Boston University CAS PY251
Principles of Physics I: Mechanics and Thermodynamics

PY251 is intended for physics majors and minors and other well-prepared students wishing an in-depth and rigorous treatment of classical mechanics and an introduction to thermodynamics.

Instructor

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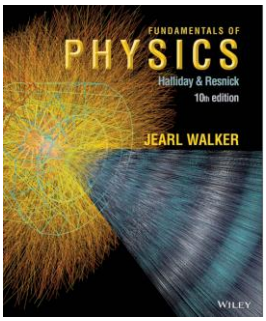

Teaching Fellow and Learning Assistant contact information is posted on piazza, as well as all office hours.

Prerequisites

A good grasp of mathematics is essential. Students should be fluent with arithmetic, algebra, trigonometry, and vectors. The course will be taught using calculus. Calculus at the level of MA 123 is a prerequisite; most students will be taking MA 124 concurrently. If you feel uncertain about your preparation, please meet with the instructor promptly as the semester begins (in the first week of classes).

Textbook

Fundamentals of Physics, 11th, 10th, or 9th Edition, by Halliday, Resnick and Walker. 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.

BU Hub Successful completion of PY 251 satisfies:

1) Quantitative Reasoning I - Students will learn to develop simple physical models to help explain natural phenomena. Students will acquire a toolbox of skills with which to analyze the physical world and get plenty of practice in selecting and applying those skills.
2) Scientific Inquiry I - Quantitative reasoning permeates most physics courses. PY251 is no exception. Students will use algebra, trigonometry and calculus to help them understand and analyze physical systems. In addition, students will use Python as a means to explore and explain the workings of physical systems: by doing calculations and creating models, graphs, and tables.
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. Training in and the practical experience of teamwork teaches the process of innovation, develops leadership, and fosters knowledge of one's own strengths and appreciation for those of others. Students will receive teamwork training in the laboratory and discussion sections throughout the semester, teaching them the tools for working successfully with a diverse group, such as assigning roles and responsibilities, giving and receiving feedback, and engaging in meaningful group reflection that inspires collective ownership of results. Students will receive guidance on how to identify the characteristics of a well-functioning team. The labs will be done in partnership with a lab mate, and two of the homework problem sets will be done in teams, with each member of the team receiving the same grade for the corresponding problem set. Teamwork assessment surveys will be administered at the start and end of the semester to assess the students' teamwork attitudes and capabilities.

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 PreLecture Quiz; these are due at 12 noon on the day of the lecture (see FlipItPhysics section below). These will give you an introduction to the material covered on that day. Lecture attendance is required.

Discussion Sections

Discussion sections are a required part of the course. You must have an assigned discussion section. The discussion instructor 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 on 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.

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 PY251 class site is: https://piazza.com/bu/fall2019/py251

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 PY251.
It will be your responsibility to check the accuracy of your grades.

FlipItPhysics is a required online interactive component of the course. You have two assignments: a PreLecture and a PreLecture 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 PreLecture Quiz questions will be presented. You will earn course credit for completing the PreLecture and Quiz. Your answers to the PreLecture and 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 PY251 at Boston University is: 2019PY251
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 taught in the first lab. Homework 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 PY251 by going to: https://physics.bu.edu/jupyter-py251

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 5pm on Mondays. Submit your homework into the box marked “PY251”, 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. One of the homework sets will be team-based: you will complete these in a team of 2-5, for each of these homework sets all members of a team will receive a common grade.

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 the 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.

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.

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 midterms and a final exam during the regularly scheduled final exam period. The exams will consist of a mixture of short-answer, multiple choice, and in-depth questions. You will be expected to show your work, and partial credit will be available. Material for the exam will mainly be inspired by: FlipItPhysics, the textbook, the discussion worksheets, the homeworks, and the labs.

