

Physical Sciences 12b: Electromagnetism from an Analytic, Numerical and Experimental Perspective

Harvard University, Fall 2018

(M), W, F 9:00–10:15am, Science Center C
Website: <https://canvas.harvard.edu/courses/46239>

Instructors: Dr. Logan McCarty (mccarty@fas.harvard.edu; 496-9009; Science Ctr 108)
• A schedule of **office hours** will be posted on the course website.

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Sectioning: Please select your lab section preferences on the Canvas course website. **The deadline for requesting sections is 11:59pm on Friday, Sept. 7. Any requests after that deadline will be considered on a space-available basis.** For questions about sectioning, please contact the instructor.

Course Text: OpenStax University Physics, available **free** at:
<https://openstax.org/details/books/university-physics-volume-2>
A Student's Guide to Python for Physical Modeling, by Jesse M. Kinder and Philip Nelson (Princeton University Press 2015), ISBN 978-0691170503 (**recommended**)

Course Description: This is the second term of a two-semester introductory sequence that uses a combination of analytic and numerical methods to understand physical systems, to analyze experimental data, and to compare data to models. Topics include electrostatics and magnetostatics, electromagnetic fields, circuits, and wave optics. The course is aimed at second year students who have an interest in pursuing a concentration in the sciences and/or engineering. The course structure includes lecture, discussion and laboratory components.

Prerequisites: We assume that students have completed Physical Sciences 12a, or a comparable course in mechanics (PS2, AP50a, Physics 15a). Single-variable calculus at the level of Math 1b will be used extensively. Coding experience is helpful but not required; we will be using Python extensively in the laboratory but assume no prior experience.

Important Dates: There are four **quizzes**, once each month on the following Mondays:
September 24, October 15, November 5, and December 3.
The **final exam** is scheduled according to the Registrar at 2:00pm on December 12.

<i>Course Grading:</i>	Quizzes (4)*	35%	Note: There will be no makeup quizzes . If you miss one quiz for a valid reason, your final exam score will be used in place of the missed quiz.
	Coding exam	5%	
	Final exam	25%	
	Homework	15%	Note: Missing one lab will cut your lab grade in half; missing two or more labs makes it zero overall.
	Laboratory	10%	
	Course participation†	10%	

*Each quiz is worth 7% of your total grade, and your best quiz is worth an extra 7%.

†An important part of any class is your active participation. Course participation includes in-class activities, pre-class quizzes, and other activities designed to help you learn. If you earn 90% of the participation points you will get full credit for participation; anything less will be prorated accordingly.

<i>Laboratory:</i>	Laboratory sections will meet every week for 2.5 hours at a schedule to be arranged (likely: Wed. 3–5:30pm and 7:30–10pm, Thu. 9–11:30am, 3–5:30pm and 7:30–10pm, or Fri. 3–5:30pm) All labs meet in SC 106; attendance and participation is required.
<i>Help Room:</i>	Teaching Fellows will be available to help with homework and coding on Mondays and Tuesdays in Science Center 106 at times to be arranged.
<i>Homework:</i>	Homework will be posted online every Wednesday and due the following Wednesday by 9am. The paper portion of each problem set is to be placed in the Science Center boxes, located near SC 108. The boxes will be labeled with your lab section. Late homework will not be accepted. Any computational component must be submitted on Canvas as follows: 1. At the top of your Jupyter Notebook, write your name, date, and the homework assignment number either as a comment or in markdown. 2. Your code should be readable and appropriately commented. 3. Your code should run without error. The TF will not debug your code. 4. When you are ready to submit, save your code as an HTML file: Click File → Download as → HTML. 5. Select the appropriate homework assignment on Canvas, click Submit Assignment, and then upload your file.
<i>Quizzes and Exams:</i>	The in-class quizzes will be held in a “two-stage” format. First you will have 45 minutes on your own to solve the quiz. We will then collect the quizzes, and you will gather in groups of 3 to re-do the same quiz as a group. Your score will be a weighted average of the two scores: 80% individual and 20% group. In the rare case that your group score is lower than your individual score, you will get your individual score. In other words, the group portion of the exam can only help your score. At the end of the semester there will be a take-home exam to assess basic proficiency in Python. This exam must be completed on your own; schedule and due date TBA. The final examination will be a comprehensive 3-hour exam covering all of the course material, with some extra emphasis on the topics from lectures 23–25 that were not covered on any of the quizzes.
<i>Academic Integrity:</i>	Please read the Harvard honor code, at http://honor.fas.harvard.edu/honor-code. A few specific notes about academic integrity in PS 12b: • Quizzes and exams (including the take-home coding exam) are to be completed independently without any assistance from human or electronic sources, except as specified by the instructor (e.g. the group portion of the quizzes). • Class participation must be earned by in-person attendance. Electronic or other submission of work for participation credit by anyone not physically present is a violation of academic integrity. • Homework collaboration is allowed (and encouraged) while you are thinking, calculating, drafting, sketching. The final written submission however must be your own, not copied from another student or another source. It is not acceptable to show your fully worked-out solution or code to another student, or to copy the solution or code from another student (or from any source). • Regrade requests for quizzes must be submitted in writing before you leave the room when the quiz is returned to you. You must not write on, erase, or change any part of a quiz before submitting it for a regrade. Clerical errors (e.g. addition mistakes) will be corrected immediately; other requests will be accepted only if there is clear evidence that a mistake was made in grading a specific question.
<i>Accessible Education:</i>	Any student receiving accommodations through the Accessible Education Office should present their AEO letter to the instructor by Friday, Sept. 14. Failure to do so may prevent us from making appropriate arrangements for the first quiz.

