

MATH54-002, LINEAR ALGEBRA & DIFFERENTIAL EQUATIONS

4 units, Spring 2021

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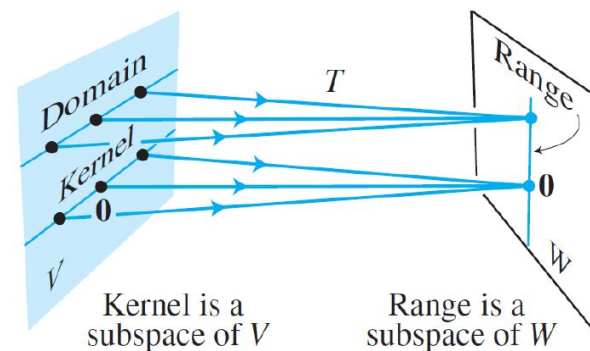
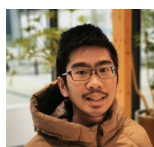
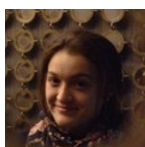
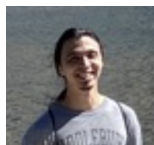
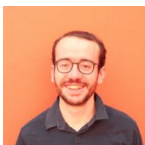
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recent updates are highlighted

Quick Links: [Zoom for Tue/Thu 8-9:30](#) [Drop-In space](#) [public MATH54 folder](#) [campuswire forum](#) [FAQ](#)
[Semester-Calendar of Topics and Deliverables](#) [GSI contacts & office hours](#) (and zoom links for open sections)

OBJECTIVES & COURSE DESCRIPTION

The problem solving skills trained in Linear Algebra and Differential Equations have not changed in centuries. This has been used as an argument for not revising the pedagogy either. The current pandemic, however, has forced a change in teaching medium, and the [#BlackLivesMatter](#) movement has made [anti-racism pedagogy](#) a broadly accepted goal at UC Berkeley. So this iteration of MATH54 will be a first approximation of what an online MATH54 course might look like when we take

Black lives matter!

The Mathematics Department stands against white supremacy, racism, and discrimination in all of its forms.

as a mandate to implement anti-racist pedagogy - which starts with basic insights from Education Research, such as “Teaching is about students learning”.

So we will cover [the usual MATH54 topics](#), but more specific learning objectives will be developed with your help - as part of a [Community of Inquiry](#) - and the following structure is a proposal that the teaching team will offer for 4 weeks (based on a proposal of objectives that I’ll present in class). I am asking you to give it a serious try, as it is based on 25 years of experience with guiding engineering and science students in their struggle with differential equations and linear algebra, 4 years of intense anti-racism activism and education, and a deep desire to create an online-space that is as supportive as can be of both your learning and general thriving as human. But I also invite you to step into your power as expert for your own learning capacity and needs - and to join me and the rest of the teaching team (the GSIs and [Branden Saenz from the SLC](#)) in co-creating this space and improving on the first approximation of a 21st century online MATH54 structure in the rest of this document.

If this document leaves questions open, see the [FAQ](#), ask on [campuswire](#), during our Tuesday Q&A, or in office hours. (Sorry, email is not a sustainable form of communication with 500 students.)

Prof. Katrin

PS: In more concrete terms, everything in this syllabus is negotiable - not on an individual basis, but towards a fair and supportive learning environment for all. We will collect ongoing feedback - in person, via forum, or via [this form \(that can be anonymous\)](#), and also open an intentional dialogue once the semester is under way.

If you do not have the wish or bandwidth to contribute to developing this structure, I commit to providing a stable learning environment such that - if you do the work and ask for help - you will succeed with both your learning and grade goals.

ACCESSIBILITY and ACCOMMODATIONS

We strive to apply the framework of [Universal Design for Learning \(UDL\)](#), and acknowledge that this is a steep learning curve for our teaching team. So we encourage you to speak up about your needs in each moment as much as possible, as well as **give us feedback throughout the semester** - in person, via forum, or via [this form \(that can be anonymous\)](#).

