Physics 7B: Physics for Scientists and Engineers

UC Berkeley, Spring 2021

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Office Hours: Wednesday 9:10AM – 10:00AM @ Zoom

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Lecture: MWF 1:10 – 02:00 PM @ Zoom (Lectures will be recorded)

Course Objectives and Contents

The goal of this course is to give you a solid foundation on **thermodynamics and electromagnetism**.

The first part of the course covers thermodynamics, a subject that deals with systems of large degrees of freedom. We will start from the definition of temperature and its relation to microscopic degrees of freedom and move on to heat, calorimetry and transitions of phases. The dynamics of large number of non-interacting particles, aka ideal gases, will be discussed. We will introduce the statistical definition of entropy and the 2^{nd} law of thermodynamics.

The 2^{nd} part of class, which will take about 2/3 of the semester, introduced electromagnetism. Electromagnetic interaction is one of the fundamental interactions of nature that we most commonly observe, alongside with gravity, in our daily life. The emphasis will be on both ***conceptual understanding*** and ***quantitative calculations***, in particular using calculus in physics. Starting from **electric charges** and **electric forces**, we will introduce the notion of **electric field** and **electric potential**, as well as utilizing **symmetries** in problem-solving. We will then discuss the relation between these ideas and **electric circuits.** After the study of electrostatics, we will turn our focus to **magnetic force** and **magnetic field.** We will first see that magnetic interactions are closely related to electricity in the sense that moving electric charges create and feel magnetic fields. Not only that, we will further see that **time-varying magnetic field creates electric field and vice versa**. The class will end with the emphasis on the unification of electricity and magnetism under Maxwell's equations, and show that **electromagnetic (EM) waves** are solutions to Maxwell's equations and the light we observe in daily life is a kind of EM waves.

Textbook

D. C. Giancoli, *Physics for Scientists and Engineers*, custom edition for UC Berkeley, Vol.2
ISBN: 9780558229030

7B Workbook, by Hedeman, which will be packaged with Giancoli at the Cal Student Store. These will be used in section and are required.

You can purchase electronic access of both the textbook and the 7B Workbook at http://www.pearsoncustom.com/ca/ucb_physics/

Homework

Weekly homework problems will be given through the online platform *Mastering Physics*. The online HW weighs 10% of your grade, to prompt you to keep up with the regular routine. **Late submission will only receive partial credit (5% reduction per hour late). We will NOT grant extensions/accommodations for Mastering Physics HW, but the *three* lowest HW will be dropped.**

Mastering Physics assignments are due on Mondays, 11:59PM, unless stated otherwise.

Course ID for Mastering Physics: chiang57567

Note that Mastering Physics homework only provides a baseline. Do not expect that you will be able to solve problems on the exams by just doing the MP assignments. You have to READ the textbook, understand and be able to reproduce the *derivations*, and do the optional problem sets posted on bCourses (even though they do not count toward your grades).

Labs

Due to the pandemic, all lab activities have been recorded and you are asked to team up in **groups of three to four** to collaboratively work on the lab assignments. **Each group turns in one worksheet/lab report for each lab assignment.**

ALL lab assignments will be counted toward your course grade. Students must complete 4 out of the five labs to pass the course.

Discussion Sections

As we only have 150 minutes of lectures per week, we won't be able to cover that many example problems in the class. **Attending discussion sections is vital to your success in this course.** In the section, your GSIs will give more example problems, and also complete exercises problems with you, in a collaborative setting. It is also a good place to connect with your peers, and find potential study mates. **Studying physics alone is very inefficient, if not ineffective.**

Due to the early drop policy, attendance to the discussion sections in the first two weeks is mandatory. If you cannot make it, please contact your GSI asap. On the other hand, **if you do not plan to take this course, it is your responsibility to drop the class.**

Discussion sections meet twice a week, regardless if there is a lab scheduled or not. You will be assigned problems to be worked on during the discussion sessions, and at the end of it you will turn in your solutions to these problems**. The GSI will then randomly choose one of these submissions to grade, and every member of the group will receive this same grade. These grades will be used to determine the Discussion portion of your grade at the end of the semester.** The grading will be based on effort—how many problems you worked on—and not on correctness. If you are an overseas student, you will have 24 hours from the start of your discussion session (based on Pacific Standard Time) to submit your solutions.

