Linear Algebra and Differential Equations

GENERAL COURSE INFORMATION

Lectures: MWF 10:10–11, Room 155 Dwinelle
Course Control Number: 22496
Instructor: Constantin Teleman (https://bspace.berkeley.edu/portal/index.html), 903 Evans, e-mail (mailto:teleman@math.berkeley.edu)
Office Hours: M11:15-12:30, W11:45-1, Friday by appointment.
GSI Office Hours:

- Kuan M3–4, W3–4:30 in 1042 Evans;
- Lim M9–10, 11–12 in 1020;
- Luecke W3–4, Th10–11 in 854;
- Nelson WTh1–2 in 1060;
- Oltman M12–2 in 840;
- Padgett M1–3 in 1060;
- Shankar TuTh 2:30–3:30 in 739;
- Stefanich W9–10, 12–1 in 737;
- Yan M2–3, W3–4 in 747

Prerequisites: Math 1B.

Topics covered:
Basics of linear equations. Matrix algebra. Vectors, vector spaces and Linear transformations. Determinants. Eigenvalues and eigenvectors. Diagonalization. Inner product spaces. Projections. Least squares. Linear ordinary differential equations. Fourier series.

Textbook:
Custom UC Berkeley Edition, combining in a single volume parts of:
David Lay, *Linear Algebra*, 5th ed., and
Nagle, Saff & Snider, *Fundamentals of differential equations and boundary value problems,* 9th ed.

The schedule of lectures, homework assignments and additional reading is found in the syllabus.

HOUSE RULES

Class attendance: Highly recommended; the only way to stay current with the material, which is essential. There is evidence that taking notes in real time helps your understanding. Questions during lecture are welcome: if you think you spot a mistake, cannot read a formula or find a comment difficult to digest, your colleagues may well be grateful to you for raising that. Still, the limitations of

the lecture medium might mean that complex points are better addressed in individual or small group discussion; please do take advantage of office hours.

You may find that you do not follow everything in lecture. This is not unusual, especially upon first exposure to the material. Write things down, working out a personal code to flag things you are unsure about, or which you want to review later. Reading the relevant textbook sections in advance is a great way to improve your uptake in class. Re-read the book after lecture, and refer to it again when doing your homework.

Class behavior: Please display reasonable courtesy to your peers. Late arrivals and early departures, texting, email and other use of social media can be quite distracting for your neighbors.

Section attendance: Mandatory. Your section grade will suffer if you go AWOL.

ASSESSMENT

Homework: Assigned for every lecture; please keep up, as it is essential for following the material, which builds up quite quickly. We are experimenting with electronic submission and assessment. For now, the homework comes in several portions, all assigned for each lecture:

- WebWork, due by midnight on the day of the next class meeting. (WebWork link in the left column).
- A written assignment (gold highlighted problems on the syllabus), due in section every week, normally on Tuesdays. These will be marked based on completion and not reviewed individually
- A thinking assignment (**green problems** on the syllabus), to be discussed in section. Your GSI may call upon you for comments, so do give them some thought before the section meeting.
- Additional recommended problems (**black** on the syllabus), which also serve for exam review. No submission is needed, but you are encouraged to discuss them.

Quizzes: Every Thursday in section (exam weeks excepted).

Exams: In-class, CLOSED book unless otherwise instructed, NO calculators or electronic devices permitted.

- Exam 1, in class, Friday 4 October
- Exam 2, in class, Wednesday 6 November
- Final, Monday 16 December, 8–11am, Location: TBA.

Grading Formula: 40% Homework+Quizzes+Section; 20% each Exam; 40% Final.

The lowest 20% exam component (the Final has two) will be discarded, as will be the two lowest quiz scores. We will assign a letter grade to each item above; these will be averaged into your final grade, weighted as above. (In other words: the exams and section grades are curved separately and there is no final re-curving.)
In borderline cases, we will use the numerical scores to decide the final grade.

Important: **No make-up examinations or quizzes** are offered. PLEASE mark these dates in your diary. Any scheduling issues with the midterms should be discussed with me or with your GSI **no later than Wednesday, September 4**.

If you must miss an exam due to force majeure, we expect advance notice: please tell or e-mail your GSI. The normal solution is that the missed exam will become the one omitted from the formula. If you skip an exam without notice, you can expect the failing grade to be included in your tally.

If you miss the final exam, absent arrangements, you should expect to fail the course.

Cheating on exams results in automatic failure, in addition to other disciplinary action. Plus, it's really really embarrassing for everyone.

Collaboration: You are encouraged to work in groups on the **written** homework problems, but the submission must be your own writing. The online homework (WebWork) must be your own doing.