To accommodate needs related to COVID-19, disability, family-emergencies, and the many forms of oppression - while our teaching team is ill equipped to judge the ever growing number and complexity of requests - **we offer all students 20% “no questions asked” excuses** on each type of deliverable by dropping the 20% lowest scores (5 check-ins, 3 discussions, 3 quizzes). **This allowance covers all absences for any reason - including adding the course late. If you have used those up (and no earlier than that)** and require further accommodations, **you can request two more 7.5% excuses (2 check-ins, 1 discussion, 1 quiz) by filling out [this form](#) or speaking to your GSI or Prof.Katrin.**

We cannot offer make-ups after solutions have been discussed publicly, due to considerations of fairness and workload. However, your GSIs are available to provide ungraded feedback on late submissions.

If you want to pursue the course despite missing over 35% deliverables, please contact your GSI as soon as this situation is foreseeable. We would need written evidence of your exceptional circumstances (e.g. a doctor's note that explicitly excuses the missed deliverables beyond the initial 20% - listed with dates). In such cases deliverables will usually be made up for by oral exams or using the score of the final exam.

The [Student Learning Center \(SLC\)](#) offers highly recommended [adjunct courses](#) and drop-in tutoring for this particular course. It also offers general [online study and success strategies](#) and [individual appointments for students experiencing academic difficulty](#).

The [Disabled Students' Program \(DSP\)](#) also provides access to a variety of services.

If you or someone you know is experiencing **financial, food, housing or other basic needs challenges - you can find support & services at tinyurl.com/UCB-BNC-C19.**

SCHEDULE - calendar, zoom links, office hours, course materials, etc

Here is the **scaffolding** that we will provide to support you in constructing your own understanding of [the usual MATH54 topics](#), along with a suggested schedule of discovery-work, and some **deliverables** to support your focus¹.

Including dates and topics, this is summarized in the **Semester-Calendar of Topics and Deliverables**.

All times are PST and already include the 10min shifts of BST (Berkeley Standard Time).

Thursday 8:40-9:30am	<u>Executive Summary Lecture</u>
	Take 3*(15-30)min to work on each Block 1-3 of the <u>weekly WorkScript</u>
Friday 2h before your GSIs first section [the general due time is forced by gradescope - 3h before your section is safe]	<u>Check-In on gradescope</u>
Friday sections	<u>Group work on Blocks 1-3</u>
	Take 3*(15-30)min to work on each Block 4-6 of the WorkScript
Monday 2h before your GSIs first section [the general due time is forced by gradescope - 3h before your section is safe]	<u>Check-In on gradescope</u>
Monday sections	<u>Group work on Blocks 4-6</u>
Tuesday 8:10-9:30am	<u>Q&A activities</u>
Wednesday sections	<u>Review Jigsaw for Blocks 1-6.</u> If you have not yet contributed in sections, you may volunteer for discussion and presentation of one of the Block Reviews to satisfy the <u>weekly discussion contribution deliverable</u> .
sometime Wed 7pm - Thu 8:40am ²	<u>30min Quiz on gradescope</u>

¹ The need for regular serious deliverables has been one of the main changes suggested by prior students. One reason is that other coursework and life at large are likely to fill up any time vacuum, so these deliverables intend to defend your math learning time - while directly supporting learning. If - after a serious trial - they do not support your learning style, you may propose a plan for alternative deliverables by speaking to your GSI or Prof.Katrin.

² The suggested quiz time is Thursday 8-8:30am. During that time, answers to technical questions about the quiz will be available on the lecture zoom. Posts on campuswire are not allowed while the quiz is open. Please respect your fellow students' need for fairness and integrity.

Zoom links

Tue/Thu 7:30-10am (office hour and lecture/Q&A): <https://berkeley.zoom.us/j/91076888392>

Drop-In space: <https://berkeley.zoom.us/j/91489341894> (zoom can be used any time; GSI presence will be announced)

Recordings

Each Fri/Mon, we will share a recording of **an instructor walking through their way of filling out the WorkScript**.

Thu lecture, Tue Q&A: We hope to record but cannot guarantee timely posting due to technical issues outside of our control.

Fri/Mon sections: no recording. (The instructor's WorkScript recording is intended as review material if you miss a section.)

Wed sections: may be recorded if live section participants decide to do so. (Otherwise see instructor's WorkScript recording.)

