Physics 89 - Fall 2023

Mathematical Methods in Physics

Course Instructor: Ori Ganor

GSIs: Krish Desai and Yue Wang

Welcome to Physics 89!

Over the next 15 weeks, we'll cover mathematical concepts and techniques that will be helpful in upper division courses such as Analytical Mechanics, Electromagnetism, Quantum Mechanics, Statistical and Thermal Physicsm and beyond. We'll start with **Taylor series**, and continue to **complex numbers** and **functions of a complex variable**. We'll then talk about **vectors** and **tensors**. The next topic will be **linear algebra**, starting with the notion of a vector. We will cover the definition and properties of matrices, determinants, eigenvalues, vector spaces and **Hilbert spaces**, and how to apply a function to a matrix – this will be most useful in Quantum Mechanics. The theory of **groups** and their representations, with an emphasis on the group of rotations and applications to the mechanics of solid objects will follow. The first half of the course will end with **Fourier series** and the **Fourier transform.** We will spend most of the second half on **differential equations** (ordinary differential equations, followed by partial differential equations). Differential equations are ubiquitous in physics, and we will cover a variety of techniques for solving the most common ones.

(A complete lecture-by-lecture schedule can be found on bCourses.)

Our discussion will be mostly mathematical, but interspersed with physical applications. In the exams, you'll only be asked about the math component of the course.

Class attendance, start time, and participation

Attendance is not required, and recording of the TuTh Lectures will be available via CourseCapture on bCourses's **Media Gallery.**

Classes start on "**Berkeley Time**" (10 minutes after the formal time).

Lectures start at 12:40pm. Wednesday discussions start at 12:10pm, and Thursday discussions start at 4:10pm.

See classes.berkeley.edu/content/2023-fall-physics-89-001-lec-001 for locations.

We encourage participation in the lively conversations we intend to have during Discussions and Lectures. Participation is not part of the grade, and we understand that voicing ideas in a large class might not always feel comfortable. Nevertheless, we strive for a friendly atmosphere, and if you don't feel at ease joining the conversations, please let us know what we can do to make it easier.

Websites

Main course website is on **bCourses.Berkeley.Edu**

Ed Discussion site can be reached through **bCourses**.

Textbook

Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd Ed., 2006, Wiley & Sons.

https://search.library.berkeley.edu/permalink/01UCS_BER/s4lks2/cdi_askewsholts_vlebooks_9781118048887

Grade formula

Final grade = 20% Homework + Max(40% Midterm +40% Final Exam, 80% Final Exam).

The final grade will be calculated as the **maximum** of the following four different weighted averages of homework, midterm exam, and final exam:

	Homework	**Midterm**	**Final**
Weighted Average 1	20%	40%	40%
Weighted Average 2	20%	0%	80%
Weighted Average 3	0%	50%	50%
Weighted Average 4	0%	0%	100%

While homework problems and classroom examples will include both math and physics applications, all exam questions will be about the **math** only (not the physics).

Midterm exam

Midterm on **Thursday**, October 12, 12:40-2pm (instead of the usual lecture) will cover material up to and including October 5.

The midterm exam will be Closed Book, and a formula sheet will be provided. Please bring your own blank sheets (doesn't have to be a "blue book").

Assuming the current mode of instruction does not change, the midterm exam will have 3 problems, 2 of which taken out of the homework assignments, perhaps slightly modified. *However, If unforeseen circumstances forces us to hold the midterm exam remotely, the problems will not be taken out of the homework.*

Final exam

The final exam is on **Friday**, December 15, 8-11 am.

The final exam will be again Closed Book, and a formula sheet will be provided. Please bring your own blank sheets (doesn't have to be a "blue book").

Assuming the current mode of instruction does not change, the final exam will have 6 problems, 4 of which taken out of the homework assignments, perhaps somewhat modified. *However, if unforeseen circumstances forces us to hold the final exam remotely, the problems will not be taken out of the homework.*

Time conflicts with exams

If you expect to have a time conflict for the midterm (Oct 12) or final exam (Dec 15), please notify us by email by the end of the third week of the semester (September 8), so we can try to make arrangements for a makeup exam. If an unforeseen conflict arises later, please notify us as soon as possible.

Homework policy

Homework is due before **6pm** on the **Friday** of each week.

There are 12 problem sets and you are required to turn in **at least 10**.

The problem sets will be available on **Gradescope**. The first problem set is due on Sept. 8.

Late homework penalty

Grades of homework late by N days will be multiplied by a factor of $\mathbf{0.9^N}$.

Please plan to submit the homework at least an hour before the deadline, since any homework submitted at 6pm or after will count as **one day late**.

The 0.9^N factor can be waived at the discretion of the instructors if an issue beyond your control prevented you from turning in the homework on time. If it is a medical problem, you won't need to go into any details, but you may be asked to provide documentation, such as a letter from a physician attesting that a medical issue prevented you from submitting the homework.

Travel (including for conferences) is generally not an acceptable reason for a waived 0.9^N factor, unless it is for an emergency.

Contact information

Please feel free to contact us with any questions, concerns, or suggestions you may have.

(Please include [Physics 89] in the subject. See Emails below.)

Krish Desai **[krish.desai@berkeley.edu]** Pronouns: he/him OH: To be announced Location or Zoom link: To be announced Location:	Yue Wang **[yue_wang@berkeley.edu]** Pronouns: she/her OH: To be announced Location or Zoom link: To be announced
Ori Ganor **[ganor@berkeley.edu]** Pronouns: he/him OH: Wed 11am-1pm Zoom links are on bCourses/Zoom	

Accommodation for disability

Please talk to the instructor (Ori) in private to let us know how we can make the class and course materials more accessible. (Please see below about DSP accommodations.)