For five weeks, spread throughout the semester, you will be doing a laboratory assignment during one of the two discussion/laboratory sessions during that week. The write-ups for the assignments are from the workbook. Each laboratory is scored out of five points. The due date for the laboratory report will be announced by your GSI. The lab schedule and lab policy will be posted on bCourses.

To mitigate differences the GSIs, your total discussion and laboratory score at the end of the semester may be adjusted so that the average discussion and the average laboratory score in each section is statistically similar.

After the first two weeks of instruction, attendance to discussion section is not mandatory, and we do not take attendance. However, **discussion sections will NOT be recorded**. (If GSIs choose to record the sections, the recordings are only available to students who currently live in a time zone that makes attending sections extremely difficult.) **If you do not attend the synchronous discussion sections, you are still required to complete the assignments given by your GSI independently. The discussion section assignments are graded based on completeness, *at the discretion of your GSI.***

Exams

There will be **two midterm exams** and **one cumulative final exam**, scheduled at the following time:

Midterm 1: Monday, February 22, 07:00 – 9:00PM

Midterm 2: Monday, April 5, 07:00 – 09:00PM

Final: Tuesday, May 11, 08:00 – 11:00AM

An alternative examination will be given for students overseas. The date and time for these exams will be announced later during the semester.

All exams are timed and are done remotely. That is, the pdf of the exam will be available on bCourses or Gradescope at the start time, you print out and work on it, and submit your work by the end time. More logistic details will be announced as the exams approach.

As the exams are done remotely, they will be open-book. A more detailed instruction of the open-book policy will be given before the exams.

You must take the final exam to pass the course.

You need to show your work on all exams. Correct answers without supporting work will not receive credit. Full credit will only be given when you explicitly show the logical steps in a clear manner. Please make sure your handwriting is legible. We cannot give you credit if we don't understand your writing.

Grade

The course grade is based on your scores in homework assignments, labs, discussion section assignments and exams, with the following weighting:

Homework 10%

Lab 5%

Discussion Section Assignment 5%

MT1 23%

MT2 23%

Final 34%

The final letter grade is assigned based on **EITHER** the department grading guideline -- that is ***about*** 25% A/A-, 40% B+/B/B- and 35% C+/C/C-/lower – **OR** the following ***tentative*** table, *whichever is advantageous to you*:

Course Grade	Letter Grade	GPA
Outstanding	A+	4.0
$\geqq$89%	A	4.0
87%$\leqq$ x < 89%	A-	3.7
82%$\leqq$ x < 87%	B+	3.3
76%$\leqq$ x < 82%	B	3.0
70%$\leqq$ x < 76%	B-	2.7
65%$\leqq$ x < 70%	C+	2.3
60%$\leqq$ x < 65%	C	2.0
55%$\leqq$ x < 60%	C-	1.7
50%$\leqq$ x < 55%	D	1.0
x < 50%	F	0.0

This grading scale—at my sole discretion—may be shifted downward if needed. Due to the impact of the pandemic, we will not grade on a curve *in the sense* that **we will post the finalized letter grade cutoff table after MT2 and before the final exam** when we have enough statistics, and we will honor that table, i.e. we will not limit the number of people who will get an A and so forth. However, when we determine the finalized cutoff scales, the traditional grading curve (25% A/A-, 40% B+/B/B- and 35% C+/C/C-/lower) will still be taken into account. If the final exam turns out to be much lower than we expected such that we have to adjust the table again, the traditional grading curve will also be our main reference, although we may consider the impact of the pandemic and ***may*** be slightly more lenient.

Academic Dishonesty

Simply put, just don't cheat.

Since the start of online learning last spring and continuing through this summer and the fall, the physics department and the university as a whole has learned a great deal about the means by which students try to cheat on examinations for online classes. The experience gained and the lessons learned have driven how we mitigate, detect, and resolve acts of academic dishonesty.