Drop-In and Office Hours

To further support your discovery-work, you can use the **[Collaboration, Tutoring, and Office Hour Drop-In space](#)** at any time (except for weekdays 8-10am PST when the zoom setup switches) to collaborate with other students, find tutors, or join office hours.

For starters, watch out for an email about scheduling **small group meetings with your GSI in the first week**. **You can score the week 0 discussion contribution point by attending one!**

Prof.Katrin's office hours will be before/after lecture times as [announced on campuswire](#), and in the [Drop-In space](#) as per (weekly varying) schedule.

Course Materials

This course aims to support you in **writing your own textbook by working through [weekly WorkScripts](#)**.

All scripts, solutions, and other course materials/information will be posted in the [public MATH54 folder](#) and/or the [campuswire forum](#).

So, unless/until we collectively decide to deviate from the WorkScript model, the [Lay-Nagle textbook](#) will not be referred to - for content or exercises. If you would find a traditional text helpful, the [Schedule of Topics and Deliverables](#) lists

corresponding sections in this book. These may not always match with the content and learning goals as laid out in the WorkScripts, so please only use them as supplementary material.

IF we do (collectively decide to go back and) use the Lay-Nagle textbook, your teaching team will make sure that no particular edition is required.

The linear algebra parts on our topic list are also covered well in the (free!) [Linear Algebra textbook and online resource written by David Cherney, Tom Denton, Rohit Thomas and Andrew Waldron](#). However, the mathematical sophistication in that book sometimes goes quite a bit beyond what's realistic for MATH54.

Lectures

The intention of this scaffolding is to replace the traditional lecture format - which in MATH54, due to the abstraction and density of materials, has rarely done much more than create confusion ... layered upon confusion ... in 80min blocks.

If, however, you would find traditional lectures helpful, you can find a list of suggested lecture recordings in the [Schedule of Topics and Deliverables](#). These may not always match with the content and learning goals as laid out in the WorkScripts, so please only use them as supplementary material.

GRADING MATTERS:

We commit to providing a stable learning environment such that - if you have the prerequisite skills, do the suggested work, and ask for help as needed - you will succeed with both learning and grade goals.

Prerequisites

This course builds on a lot of the material from Berkeley's Calculus (1A-1B) sequence. In particular, if you are not comfortable with complex numbers and 2nd order ordinary differential equations (Stewart, Calculus: Early Transcendentals, 7th Edition, Chapters 9 and 17, Appendix H), expect to need extra time and help with [WorkScript 1](#) at the beginning of the course. Complex exponentials will also be used when discussing eigenvalues and ODE systems in Weeks 9 and 10, so they are worth paying special attention to (besides just being cool ;-) ... and asking for help if they are new to you! A quick review of series (Chapter 11) is recommended before we discuss Fourier series in Week 11.

Deliverables and Proposal for Grade Computations

The deliverables are structured to support your learning.³ Since UC Berkeley requires a letter grade, here is a proposal for determining those from the work that you will hopefully do anyways, “just” to learn. Though we also suspect - given all the other pressures in your life - that grade computations support you in doing the regular work required to learn all this material. This very much is up for collective discussion - just not individual re-negotiation. To give you a stable base, we commit to not making any of the computations less favourable than what is proposed here.

Check-Ins: We will have 2 check-ins for each of 13 topics (except for topic 4 due to a holiday), a special 0-th check-in, and a check-out. We propose to count these as 0/1 with no extensions (as the point is to prepare yourself and your GSI for section), but allowing for 20% no-questions-asked excuses (for 5 check-ins), and further 15% excuses (for up to 4 check-ins) via [this form](#). So you would score 100% for completing 22 of the 27 check-ins (or possibly just 18/20 with reasoned excuses).

The structure of these Check-Ins has been developed over several iterations of MATH54, and - together with a section structure of group work on uniform problems across all sections - seems to work much better (even in terms of exam scores) than a weekly list of graded homework problems (often copied late at night or while the lecture is talking about the next

³ If - after a serious trial - these deliverables do not support your learning style, we may collectively adjust them. Or if it's more of an individual need, you may propose a plan for alternative deliverables by speaking to your GSI or Prof.Katrin.

subject, and barely graded for completion by overworked GSIs). Online submission makes this an even more effective tool to guide GSIs in preparing for sections. And we are always open to improving this structure further!

