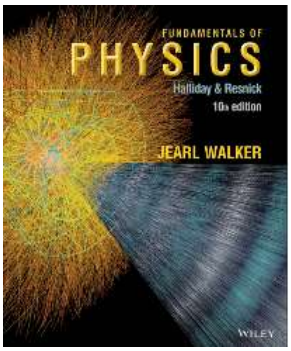
Boston University CAS PY252
Principles of Physics II: Electricity and Magnetism

PY252 is intended for physics majors and minors and other well-prepared students wishing an in-depth and rigorous treatment of electricity, magnetism, and electromagnetic radiation.



Lectures are T/Th 12:30 to 1:45 PM in SCI-117.
Discussions are W 11:15 AM–12:05 PM (PSY-B39) or 1:25–2:15 PM (SCI-115).
Labs are M 8:00-10:45 AM, 2:30–5:15 PM or 6:30–9:15 PM in the basement of SCI.

Instructor
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Teaching Fellow and Learning Assistant contact information, and all office hours, are posted on Piazza.

Prerequisites
A good grasp of mathematics is essential. Students should be fluent with arithmetic, algebra, trigonometry, vectors, and the calculus of a single variable. The course will be taught using calculus; good performance in MA124 is strongly preferred. Most students will be taking MA225 concurrently; select topics in multivariable calculus will be introduced as needed. Students should have completed PY251 (this is a prerequisite), otherwise you need instructor consent. If you have any doubts, please discuss your preparation with the instructor promptly as the semester begins (in the first week of classes).

BU Hub Successful completion of PY 251 satisfies:
(1) **Quantitative Reasoning II** - Students will frame and solve complex problems using quantitative tools and usually by using the simplest means at their disposal: sometimes computational methods will be used but at other times, conservation laws can be invoked to greatly simplify the problem. Students will learn that the methods of physics analysis are widely applicable. That will be reflected in the wide variety of settings in which homework problems are posed. Students will formulate and test arguments by marshaling and analyzing quantitative evidence. This is particularly true of the lab component of the course, in which students will use data collected by themselves in order to investigate models of physical phenomena.
(2) **Scientific Inquiry II** - Laboratories are an important component of the course. In order to test basic physical models, students collect and analyze data. Data is obtained from both simulations and hands-on experiments. Using their knowledge of the natural and social sciences, students will engage with issues of public policy, such as the impact of science and technology in society. While not the main focus of the course, lectures and homework exercises underscore the importance of science in the modern world.
(3) **Intellectual Toolkit: Critical Thinking** - Critical thinking is required for the effective use of technical skills, and for the development of citizen scientists who will help shape public policy. Students will learn about the connections between physical ideas. Students will learn how to identify, construct and evaluate arguments that deal with physical phenomena. They will receive extensive training in both deductive and inductive reasoning. Students will learn how to solve problems systematically and to avoid common mistakes in reasoning. Aspects of critical thinking will appear in every element of the course: in the lectures and reading assignments, in the laboratory exercises and associated reports, in homework and in discussion sections, and on quizzes and tests.
(4) **Intellectual Toolkit: Teamwork/Collaboration** - Science is a collaborative effort. Everyone must learn to work with and communicate their ideas and observations to others. Effective collaboration also improves learning outcomes and fosters knowledge of one's own strengths and appreciation for those of others. In the first laboratory section, guided by the instructor, students will review the teamwork training they received in PY251: the techniques for working with a diverse group, including assigning roles, responsibilities and deadlines, giving and receiving feedback, troubleshooting, and identifying the characteristics of an effective team. Teamwork will be reinforced in lecture and discussion section, through the use of group activities and discussions. In order to give the students sustained training and experience in teamwork, each of the lab sections will be performed in teams of two students, each discussion section will be completed in groups of 3-4, and two of the weekly problem set homework assignments will be completed in teams of 2-5 students. Several of the lab writeups will involve more extensive teamwork than in PY251: each member of a student pair will provide written feedback on their partner's first draft, feedback that will also be shared with the teaching staff.