Extra time accommodations can only be given with a DSP accommodation letter. If you expect to be eligible for DSP accommodations, please see the DSP office (see below) as soon as possible, since the letters take time to issue.

Links to University Services

- Academic Calendar and Student Accommodations - Campus Policies and Guidelines: **http://teaching.berkeley.edu/academic-calendar-and-student-accommodations-campus-policies-and-guidelines**

Should an exam or deadline fall on a cultural or religious holiday, and you wish to seek an accommodation, please email the instructor (Ori) with your name, with ample advance notice.

- Services for students with disabilities: **http://dsp.berkeley.edu**

DSP serves currently enrolled UC Berkeley students with documented disabilities seeking undergraduate and graduate degrees. If you have a disability, or think you may have a disability, you can work with DSP to request an official accommodation. DSP is located at 260 César Chávez Student Center. Students may call 642-0518 (voice), 642-6376 (TTY), or e-mail dsp@berkelely.edu.

- Tang Center: Counseling and Psychological Services **https://uhs.berkeley.edu/counseling** CPS offers short term counseling for academic, career and personal issues. There is no charge to get started, and all registered students can access services regardless of their insurance plan.

- Path to Care **http://sa.berkeley.edu/dean/confidential-care-advocate**

The PATH to Care Center provides affirming, empowering, and confidential support for survivors and those who have experienced gendered violence, including: sexual harassment, dating and intimate partner violence, sexual assault, stalking, and sexual exploitation. Confidential advocates bring a non-judgmental, caring approach to exploring all options, rights, and resources.

- Student Wellness Resources **https://wellness.asuc.org**

A partial directory outlining campus services that may prove useful throughout a student's time, ranging from direct academic assistance to student health and wellness resources.

- The Basic Needs Center **https://basicneeds.berkeley.edu**

provides support with all the essential resources (food, housing, etc.) needed to not only survive, but thrive here at UC Berkeley.

- Suggestions or comments about your courses, the department or your instructors can also be submitted anonymously via the Climate Feedback Form of the physics departments' DE&I website. **https://physics.berkeley.edu/equity-inclusion/climate-feedback**

Commitment to Equity and Inclusion

All individuals in the Department of Physics have the right to work and learn together in an environment free of harassment, exploitation, or intimidation. We seek to establish a classroom culture that nurtures the physics identity and remove barriers to entry in order to strengthen pathways into the field. Setting students on a path to envision themselves with a degree in physics and related STEM fields in greater numbers ensures more diverse graduating classes, more diverse graduate programs, and in turn has the potential to inspire a new generation of physicists. We strive to ensure these ideals are the core of our culture.

Exams and assignments in this course are a diagnostic of your current skill levels, which can be improved with practice, and are not a measure of permanent ability. As a participant in this class, you can be proactive about making other students feel included and respected. We encourage you to approach your instructor or Student Services if:

- Your official records do not reflect your correct name and/or set of pronouns that you would like us to use.

- Your performance in the class is impacted by your experiences outside the class (e.g., family matters, current events); we would like to help you find resources to cope. See the Links to University Services below).

- Something was said in class (by anyone) that made you feel uncomfortable.

Non-Discrimination Statement

In accordance with applicable Federal and State law and University policy, the University of California, Berkeley, does not discriminate on the basis of race, color, national origin, religion, sex, gender identity, pregnancy, physical or mental disability, medical condition (cancer related or genetic characteristics), ancestry, marital status, age, sexual orientation, citizenship, or service in the uniformed services. The University of California, Berkeley also prohibits sexual harassment. This nondiscrimination policy covers the following individuals: students, employees, applicants for admission and employment, access, and treatment in University programs and activities.

The federal and state laws and regulations prohibiting discrimination and harassment include the Americans with Disabilities Act (ADA), Section 504 of the Rehabilitation Act of 1973, Title IX of the Education Amendments of 1972, Title VII of the Civil Rights Act of 1964 as Amended by the Equal Employment Opportunity Act of 1972, and the California State

Honor Code

UC Berkeley's Honor Code states: "As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others."

If you are feeling tempted to compromise your academic integrity as a result of stress or frustration please see us. We will do our best to help you identify resources that are in compliance with our code of conduct AND can help you achieve success. The Student Code of Conduct **https://sa.berkeley.edu/code-of-conduct** is in effect at all times. In particular, looking for solutions to homework or exam problems on interactive online forums and services, or posting homework or exam problems on such services, is considered a violation of the honor code, which might result in an F grade, as well as other serious consequences. If someone you know is considering plagiarism or cheating, please remind them that it is wrong, and it is not worth it, and that there can be serious long-lasting consequences.

Examples

Please note that the following permitted or prohibited activities are specific to Physics 89 Fall 2023. For other courses, if in doubt, please check with their instructors about what they allow or proscribe.

OK: Working together with another student, or a study group, on **solving** the weekly problem sets.

Not OK: Copying (or paraphrasing) the solution to a problem on the weekly problem set from another student. You need to show that you **understand** how to solve the problem.

OK: Studying together online or offline for an exam, a quiz, or homework.

Not OK: Taking an exam with another student or discussing the answers to the questions.

OK: Consulting online sources, such as Ed Discussion, or other interactive online sources on general questions related to problem sets, for example, *"What is the Fourier transform of f'(x) given that of f(x)?"*

Not OK: Posting a homework problem online.

Not OK: Looking up the solution to a homework problem from online services that solve problems for you.

Not OK: Consulting online sources during the midterm or final exam.

OK: Using review questions or test banks provided by your instructor to study for an exam.

Not OK: Obtaining (or distributing) the questions and answers to a homework problem from a student who took the exam previously, or from an unauthorized test bank and/or websites.