Discussion Contributions: The purpose of this deliverable is to encourage *everyone* to make constructive contributions to the section discussions. In particular, questions or verbalizing a confusion are immensely constructive.

We propose to count this deliverable as 0/1 over the course of each of the 14 weeks. In the 0-th half week, before we get into topic 1, we hope you will complete this deliverable by joining a small group meeting with your GSI (if not in this first week, then at some point soon). In the next weeks (Thu-Wed), we will start counting (on [bcourses](#)) a 1 for one or another of

- verbal discussion contributions on Friday or Monday (if that's inaccessible then writing in realtime - chat or google doc)
- facilitating the discussion and presenting one of the Block reviews on Wednesday (when, for each of Block 1-6 of the WorkScript, a small group will compile an executive summary to present to the whole section).

Using our general excuse policy, you would score 100% for completing 11 of the 14 discussion contributions (or possibly just 9/10 with reasoned excuses).

This, in particular, is a deliverable whose counting we would like to get feedback on: How do we formalize the counting such that we encourage constructive participation in discussion sections, rather than artificial attendance to tick a box?

Quizzes: We will have a first survey quiz 0, and one quiz for each of 13 topics with 2 problems for which you'll get feedback 0/1/2 for "review material from scratch"/"reasonable start"/"essentially complete". See below for re-takes and late submissions. This makes for 14 scores of 0-4. Following our excuse policy, we propose to count the highest 11 of these 14 quiz scores (or 9/10 with reasoned excuses).

Based on proposed learning objectives of conceptual understanding and general problem solving strategies (rather than rogue problem solving by symbol manipulation), the quiz problems will ask for solutions *with explanation*. Our preliminary grading criterion for "good explanation" is that, after erasing specifics of your computations, the explanations and overall structure would empower a fellow student who missed all the reading and work in this Block to do the computations themselves - and understand what's going on.

This, in particular, is a criterion where we will need a feedback loop to see how GSIs interpret the criterion and then adjust it to the ways in which explaining and understanding is working for you in reality. Also, aside from grading criteria: What are the characteristics of a good explanation for you?

Quiz-Retakes and late submissions: After the initial grading (usually by Monday night), you can change your submission (or submit a late submission) as often as you need to - until you are convinced that it is correct and well explained. Your GSI will grade it only after the final re-submission deadline (2 weeks after the original deadline). They will only re-grade parts that had 0 or 1 points. The goal is for you to get 2 points - if you do the work. It's okay to look at the solutions and get help from other humans, office hours, campuswire, etc. It's not okay to then submit a copy of the solutions or someone else's work. You should understand the solution - and then submit your own thinking and words.

Exams: We see little utility in midterm exams - other than to force engagement with the material, which we believe is better achieved by weekly quizzes with less high stakes. We do have a Final Exam scheduled for Thursday, May 13, 7-10pm PST. We commit to designing this - with your input - not as feedback (whom are we kidding) but so it can be A-ed by "simply" having understood the core principles of 80% of our material. We also commit to allowing any materials that you wrote yourself - for example, by editing and compiling the WorkScripts.

This is another area where we particularly hope for feedback once you have seen what your learning outcomes are. How do you imagine this much more conceptual learning to be measured fairly? What preventative measures would you like us to take (or not) to discourage cheating?

We do not (yet?!) have good ideas for offering a fair exam at different times - setting different versions is never fair (and an unreasonable amount of work if done well), nor is the cheating potential for the later time. We are open to reasoned proposals for an unsupervised final. But - unless there is a collective decision otherwise - please ensure that you are available for the final exam at the scheduled time.

Final Exam UPDATE: We collectively decided to have an essay-style final (see discussion in lecture 4). This will heavily draw on your work with the WorkScripts and - of course - ask for math content. It's not an english writing test! There will be a sample assignment and grading rubric by spring break (the latest). The actual essay options will be published on April 22, and are due by 10pm PST on May 13.