Textbook

Volume 2 (chapters 21-37) of Fundamentals of Physics by Halliday, Resnick and Walker, 11th, 10th, or 9th Edition. Students are expected to read the textbook as the class progresses, including working Sample Problems and Checkpoints. The Sample Problems and Checkpoints will provide training in the techniques of solving physics problems as well the critical thinking required to use physical ideas effectively.

Online Resources

Piazza will be used as an online collaborative bulletin board, for posting homework assignments, solutions, lecture notes, and for class announcements. Piazza is also the place where you will find course guidelines, schedules, contact information, and so on.
The piazza PY252 class site is: piazza.com/bu/spring2020/py252

Blackboard Learn will be used for keeping track of grades. Use it to check your grades (labs, homework, exams, etc.) during the semester. Start at https://learn.bu.edu and click on the link for PY252.
It will be your responsibility to check the accuracy of your grades.

FlipIt Physics is a required online interactive component of the course. You have two assignments: a PreLecture and a Checkpoint Quiz, that you should complete before 11am on day of the regular live lecture, each Tuesday and Thursday. The PreLecture will introduce the material that will be covered further during each class. Each PreLecture is a series of short narrated, animated presentations covering physics concepts and deriving many of the important results. After finishing the PreLecture, the Checkpoint Quiz questions will be presented. You will earn course credit for completing the PreLecture and Checkpoint Quiz. Your answers to the PreLecture and Checkpoint Quiz questions, as well as to a feedback survey, will be used to fine-tune the lectures and the pace of the course.
To access FlipItPhysics, go to https://www.flipitphysics.com
The access key for PY252 at Boston University is: 2020PY252
As your login (student ID), use your BU login name (the characters before '@bu.edu' in your BU email address)

Jupyter hub will be used to access python scripts for computational assignments. We will use the python programming language to numerically solve real-world problems and plot results. You will compose, run, and submit python scrips on jupyter hub, which can be accessed from your browser. The basics of python and jupyter logistics will be reviewed in the first lab. Group assignments through the semester will have components to be completed using python. You will need a device, such as a laptop, tablet, or a smartphone, that can connect to the internet via a browser. If you do not have access to such a device, please email the course instructor in the first week of the semester.
Access Jupyter site for PY252 by going to: https://physics.bu.edu/jupyter-py252
As username, use your BU login name (the characters before '@bu.edu' in your BU email address) and as password, use your BU password. Check that you can log in *in the first week* of the semester; email the instructor if there is a problem.

Lectures

The topic to be presented during each lecture is listed on the course calendar. Each lecture has a matching reading assignment from the textbook – read this before the lecture. Before each lecture, you are also required to complete an online FlipItPhysics PreLecture and Checkpoint Quiz; these are due at 11 am on the day of the lecture (see FlipIt Physics section above). These will give you an introduction to the material covered on that day. Lecture attendance is required.

Labs

Laboratory sections are a required part of the course. You will learn about the construction of physical models, the design of experimental measurements, and the collection and presentation of data. You will learn how to discuss the results and prepare an argument to justify your conclusions. Each lab will be performed with a lab partner. You will perform seven experiments and write up your observations and measurements in a suitable laboratory notebook. A low-cost, quadrille (square grid), spiral-bound notebook is satisfactory. Your lab notes are due at the end of each laboratory period. All labs are required. Turning in fewer than all assigned labs will result in a letter grade penalty for the course. To determine the room in which the lab is held, see the posted card on the door of *any* lab room in the basement of SCI bilding. Lab write-ups are available from: http://physics.bu.edu/ulab/all_labs.html
You do not need to perform the online prelabs that are mentioned in the above web page.

