Math 54 - Linear Algebra And Differential Equations

Instructor: Katrin Wehrheim

Email is not a sustainable form of communication in this course

Contact: via Forum, your GSI, or in person during office hours

Lectures: Tue/Thu 5 - 6:30pm in 155 Dwinelle

Office Hours: Tue 12:30-1:30pm in Evans 907, Tue/Thu 6:30pm-... around lecture hall; with updates here

Participation via Forum, bcourses, and gradescope is crucial for this course.

If you were registered by August 29, you will be added automatically to all these platforms. If you are not yet registered, please join the forum (with an .edu email) and find a section (starting Aug.28) with sufficient space and give your email and SID to your GSI to add you to bcourses/gradescope. (Sorry, the form was getting filled out by far toooooo many registered folks. The real issue was that bcourses wasn't published. It is now.)

CONTENTS

Topics: Basic linear algebra, matrix arithmetic and determinants, vector spaces, eigenvalues and eigenvectors, linear transformations. Linear second-order differential equations; higher-order homogeneous differential equations; linear systems of ordinary differential equations; Fourier series and partial differential equations.

Textbook: Lay, Nagle, Saff and Snider, **Linear Algebra and Differential Equations**, second custom edition

PREREQUISITES / REVIEW

This course will build on a lot of the material from Berkeley's Calculus (1A-1B) sequence. In particular, if you are not comfortable with **complex numbers** and **differential equations** (or your calculus course did not cover much of them), then you should learn/review this material (Stewart, Calculus: Early Transcendentals, 7th Edition, Chapters 9 and 17, Appendix H) before the complex eigenvalues / differential equations parts of the course. A quick review of **series** (Chapter 11) is recommended before we discuss Fourier series.
If you did not take Multivariable Calculus (53), then you should get familiar with **partial derivatives** (Stewart, Multivariable Calculus for UCB, 7th Edition, Chapter 14) before the PDE part of the course. See the syllabus for concrete dates.

PROFESSIONALITY EXPECTATIONS AND COURSE STRUCTURE

If you take this course you are expected to attend lectures, enroll and participate in one of the discussion sections, enroll, participate, and pay attention to announcements in the online forum, and to be committed to learning the material (by e.g. reading the book and working through the practice problems) as well as to checking/demonstrating your learning in the common assignments (quizzes, midterms, final).
In return you can expect your instructors full commitment to supporting your learning - by structuring the material towards main goals, providing constant opportunites to get questions answered (in sections, forum, office hours), and giving you timely feedback on assignments.
To take maximal advantage of what we can offer, you should in particular attend your section meetings regularly and well prepared to follow and contribute to the discussion, by having done the reading, attended lecture, and attempted some practice problems. **Sections will not serve as introductory lectures, but as venues to clarify, deepen, and practice your understanding interactively.** To support you in staying current with the material, there will be no classical homework; instead the course structure is designed to support an active learning rhythm detailed in the forum. It does not mandate active participation in sections but strongly encourages it by daily assignments which directly seed the discussion during sections.
To ensure that this course structure does not conflict with your other commitments, please make sure that you have no obstructions to attending lectures or sections, and check the exam dates on the syllabus before committing to this course. If you need accomodations for exams, please contact the Disabled Students Program before the start of the semester. For more details on course policy and structure see the logistics tab.

COMMUNICATION

If you have a **logistical question**, ask a fellow student, post in the forum (after checking whether this question was already answered), or ask in the discussion section. If you have a **mathematical question**, ask a fellow student, ask in the discussion section, post on the forum (after checking for posts on that topic), or come to office hours. If you have a **personal question or issue**, talk to your section leader (GSI - who may communicate your issue to the head instructor) or the head instructor in person in office hours.

We ask you to refrain from email so we can concentrate our time and energy on helping everyone with mastering the material. For that purpose we will monitor the online forum regularly - in our waking hours. However, since we're not necessarily awake when you are working, and there are a lot more students than instructors, the most efficient use of the forum is for all of you to rather ask "silly" questions or chance a "wrong" answer than to sit back and be confused. Between 500 eager minds, usually the truth will prevail; and if it doesn't, that's important feedback for us and a good learning opportunity.