Letter Grades: We propose to compute a total score by 20% Check-Ins, 20% Discussions, 30% Quizzes, 30% Final Exam, that is (assuming no extra excuses, and replacing any quotient >1 by 1)

$$S = 20 \cdot \frac{\#check-ins}{22} + 20 \cdot \frac{\#discussions}{11} + 30 \cdot \frac{sum\ of\ 11\ highest\ quiz\ scores}{44} + 0.3 \cdot final\ score\ (on\ scale\ of\ 0 - 100)$$

and then determining letter grades as

A+ for $S \geq 95$, A for $95 > S \geq 90$, A- for $90 > S \geq 85$, B+ for $85 > S \geq 80$, B for $80 > S \geq 75$, B- for $75 > S \geq 70$,

C+ for $70 > S \geq 65$, C for $65 > S \geq 60$, C- for $60 > S \geq 55$, D for $55 > S \geq 40$, F for $40 > S$.

Implications are, for example, that you can pass this class by doing regular check-ins, contributing to discussions, filling out the entry survey quiz 0 (for 4 points), and finding a reasonable start for each quiz problem in 9 of 13 weeks. Or you can skip all the check-ins and discussions and “just” get full scores on quizzes and final exam.

You can score a B- by doing all the suggested work in check-ins, discussions, quizzes (replacing lower scores by revisions), no matter your final exam. We suspect that if you do all that work, you’ll also do quite well on the final exam, but if you don’t want to take it you could be done after week 11.

And to score an A- you would, for example, need this complete work and a score of 50 on the final exam.

Incomplete grades

These can, according to [university policy](#), only be given if you have “completed and passed a majority of the work required” (that is more than half of the deliverables) before unanticipated events beyond your control make it impossible for you to complete the course. In such cases, contact your GSI or Prof.Katrin as soon as possible after the events, and arrange for written evidence to be sent to us.

To make up an incomplete, one ordinarily takes the missed assignments in another Math 54 class, taught by a different instructor, in the subsequent summer or regular semester. Prof.Katrin will be teaching Math 54 again in Fall 2021. For other courses, be advised that grading policies and specific contents may be quite different than in this course.

Even with the same policies and contents, this process almost always causes a lot more suffering than one hopes - from grade pressure via the makeup work not counting as units, to underestimating the amount of work, or how much one forgets in a few months. So, while claiming this grade option is relatively simple, our advice is to use it only in extreme circumstances - essentially, when you just have no other choice.

ACADEMIC INTEGRITY, PRINCIPLES OF COMMUNITY, and BACK CHANNELS

Please review the campus-wide commitments to [Academic Integrity](#) and [Principles of Community](#); in particular:

We affirm the dignity of all individuals and strive to uphold a just community in which discrimination and hate are not tolerated. In fact, instead of focussing on the fine line of “appropriate behavior”, we invite every member of this course community to strive for their actions in all contexts to be genuinely respectful and supportive rather than merely appropriate.

We embrace open and equitable access to opportunities for learning and development as our obligation and goal. In fact, we are only too aware of many undue stressors on you, as a student and multifaceted human, in these times at UC Berkeley, and are committed to supporting you with overcoming any unfair obstacles. In order for us to provide support in an equitable manner, we ask you to let us - or [another source of support](#) or [crisis counseling](#) - know about your distress as soon as possible.

In our experience, cheating is almost always caused by unaddressed stress, and expectations to “get away with it” can be conditioned by relatively privileged circumstances. This is why asking for support is part of our grading scheme - via the discussion contributions deliverable. If cases of cheating come to the attention of the teaching team, we will ask the course community to guide our response in the spirit of [transformative justice](#), as the main problem caused by cheating is a potential unfairness in the grade distribution.

SLACK, DISCORD AND OTHER BACK CHANNELS

Back channels come with both benefits and dangers. Building community away from supervision by the teaching team, and getting advice from each other is great, but back channel gossip can lead to beliefs that clearly contradict the syllabus or mathematical facts - in short “fake news.” So please discuss matters of course policy and contents in the [official campuswire forum](#), or at least check facts there before you believe them. Our teaching team monitors this forum regularly and will strive to clear up or flag any confusions within 12hours.

We also urge you to apply the same integrity and principles of community to your communication in back channels as you would in the classroom or official online forum. For equitable access, please make sure that invitations to any back channel that you find helpful are shared with the rest of the class - e.g. as community announcement on campuswire.