Discussion Sections

Discussion sections are a required part of the course. You must have an assigned discussion section. The teaching assistant will supplement the lecture material, assist in problem solving, and help prepare you for exams. *Worksheets* are an important part of the discussion section. These are supplemental problems, generally at a good level for exam practice, which you will work with each other and with the instructor. Discussion sections also provide an opportunity for you to construct and discuss physical arguments and work with other students to master important physical concepts. The group-based activities give you opportunities to teach and learn from one another. Groups must collaborate to solve a series of problems and cannot move on until all members of the group understand and can explain each concept or solution. Group members are responsible for one another and are expected to nurture an environment in which everyone feels comfortable asking for help, asking if someone needs help, and asking "what would happen if…" or "how do we really know that…" kinds of questions that help expand your thinking or deepen your understanding. The emphasis is on understanding, not completing all available problems during class. Groups are rotated periodically so that you have a chance to meet more people and gain experience working with a broad range of people.

Homework

Homework assignments are a required part of the course. Homework will be posted on piazza, roughly a week before they are due. Each homework assignment states the due date and time, this will usually be at 12:30pm on Tuesdays. Submit your homework into the box marked "PY252", located on the ground floor of the Metcalf Science Center, next to SCI-121. You may work together to understand questions, but the solution you turn in must be your own. Your problem sets should be neat, readable, and sufficiently well organized that your approach to the problem is clear to the grader. For most full-length problems, at least one page of paper per problem is appropriate. Make it easy for the grader to give you partial credit. Place a box around final answers so they are easy to find. The problem sets will be graded by a teaching fellow and will be returned during discussion section. Solutions will be posted on piazza. Once the solutions are posted we cannot accept homework for grading.

Group assignments

In addition to individual homework sets, you will be given 2-4 group-based assignments over the course of the semester. These assignments are typically more involved and often include computer programming. They will require a team effort. Teams will be assigned and changed for each new project. Teams will be asked to create their own structure for collaborating and sharing the work, based on what they have learned and discussed about teamwork and collaboration in the lab and discussion sections. A single solution or write-up, including a description of the team structure and a reflection on the effectiveness of this structure, will be submitted by each team and will receive a common grade. Each team member will also be asked to submit an individual reflection on the project, for which they will receive an individual grade. This reflection should incorporate an evaluation of their own performance and of the performance of the team overall. For assignments involving larger teams (4-5), students will be asked to provide anonymous constructive feedback to each other team member.

Makeup rules

For students with valid excuses you will generally be allowed to attend another discussion or laboratory section. If you need to miss a lab section, your should go to a different lab section in the same week. There will be an opportunity to makeup one missing lab at the end of the semester— only if a valid excuse is authorized *in advance in consultation* with the professor. If the consultation is not done in advance, you will still have to makeup the lab but there will be a scoring penalty. There will be no makeup exams except for very serious, documented excuses such as illness.

Exams

There will be three exams: two evening midterms and a final exam during the regularly scheduled final exam period. The exams will consist mostly of problems, roughly at the difficulty level of discussion worksheets. You will be expected to show your work, and partial credit will be available. Material for the exams will likely be inspired by: FlipIt Physics, the textbook, the discussion worksheets, the homeworks, and the labs.

Grading Summary

25% Final exam
15% Midterm 1
15% Midterm 2
15% Homework
10% Laboratory
5% FlipIt Physics pre-lectures
5% Group assignments
5% Discussion participation and worksheets
5% Instructors' discretionary assessment (TF+Professor)

Accommodations for Students with Disabilities

The University will make reasonable accommodations for students with documented disabilities. If you are a student with a disability or believe you might have a disability that requires accommodations, please contact the Office for Disability Services (ODS) at (617) 353-3658 to identify and special needs. ODS is located at 25 Buick Street on the third floor. Once you have an accommodation letter from ODS, email a copy to the professor.

Academic Conduct

You are expected to be familiar with and adhere to the College's Academic Conduct Code. The homework and labs you turn in must be your own work, subject to reasonable collaboration with your peers in this class as discussed above. Use of solution manuals, solutions from previous years, or help from postings on the Internet is expressly forbidden. Cheating on exams, quizzes, or other course work will not be tolerated. Evidence of cheating will be immediately reported to your college's Academic Conduct Committee.