Students often do not realize that while they may use the internet to search for resources to help them answer exam questions, the GSIs can use the same internet to search for the same resources to answer the same questions. They will be doing so before, during, and after the examination is given. The GSIs have access to all the examination solutions submitted by students, and they will be looking for acts of plagiarism both between students, and between students and solutions posted online. Moreover, if any exam problems are posted to homework sites, the links used to post these problems will be provided to the Center for Student Conduct, which will launch an investigation. Historically this has resulted in identifiable information provided by the sites related to the individual who posted the questions and to the students who accessed any solutions and then ultimately in appropriate ramifications for these students for their breach of academic integrity.

During the Spring of 2019, over thirty students were reported to the Center of Student Conduct in one section of a physics class alone for cheating on the final exam. More acts of academic dishonesty were detected and reported during the Fall semester, including over 30 incidents of cheating during the second midterm in Physics 7B. These students faced penalties imposed by the instructor, and they faced further penalties placed on them by the university through the Center for Student Conduct. In addition, a record of their actions is kept by the university.

You can learn more about the center, and the role they plan at the following website: https://sa.berkeley.edu/conduct.

We will be doing the same this semester in response to any act of academic dishonesty found this semester.

Study Guide

Physics is a hard subject, no matter who teaches it or learns it. It was a hard subject for me when I first learned this. But I deeply believe with the necessary efforts invested, it is also a subject that ordinary people can learn. It's not a subject for a few smart people. It can be frustrating some time but try to be patient and persistent. I am aware of the cultural and academic challenges associated with college-level physics class. Know that no matter your background, you are in this class because you are capable of doing the work and learning the material. I believe in your academic potential, and if you let me, I will help you become a stronger student by supporting you and challenging you. Below are some items that are worth to keep in mind when you study:

1. Studying physics takes a lot of time. Although this varies person by person, if the goal is to get an A for this class, **at least 8hrs/week** outside the class meetings is most likely needed. With that said, I also have to be honest that, in a physics class, it is possible that one spends the huge effort (say more than 10hrs/week) and still cannot get an A. However, I try my best to frame my course in a way such that hardworking students can at least get a B. (Though I obviously cannot guarantee it.)
2. **Understanding derivations of important formulas and being able to reproduce them is vital** for understanding the physics. In the exams, I will ask you to derive equations.
3. I do not encourage memorizing formulas. However, if you find yourself frequently referring to formula sheets, that's usually a sign of not being familiar with the material enough.
4. Do not randomly search for equations and manipulate them. Understand the context of a given equation; know when you can and cannot use an equation.
5. Imitation is an important process for learning physics. Study the example problems carefully and try to mimic the way of solving problems.
6. Do not leave things behind. Make sure you understand the example and exercise problems given in the lecture. If you don't understand anything I said, **please do not hesitate to ask!**
7. Make this class a positive mathematical experience by **collaborating with your peers and learning from one another.**

If you are in trouble (behind in homework, doing worse in the course than you would like, etc.) for whatever reason, please let us know. We'll try to help! Additional help is available through the Student Learning Center (Golden Bear Center), the Honors Society, the Society of Physics Students, and the Physics Scholars Program. Inquire in the Physics Department Undergraduate Student Services Office (368 LeConte Hall) for further information. There is quite a lot of material in this course, and not a lot of time to learn it. There are many resources available to help you. We strongly encourage you to take advantage of them.

Accommodations

UC Berkeley is committed to creating a learning environment that meets the needs of its diverse student body including students with disabilities. If you anticipate or experience any barriers to learning in this course, please feel welcome to discuss your concerns with me.

If you have a disability, or think you may have a disability, you can work with the Disabled Students' Program (DSP) to request an official accommodation. The Disabled Students' Program (DSP) is the campus office responsible for authorizing disability-related academic accommodations, in cooperation with the students themselves and their instructors. You can find more information about DSP, including contact information and the application process here: dsp.berkeley.edu. If you have already been approved for accommodations through DSP, please meet with me so we can develop an implementation plan together.