REGISTRATION LOGISTICS

Anything involving registration, wait list, sections, etc: Sorry, most of this is outside of departmental control. See the forum for updates.

Concurrent Enrollment Program: As long as there is physical space, we will be happy to have you, however we need to wait for UCB registration to settle. So please start attending the lectures, find a discussion section with free seats in the classroom, and see one of our undergraduate advisor staff in the first week to pick up the Concurrent Enrollment form. I will make an announcement on the forum if/once I can start signing these.

Math 49 option: This enrollment option is offered only to resolve administrative issues with unit restrictions. You will still have to take all the quizzes and exams required for Math 54. The reason for this policy is that our syllabus builds its treatment of Differential Equations on the advanced Linear Algebra concepts which are usually not taught in other courses. However, if you can demonstrate to your section leader (GSI) that attending lectures and sections on the linear algebra part will be a waste of your time, then they can allow you to miss all but the quizzes; determining your discussion grade for this part only from the quiz scores.

	date			topic / **work due**	**reading**	suggested practice problems
		lecture	6	solution sets and linear independence	1.5, 1.7	1.5:5,7,13,15 (old book=17),23,25,27,29; 1.7:1,3,11,13,21,23,31,37 (find examples from your major in 1.6, 1.10 - relevant for life but not exams)
W	Sep-18	section		**core problems: 1.5:5&17, 1.5:25, 1.7:1&3**	**Caution: new&old book have different numbers in 1.5:5&17, 1.7:3**	
R	Sep-19	lecture	7	matrices and linear transformations	1.8-9, 2.8 (old book 2.6), 4.2	1.8:5,9,11,13,17,19,21,31; 1.9:1,3,13,23,25,31,35; 2.8 (old book 2.6): 21abce; 4.2:21,25,29; A+level practice 4.2:35,36, and see how kernel/range are examples
F	Sep-20	section		**core problems: 1.8:17&19, 1.9:1&3, 1.9:31**	**UPDATED 9/18; Caution: new&old book have different 1.9:3**	
				Global Climate Strike Sept.20		
				students participating in the climate strike on Friday may submit Friday's assignments in section on Monday		
M	Sep-23	section		**submit 2 problems from lectures 6,7**		
T	Sep-24			**due Tuesday 5pm: take-home quiz on lectures 6-7**		
		lecture	8	matrix operations and inverse	2.1-2	2.1:1,5,7,9,10,23,24,25,26; 2.2:1,5,7,9,13,15,21,23,31; 4.1:21
W	Sep-25	section		**core problems: 2.1:9&10, 2.2:7, 2.1:23&24**	**UPDATED 9/23**	
R	Sep-26	lecture	9	matrix inverse and determinants (in 3.2 and 3.3 we discuss only Theorems 4, 6, 8)	2.3, 3.1-3	2.3:1,3,5,15,17,19,21,35,39; 3.1:1,9,15; 3.2:21,25,29,31; 3.3:11,17
F	Sep-27	section		**core problems: 2.3:1&5, 3.1:1&9, 3.2:25**	**Caution: new&old book often have different numbers in the matrices here**	
M	Sep-30			**submit 2 problems from lectures 8,9**		
T	Oct-1			**due Tuesday 5pm: take-home quiz on lectures 8-9**		Yes, this is a quiz just before the midterm - to optimize this feedback for you, GSI's will have it graded by Wednesday sections!
		lecture	10	basis, dimension, coordinate systems	4.3-5	4.3:3,5,7,20,21,23,29; 4.4:1,5,13,19,21,25; 4.5:3,9,11,20,25,31
W	Oct-2	section		review (no problem submission)		
R	Oct-3	**exam**		**midterm 1 in class on lectures 1-9 (not 10)**		
F	Oct-4	section		debrief of midterm (no problem submission)		
review the 1B material on complex numbers before Oct.10					part III App.B	also Stewart, Calculus: App.H
M	Oct-7	section		**core problems (for L10): 4.3:19, 4.4:13, 4.5:9**	**updated 10/1**	
T	Oct-8	lecture	11	rank; change of basis (we skip 4.6 so won't discuss row space)	2.9 (old book 2.7), 4.7	2.9 (old book 2.7):1,5,7,11,15,21,23; 4.7:1,3,5,7,11,13,15 (in old book, problems are misnumbered - we want both problems 7)
W	Oct-9			POWER OUTAGE - sections canceled		
R	Oct-10	lecture		POWER OUTAGE - lecture canceled		