Schedule including readings in textbook Halliday, Resnick, and Walker (HRW)

Monday	Tuesday	Wednesday	Thursday	Friday
1/20 MLK Day	1/21 **Electric charge, Coulomb's law** HRW Ch. 21	1/22 Discussion #1	1/23 **Electric field** HRW Ch. 22	1/24
1/27 No lab	1/28 **Electric flux** HRW Ch. 23 Homework #1 is due	1/29 Discussion #2	1/30 **Gauss's law** HRW Ch. 23	1/31
2/3 Lab #1: Python review **LAST DAY TO ADD COURSE**	2/4 **Electric potential I** HRW Ch. 24 Homework #2 is due	2/5 Discussion #3	2/6 **Electric potential II** HRW Ch. 24	2/7
2/10 Lab #2: Electric fields and potentials	2/11 **Capacitance** HRW Ch. 25 (2x pre-lectures) Homework #3 is due	2/12 Discussion #4	2/13 **Current and resistance** HRW Ch. 26	2/14
2/17 President's Day	2/18 Monday schedule (no lecture, no lab) **MIDTERM EXAM #1: 6:30-8pm**	2/19 Discussion #5 Homework #4 is due	2/20 **Kirchoff's rules** HRW Ch. 27	2/21
2/24 Lab #3: Ohm's law	2/25 **RC circuits** HRW Ch. 27 Homework #5 is due **LAST DAY TO DROP WITHOUT A 'W'**	2/26 Discussion #6	2/27 **Magnetism** HRW Ch.28	2/28
3/2 No lab	3/3 **Forces on currents** HRW Ch. 28 Group assignment #1 is due	3/4 Discussion #7	3/5 **Biot-Savart law** HRW Ch. 29	3/6
3/9 Spring break (no lab)	3/10 Spring break (no lecture, no homework)	3/11 Spring break (no discussion)	3/12 Spring break (no lecture)	3/13 Spring break
3/16 Lab #4: e/m ratio of electron	3/17 **Ampere's law** HRW Ch. 29 Homework #6 is due	3/18 Discussion #8	3/19 **EMF** HRW Ch. 30	3/20
3/23 No lab **MIDTERM EXAM #2: 6:30-8pm**	3/24 **Faraday's law** HRW Ch. 30 Homework #7 is due	3/25 Discussion #9	3/26 **Inductance** HRW Ch. 30	3/27
3/30 Lab #5: Faraday's law	3/31 **RLC circuits** HRW Ch. 31 Homework #8 is due	4/1 Discussion #10	4/2 **Alternating current** HRW Ch. 31 (2x pre-lectures)	4/3 **LAST DAY TO DROP WITH A 'W'**
4/6 Lab #6: RLC circuits	4/7 **Maxwell's equations, magnets** HRW Ch. 32 Group assigment #2 is due	4/8 Discussion #11	4/9 **Electromagnetic waves** HRW Ch. 33	4/10
4/13 No lab	4/14 **Light and geometric optics** HRW Ch. 33 Homework #9 is due	4/15 Discussion #12	4/16 **Optical components, instruments** HRW Ch. 34 (3x pre-lectures)	4/17
4/20 Patriot's Day	4/21 **Interference** HRW Ch. 35 Homework #10 is due	4/22 Monday schedule (no discussion, no lab)	4/23 **Diffraction** HRW Ch. 36 (no pre-lecture)	4/24
4/27 Lab #7: Interference and diffraction	4/28 **Interference and diffraction** HRW Ch. 36 (no pre-lecture) Homework #11 is due	4/29 Discussion #14	4/30 **Special relativity** HRW Ch. 37 (2x pre-lectures)	5/1 **FINAL EXAM WILL BE** **BETWEEN 5/5 AND 5/9** **TENTATIVELY:** **5/5, 12 - 2 pm**