Physics 7B **Spring 2021**

Tentative Schedule

Date	Week	Day	Lecture Topics	Textbook Reading	Exam/Lab
1/18	1	M	***Holiday***		
1/20		W	Introduction; Temperature and the Zeroth Law of Thermodynamics	17-1 to 17-3; 17-6	
1/22		F	Thermal Expansion; The Equation of State of Gas	17-4; 17-7 to 17-9; 18-5	
1/25	2	M	Temperature and Microscopic Kinetic Energy	18-1	
1/27		W	Boltzmann-Maxwell Distribution of Molecular Speed	18-2	
1/29		F	Heat and Calorimetry	19-1 to 19-5	
2/1	3	M	The First Law of Thermodynamics and Thermodynamic Process of Gas	19-6, 19-7	
2/3		W	Thermodynamic Process of Gas	19-6, 19-7	
2/5		F	Molar Specific Heat for Gases; Heat Transfer	19-9, 19-10	
2/8	4	M	The 2nd Law of Thermodynamics	20-1 to 20-6	Lab: Heat Engine
2/10		W	The 2nd Law of Thermodynamics		
2/12		F	The 2nd Law of Thermodynamics **(MT1 Cutoff)**		
2/15	5	M	***Holiday***		
2/17		W	Electric Charges; Insulator and Conductors	21-1 to 21-4	
2/19		F	Electric Force and Electric Field of Point Charges	21-5, 21-6	
2/22	6	M	Particle Motion in E; Electric Dipole	21-10, 21-11	**Midterm 1 on 2/22**
2/24		W	Electric Field of Continuous Charge Distribution with Coulomb's Law	21-7	
2/26		F	Electric Field Lines, Electric Flux and Gauss's Law	21-8, 22-1, 22-2	
3/1	7	M	Electric Field and Charges in Conductors	21-9, 22-3	
3/3		W	Electric Field of Symmetric Charge Distribution with Gauss's Law	22-3	
3/5		F	Electric Potential Energy	23-1, 23-8	
3/8	8	M	Electric Potential	23-2, 23-3, 23-5, 23-7	
3/10		W	Electric Potential of Continuous Charge Distribution and Dipole	23-4, 23-6	Lab: Equipotential Lines and Electric Fields
3/12		F	Capcitors and Energy Stored in Capacitors	24-1, 24-2, 24-4	
3/15	9	M	Dielectric in Capcitors	24-5	
3/17		W	DC Circuit I	25-1 to 25-6, 25-8; 24-3	
3/19		F	DC Circuit II	26-1 to 26-5	
3/22		M	***Spring Break***		
3/24		W			
3/26		F			
3/29	10	M	DC Circuit III **(MT2 Cutoff)**		Lab: DC Circuits
3/31		W	Magnetic Force on Charge and Current	27-1, 27-4, 27-3	
4/2		F	Torque on a Current Loop; Magnetic Dipole Moment; Hall Effect	27-5, 27-8	
4/5	11	M	Magnetic Field from Current I (Biot-Savart Law)	27-2; 28-6	**Midterm 2 on 4/5**
4/7		W	Magnetic Field From Current II (Ampere's Law)	28-4, 28-5, 28-1, 28-2	
4/9		F	Magnetic Field From Current II (Ampere's Law)		
4/12	12	M	Lenz's Law	29-1, 29-2	
4/14		W	Faraday's Law	29-2, 29-4, 29-7	
4/16		F	Motional EMF	29-3	
4/19	13	M	More Examples of Faraday's Law and Motional EMF		Lab: e/m
4/21		W	Buffer		
4/23		F	Thansformers; Inductance	29-6, 30-2, 30-1	
4/26	14	M	Energy in the Magnetic Field	30-3	Lab: O-scope and Time Dependent Circuits
4/28		W	LR Circuit	29-5, 30-4	
4/30		F	LC Circuit	30-5	
5/3		M	***RRR Week***		
5/5		W			
5/7		F			