	date			topic / **work due**	**reading**	suggested practice problems
F	Oct-11	section		POWER OUTAGE - sections canceled		
review the 1B material on differential equations before Oct.17						Stewart, Calculus: Ch.9, Ch.17
M	Oct-14	section		**submit 1 problem from lecture 10 and one attempt at lecture 11 core problems: 2.9:7, 2.9:23, 4.7:13**		
T	Oct-15			**due Tuesday 5pm: take-home quiz on lecture 10**		
		lecture	12	eigenvectors, eigenvalues	5.1, 5.2, 5.4	5.1:1,3,7,9,15,17,21,25,31,35; 5.2:1,7,9,18,19,24; 5.4:3,5,9,11
W	Oct-16	section		**core problems: 5.1:7, 5.2:9, 5.4:5**		
R	Oct-17	lecture	13	applications of eigenvectors	5.3-5	5.3:1,5,7,9,15,21,23,27; 5.4:13,17,23,27,29; 5.5:1,7,13,21,26
F	Oct-18	section		**core problems: 5.3:7, 5.4:17, 5.5:13**		
				!!! deadline for accomodations on 2nd midterm is Oct 24 !!!		
M	Oct-21	section		**submit one problem each from lectures 11,12,13**		
T	Oct-22			**due Tuesday 5pm: take-home quiz on lectures 11-13**		
		lecture	14	complex exponentials and second order ODEs	part II, 4.1-3	4.1:2,3,4; 4.2:7,9,13,15,19,21,26,27,29,35; 4.3:1,5,11,23,25,31
W	Oct-23	section		**core problems: 4.1:2, 4.2:15, 4.3:5**	**!!! in second part of book !!!**	
R	Oct-24	lecture	15	nonhomogeneous ODEs and superposition	part II, 4.4-6	4.4:1,3,7,9,17,27,31; 4.5:1,3,7,17,21,25,29,31; 4.6: 1,7,9,17,20 (interesting applications: 4.5: 41-45 - relevant for life but not exams)
F	Oct-25	section		**core problems: 4.2:35a-c, 4.4:9, 4.5:21**	**updated 10/29** .. sorry for the core problem typo! Also feel free to defer problems in 4.6 that can only be done with variation of parameters ... or just try out the formula on them. Many will be doable with undetermined coefficients though.	
	canceled lecture:		16	higher order linear ODEs	part II, 6.1-2	6.1: 1,3,9,11,17,19,23,25,26,27,31; 6.2:5,9,11,13,17,21,25,33 (in 6.1#27 ignore the hint and use Wronskian instead)
M	Oct-28			POWER OUTAGE - sections canceled		
T	Oct-29	lecture	16	review/preview		problems on linear (in)dependence of functions: Lay 4.3:33,34; Nagle 4.2: 27-36,42
W	Oct-30	section		**submit 2 problems from lectures 14,15**		
				due THURSDAY 5pm: take-home quiz on lectures 14-15		
R	Oct-31	lecture	17	systems of ODEs	part II, 9.1-4	9.1:3,7,11; 9.3:15,17,31,35,37,39; 9.4:3,7,11,19,25,27,31
F	Nov-1	section		**core problems: 9.1:1&9.4:7, 9.3:35&37, 9.4:19**	**UPDATED 10/30**	
review the 53/1B material on partial derivatives and series before this week						Stewart, Multivariable Calculus, Ch 14; Stewart, Calculus, Ch.11