Discussion sections:

Section	Days/Times	Location	Instructor	Class
201 DIS	TuTh 05:00PM - 06:29PM	Dwinelle 206	Isabelle Shankar	22314
202 DIS	TuTh 08:00AM - 09:29AM	Evans 75	Dong Gyu Lim	22315
203 DIS	TuTh 05:00PM - 06:29PM	Evans 7	Izak Oltman	22413
204 DIS	TuTh 08:00AM - 09:29AM	Dwinelle 251	Kristina Nelson	22414
205 DIS	TuTh 11:00AM - 12:29PM	Hearst Gym 242	Kiran Luecke	22415
206 DIS	TuTh 11:00AM - 12:29PM	Evans 87	German Stefanich	22416
207 DIS	TuTh 09:30AM - 10:59AM	Dwinelle 228	Dong Gyu Lim	22417
208 DIS	TuTh 12:30PM - 01:59PM	Dwinelle 229	Kiran Luecke	22418
209 DIS	TuTh 12:30PM - 01:59PM	Cory 237	German Stefanich	22419
210 DIS	TuTh 03:30PM - 04:59PM	Dwinelle 229	Isabelle Shankar	22420
211 DIS	TuTh 02:00PM - 03:29PM	Evans 70	Adele Padgett	22421
212 DIS	TuTh 03:30PM - 04:59PM	Kroeber 115	Kristina Nelson	24533
213 DIS	TuTh 03:30PM - 04:59PM	Wheeler 220	Xiaohan Yan	22433
214 DIS	TuTh 02:00PM - 03:29PM	Barrows 80	Xiaohan Yan	22434
215 DIS	TuTh 03:30PM - 04:59PM	Evans 736	Adele Padgett	22435
216 DIS	TuTh 06:30PM - 07:59PM	Dwinelle 247	Izak Oltman	22693
217 DIS	TuTh 06:30PM - 07:59PM	Dwinelle 130	Jeffrey Kuan	22694
218 DIS	TuTh 05:00PM - 06:29PM	Evans 87	Jeffrey Kuan	25758

Course Syllabus

Jump to Today

Mathematics 54-2, Fall 2019

Lecture schedule and Homework assignments

Please remember to check this page regularly for changes,
especially before starting your homework assignment!

This version: 16 December

Section numbers for lectures 1–26 refer to Lay; thereafter, to Nagle, Saff&Snider.
The Berkeley edition combines them in a single volume.
The right strategy is to read the sections *before* the lecture, and then consult them again thereafter and as you go through your homework assignment. Additional relevant reading is linked to the relevant lecture.
Some non-examinable topics (starred) may be dropped if we are pressed for time.

Homework assignments are listed with the relevant lecture. Remember:

- There is a WebWork assignment for (almost) every lecture, accessed through the WebWork link
- **Gold highlighted problems** are due in section, on the **Tuesday of the following week**; your GSI will confirm.
- **Green boldface** questions will be discussed in section: think about them ahead of time. (You need not submit answers.) **Similar questions will appear on the tests**, possibly in T/F or Multiple Choice format.
- **Black problems** are optional; no submission is needed, but you are encouraged to discuss them and refer to them for exam review.

	Date	Topic	Book Sections	Homework
1	W28 Aug	Linear systems. Matrices. Row-reduction.	1.1, 1.2; Reading	**1.1**: Odds 3-13, 15; 20, **23**, **24**; **1.2:** 1, 3, 5, 6
2	F30 Aug	Echelon forms. Parametric solution.	1.2	**1.2:** 7, 9,11; **21-24**, 25, 26; **1.3:** 5, 11, 12, **24**; **1.5: 29-32**
3	W4 Sep	Vector and Matrix equations. Parametric vector solution.	1.3 (omit Span for now), 1.4, 1.5	**1.4:** 1, 5, 7, 9, 17, **24**, **31**, **34; 1.5** (postponed)
4	F6 Sep	Span and linear independence.	1.3 (Span), 1.7	**1.5: 9, 10, 14, 23, 24, 29-32**, 36; **1.7:** 1-7, 9, 11, 17, **21**, **22**, 23;
5	M9 Sep	Subspaces of $\mathbf{R}^n$. Basis and dimension. Bases of special subspaces of $\mathbf{R}^n$.	2.8, 2.9, 4.2 (up to Kernel and Range)	**2.8:** Odds 1-11; **2.9:** 3, 5, **15**; **4.2:** 1, 3, 5, 17, 23, **25abdf**
6	W11 Sep	Linear transformations	1.8, 1.9	**1.8:** 1, 3, 9, 11, 17; **1.9:** Odds 1-7, 11, 15, **23**, **24**
7	F13 Sep	Matrix algebra.	2.1	**2.1:** Odds 1-7, 9, **15**, **16**, 17, **23**, **24**, 27; **2.3:** **11**, 21, 24, 30
8	M16 Sep	Invertible matrices and solutions to linear systems	2.2, 2.3	**2.2:** 1, 3, **9**, 11, 21; **2.3:** Odds 3-7, **12**,**13**,**15**, 18;
9	W18 Sep	Abstract vector spaces and subspaces	4.1 , 4.2 (Kernel and Range)	**4.1:** 1, 3, 9, 11,17, **23**, **24**, 27; **4.2:** 7, 9, **25**, **26**, 30
10	F20 Sep	Bases and coordinates	4.3, 4.4 (also review 2.8, 2.9) Reading	**4.3:** 1, 3, 9, 11, 15, **21**, **22**, 32, 33; **4.4:** 3, **15**, **16**, 17
11	M23 Sep	Dimension and rank	4.5, 4.6	**4.5:** Odds 1-7, **19**, **20**, 26, 27; **4.6:** 1, 3, 5, 9, **10-15**, 33
12	W25 Sep	Change of basis and change of coordinates	4.7	**4.7:** 1, 3, 5, 11, 12, 13; Supplementary **1**, 10, 11
13	F27 Sep	Determinants	3.1, 3.2	**3.1:** 1,5, 9, 13, 31; **3.2:** 1, 3, 5, 7, 11, 19, 21, **27**, **28**
14	M30 Sep	Applications: Cramer's rule and volumes	3.3; Reading	**3.2:** 31, **39**; **3.3:** 3, 5, 7, 11, 24, Supplementary **1**
	W2 Oct	Review	Quick review questions	Extra practice problems recommended
	F4 Oct	EXAM #1. In class at the usual time.	midterm1ans	Covers Lectures 1–13