Grading Summary

15%	Homework
5%	FlipIt Physics pre-lectures and participation
5%	Discussion worksheets and participation
10%	Laboratory
18%	Midterm #1
20%	Midterm #2
25%	Final Exam
2%	Instructors' (TF+prof) discretion

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
9/2 Labor Day	9/3 1D Kinematics HRW Ch. 1,2	9/4 Discussion #1	9/5 2D Kinematics HRW Ch. 3,4 No lab	9/6 No lab
9/9 Homework #1 is due	9/10 Circular Motion HRW Ch. 4	9/11 Discussion #2	9/12 Newton's Laws HRW Ch. 5 Lab #1: Position, Velocity & Acceleration - MBL	9/13 Lab #1: Position, Velocity & Acceleration - MBL
9/16 Homework #2 is due LAST DAY TO ADD COURSE	9/17 Forces HRW Ch. 5	9/18 Discussion #3	9/19 Friction HRW Ch. 6 Lab #2: Introduction to Python	9/20 Lab #2: Introduction to Python
9/23 Homework #3 is due	9/24 Work and Kinetic Energy HRW Ch. 7	9/25 Discussion #4	9/26 Potential Energy HRW Ch. 8 No lab	9/27 No lab
9/30 Homework #4 is due	10/1 Center of Mass HRW Ch. 9 MIDTERM EXAM #1: 7pm	10/2 Discussion #5	10/3 Conservation of Momentum HRW Ch. 9 Lab #3: Energy Conservation (MBL)	10/4 Lab #3: Energy Conservation (MBL)
10/7 LAST DAY TO DROP COURSE WITHOUT A 'W' GRADE Homework #5 is due	10/8 Collisions HRW Ch. 9	10/9 Discussion #6	10/10 Rotational Kinematics HRW Ch.10 No lab	10/11 No lab
10/14 Columbus Day	10/15 Monday schedule (no lecture)	Discussion #7 Homework #6 is due	10/17 Torque HRW Ch. 10 Lab #4: Impulse and Work	10/18 Lab #4: Impulse and Work
10/21 Homework #7 is due	10/22 Rotational Dynamics HRW Ch. 11	10/23 Discussion #8	10/24 Angular Momentum HRW Ch. 11 Lab #5: Torque and Moment of Inertia	10/25 Lab #5: Torque and Moment of Inertia
10/28 Homework #8 is due	10/29 Equilibrium HRW Ch. 12	10/30 Discussion #9	10/31 Gravitation HRW Ch. 13 No lab	11/1 No lab
11/4 Homework #9 is due	11/5 Static Fluids HRW Ch. 14 MIDTERM EXAM #2: 7pm	11/6 Discussion #10	11/7 Fluid Dynamics HRW Ch. 14 No lab	11/8 LAST DAY TO DROP COURSE WITH A 'W' GRADE No lab
11/11 Homework #10 is due	11/12 Simple Harmonic Motion HRW Ch. 15	11/13 Discussion #11	11/14 Pendulum HRW Ch. 15 Lab #6: Simple Harmonic Motion	11/15 Lab #6: Simple Harmonic Motion
11/18 Homework #11 is due	11/19 Waves HRW Ch. 16	11/20 Discussion #12	11/21 Waves - Sound HRW Ch. 17 No lab	11/22 No lab
11/25 Homework #12 is due	11/26 Temperature, Heat, First Law HRW Ch. 18	11/27 no discussion	11/28 Thanksgiving (no lecture) No lab	11/29 No lab
12/2 Homework #13 is due	12/3 Ideal Gas HRW Ch. 19	12/4 Discussion #13	12/5 Second Law HRW Ch. 20 Lab #7: Conversion of Mechanical Energy to Heat	12/6 Lab #7: Conversion of Mechanical Energy to Heat
12/9 Homework #14 is due	12/10 Review HRW Ch. 1 - 20	12/11 Discussion #14	12/12	12/13 FINAL EXAM WILL BE BETWEEN 12/16 AND 12/20 TENTATIVELY: 12/16, 12:30-2:30pm