	date			topic / **work due**	**reading**	suggested practice problems
M	Nov-4	section		**submit 2 problems: one from lecture 17, and as 'writeup for lecture 16' submit any book/exam problem on linear independence of functions (see list at lecture 16 and further problems in 9.4)**		
T	Nov-5			**due Tuesday 5pm: take-home quiz on lectures 17 and linear independence of functions (see 'review/preview' lecture 16)**		
		lecture	18	homogeneous linear ODE systems	part II, 9.5-6	9.5:11,15,17,19,23,25,31,33,35,37,41; 9.6:1,3,5,7,13,15,19 (applications: 9.5: 45,50, 9.6:21 - relevant for life but not exams)
W	Nov-6	section		**core problems: 9.5:11, 9.5:31, 9.6:3**		
R	Nov-7	lecture	19	nonhomogeneous systems, matrix exponential	part II, 9.7-8	9.4:23,29; 9.7:1,3,5,7,13,15,21,25,31; 9.8:1,3,5,7,9,23,25,26
F	Nov-8	section		**core problems: 9.4:29, 9.7:5, 9.8:3&23**		
				!!! online review session on lectures 18&19 / towards midterm: Please Use Campuswire!!!		
M	Nov-11			*HOLIDAY*		
T	Nov-12			**due Tuesday 5pm: take-home quiz on lectures 18-19**		
		lecture	20	PDEs, separation of variables	part II, 10.1-2	10.2:1,3,5,9,11,15,19,23,24,25,26,27,29,31,33
W	Nov-13	section		**submit 2 problems from lecture 18-19**		
R	Nov-14	**exam**		**midterm 2 in class on lectures 10-19 (not 20)**		
F	Nov-15	section		debrief of midterm (no problem submission)		
M	Nov-18	section		**core problems (for L20):**		
T	Nov-19	lecture	21	inner product spaces, function spaces	**part I,** 6.1-3, 6.7	6.1:1,9,15,17,19,29; 6.2:7,9; 6.7:21,23; 6.8:5,6,7; 6.3:3,11,13
W	Nov-20	section		**core problems: 6.2:9, 6.7:21&23, 6.8:5&7**	**!!! back in first part of book !!!**	
R	Nov-21	lecture	22	orthogonal projections and Fourier series	**part I,** 6.8 **part II**, 10.3-4	part I 6.8:9,11,13; part II 10.3:9,11,13,17,19,25,35,36,37; 10.4: 5,7,11,15 (compare #13 and #25 in 10.3)
F	Nov-22	section		**core problems: 6.8:11, 10.3:9&17, 10.4:15**		
				!!! deadline for accomodations on final is Nov.26 !!!		
M	Nov-25	section		**submit 3 problems from lectures 20,21,22**		
T	Nov-26			**due Tuesday 5pm: take-home quiz on lectures 20-22**		
		lecture	23	Heat and Wave equation (skip existence and uniqueness; d'Alembert method deferred to L24)	part II, 10.5-6	10.4: 17,19; 10.5: 1,3,7,13,15,17; 10.6: 1,5,7,9,19
W	Nov-27			HOLIDAY		

	date			topic / **work due**	**reading**	suggested practice problems
R	Nov-28			HOLIDAY		
F	Nov-29			HOLIDAY		
M	Dec-2	section		**core problems (for L23): 10.4:14, 10.5:3, 10.6:1**		
T	Dec-3	lecture	24	d'Alembert method, Laplace equation (skip maximum principles, existence, uniqueness. 3dim Laplace, Bessel functions)	part II, 10.6-7	10.6: 13,15,17; 10.7: 1,3,5,7,11,15,17
W	Dec-4	section		**submit 2 problems from lecture 23 (one can be from lecture 24 if you wish)**		
R	Dec-5			**due THURSDAY 5pm: take-home quiz on lectures 22-23**		
		lecture	P	more on differential equations ... possibly filling in higher order ODEs from lecture 16 (not exam relevant)		
F	Dec-6	section		**core problems (for L24): 10.6:17, 10.7:1, 10.7:11**		
M	Dec-9	section		review		optional quiz on lectures 24,P (no submission, not graded)
T	Dec-10	lecture		review: linearity concepts		
W	Dec-11	section		review		
R	Dec-12	lecture		review: Ansatz strategies		
F	Dec-13	section		review		
M						
T						
W						
R	Dec-19	**exam**		**final exam on lectures 1-24 TIME: 11:30–2:30 pm**		**LOCATION: TBA**
F						