15	M7 Oct	Eigenvalues, eigenvectors. Dynamical systems	5.1; 5.6 Examples 1-4	**5.1:** 1, 3, 9, 11, 17, **21**, **22**;
	W9 Oct	Class cancelled		
	F11 Oct	Class cancelled		
16	M14 Oct	Characteristic equation. Diagonalization	5.2, 5.3	**5.2:** Odds 1-9, 17, **21**, **22** **5.3:** 1, 2, 3, 9, 11, **21**, **22**;
17	W16 Oct	Geometry of Diagonalization	5.4	**5.4:** 1, 3, 9, 17;
18	F18 Oct	Complex eigenvalues and rotations	5.5; **Reading**	**5.5:** Odds 1-5, 7, 9, 11, 13, **23.**
19	M21 Oct	Inner product, length, angles, orthogonality.	6.1, 6.2	**6.1:** 1,5,7,9, 13, 17, **19**, **20**, 22, 24; **6.2:** 3, 9, 17, 21, **23**, **24**;
20	W23 Oct	Projections. Best approximations	6.3	**6.3:** 1, 3, 5, 7, 11, 17, **21**, **22**;
21	F25 Oct	The Gram-Schmidt process. QR factorization*	6.4	**6.4:** Odds 1-9, **17**, **18ab**, 22
22	M28 Oct	Least Squares and Normal equations	6.5, **Lecture** and Recordings **1**, **2** and **3**	**6.5:** 1, 3, 7, 13, **17**, **18**;
23	W30 Oct	Applications of Least Squares	6.6	**6.6:** 1, 3, 5, 7a. **Optional: 6.7:** 1, 3, 5, 7, 13, 19, 22;
24	F1 Nov	Spectral Theorem for Symmetric matrices	7.1	**7.1:** 7, 11, 13, 17, 24, **25**, **26**
	M4 Nov	Review	Chapts. 5,6, 7.1	Supplementary **1**
	W6 Nov	EXAM #2. In class at the usual time.	**midterm2ans**	Covers Lectures 15 — 24
25	F8 Nov	Singular Value Decomposition*	7.4	**7.2:** 3, 5, 9, 19, **21**, 24 **or 7.4:** 1, 3, 5, 7, 9
26	W13 Nov	Introduction. 1st and 2nd order equations. Linearity	4.1, 4.2 **Reading I** **Complex Exp**	**4.2:** Odds 5-15, 26;
27	F15 Nov	Generalities on differential equations	4.3 **Reading II**	**4.3:** 1, 3, 9, 11, 33abc
28	M18 Nov	Method of Undetermined coefficients	4.4, 4.5; **Reading III**	**4.4:** Odds 1-13, 16; **4.5:** 1, 3, 5, 7, **9-15**
29	W20 Nov	First-order linear equations. Reduction of order	**Reading IV&V**	
30	F22 Nov	Variable coefficients. Variation of parameters	4.6, 4.7 after Example 3	**4.6:** 1, 3, 9; **4.7:** 32, 33, 47
31	M25 Nov	Matrix methods for ODEs	9.1 - 9.4	**9.4:** 1, 3, 9, 11, 17, 21, 24, 27
32	M2 Dec	The eigenvector method (constant-coefficients)	9.5, 9.6 **Reading VII&VIII**	**9.5:** 13, 15, 19, 21, 31, 33; **9.6:** 1, 3, 9
33	W4 Dec	Matrix exponential. Inhomogeneous systems	9.8;	**9.7:** 3, 5, 11, 13, 25; **9.8:** 7, 9, 24, 25
34	F6 Dec	Fourier series of periodic functions*	10.3 **Fourier Reading**	**10.3:** 9, 11, 17, 19, 28, 34, 35
	M9 Dec	**Optional:** Fourier series and the heat equation	**Reading** and **more Reading**	
	W11 Dec	No class meeting, ask GSI about review		
	M16 Dec	FINAL EXAM, 8–11am, RSF Field House	**Prep info** **FinalWithKey**	Comprehensive (all the material)

Course Summary:

Date	Details