, 9.4	9.1: 3, 7, 10 9.4: 3, 5, 7, 26, 27	
34	M 11/14	Homogeneous Systems of linear ODE	9.4, 9.5	9.4: 20x, 21, 23, 28, 37 9.5: 19, 21, 31, 32, 45x.	
35	W 11/16	Complex roots, nonhomogeneous systems	9.6, 9.7	9.4: 20(skip if you did it last week), 31 9.6: 3, 5, 13ac, 20x. 9.7: 2,8.	(optional) Read 9.8. It's cool.
36	F 11/18	Intro to Partial Differential Eqns	10.1, 10.2		Guest Lecture by Prof. Lin
37	M 11/21	The Heat Equation, Eigenfunctions	10.2	10.2: 1 ,3 ,5 ,9 , 12, 15, 16.	
38	M 11/28	Fourier Series solution of the heat equation	10.3, 10.4	10.4: 5, 7, 8, 10, 17, 19.	Videos: heat equation , sawtooth, square wave.
39	W 11/30	Fourier Series	10.3, 10.4	10.3: 1, 5, 9, 14, 15.	cool article.
40	F 12/2	Review	NS and S		
	Th 12/15	Final Exam 8am--11am (in 155 Dwinelle)			