Fall 2018 PS12b Class Schedule

W	5-Sep	1. Electric forces and fields	
F	7-Sep	2. Superposition, field lines, and dipoles	
M	10-Sep	<i>No lecture</i>	
W	12-Sep	3. Fields of continuous distributions; HW 0&1 due (L1-2)	No lab
F	14-Sep	4. Gauss's Law	
M	17-Sep	<i>No lecture</i>	
W	19-Sep	5. Gauss's Law with conductors; HW 2 due (L3-4)	Lab 1
F	21-Sep	6. Electric potential energy	
M	24-Sep	QUIZ 1: Lectures 1–4	
W	26-Sep	7. Electric potential and electric field	Lab 2
F	28-Sep	8. Capacitance	
M	1-Oct	<i>No lecture</i>	
W	3-Oct	9. Capacitors and dielectrics; HW 3 due (L5-7)	Lab 3
F	5-Oct	10. Current and resistance	
M	8-Oct	<i>No lecture (Columbus day)</i>	
W	10-Oct	11. Kirchhoff's Laws and RC circuits; HW 4 due (L8-10)	Lab 4
F	12-Oct	12. RC circuits	
M	15-Oct	QUIZ 2: Lectures 5–10	
W	17-Oct	13. Magnetic fields and forces	Lab 5
F	19-Oct	14. Magnetic fields from currents and dipoles	
M	22-Oct	<i>No lecture</i>	
W	24-Oct	15. Ampère and Faraday; HW 5 due (L11-13)	Lab 6
F	26-Oct	16. Induction and solenoids	
M	29-Oct	<i>No lecture</i>	
W	31-Oct	17. Inductance and RL circuits; HW 6 due (L14-16)	Lab 7
F	2-Nov	18. Circuits with inductors	
M	5-Nov	QUIZ 3: Lectures 11–16	
W	7-Nov	19. RLC circuits and AC sources	Lab 8
F	9-Nov	20. Driven AC circuits and applications	
M	12-Nov	<i>No lecture</i>	
W	14-Nov	21. Maxwell's Equations; HW 7 due (L17-19)	Lab 9
F	16-Nov	22. Power and waves	
M	19-Nov	<i>No lecture</i>	
W	21-Nov	<i>No lecture (Thanksgiving)</i>	
F	23-Nov	<i>No lecture (Thanksgiving)</i>	
M	26-Nov	<i>No lecture</i>	
W	28-Nov	23. Wave superposition and interference; HW 8 due (L20-22)	Lab 10
F	30-Nov	24. Diffraction	
M	3-Dec	QUIZ 4: Lectures 17-22	
W	5-Dec	25. What is light?	
		Reading period (Dec. 6–11); HW 9 due Dec 7 (L23-25)	
		Final exams (Dec. 12–20); Final Exam on Dec. 12, 2:00pm	