

**PHYSICS I**

**PY105 FALL 2019**

<b>Section</b>	<b>Professor</b>	<b>Contact Info.</b>	<b>Office hours</b>
S1; S3 in SCI B23 MWF 8 – 9:45 AM MWF 12:20 – 2:05 PM	Lee Roberts Office: PRB 373	Phone: 617-353-2187 E-mail: roberts@bu.edu	M 10 – 11 AM F 10–11 AM in SCI B39
S2 MWF 10:10 – 11:55 AM in SCI B23	Andrew Duffy Office: PRB 353	Phone: 617-353-9089 E-mail: aduffy@bu.edu	M 1 – 2 PM F 8:45-9:45 AM in SCI B39
S4 MWF 2:30 – 4:15 PM in SCI B23	Paul Trunfio Office: SCI 200A	Phone: 617-353-9041 E-mail : trunfio@bu.edu	T 10 AM – 12 PM in SCI B39
S5 MW 6:30 – 9:15 PM in SCI B23	Raj Mohanty Office: SCI 206	Phone: 617-353-9297 E-mail : mohanty@bu.edu	M 5:15-6:15 PM W 5:15-6:15 PM in SCI 206

<b>Optional Text + Required Workbook</b>	Book - "Essential Physics", by A. Duffy, volume 1. Workbook - "Essential Physics Workbook, volume 1", by A. Duffy. Both are available in the BU bookstore and from Amazon, and an interactive e-book is on TopHat.
<b>Questions?</b>	For questions, use the course site on Piazza (you will get an e-mail invitation).
<b>Calculator</b>	It will be helpful to have a standard scientific calculator for the course, but calculators (or other electronic devices) are <b>not allowed on the tests or exam.</b>
<b>Clicker</b>	We'll be using the Top Hat response system – you will need the app or web access. You should receive an invitation via e-mail.
<b>Homework</b>	Due by 10 pm on the due date (usually Tuesday). Most assignments are turned in on-line on TopHat. Hand-in assignments are due Wednesdays at class.
<b>Labs</b>	The lab manual and pre-labs are available on Piazza. Pre-labs are due at the start of the lab period. Lab writeups are due at the end of the lab period.
<b>Exams</b>	Test 1 is Tuesday October 1 <sup>st</sup> from 6:30 – 8:15 pm Test 2 is Tuesday November 5 <sup>th</sup> from 6:30 – 8:15 pm Final exam date to be determined (possibly Tues. Dec. 17 <sup>th</sup> , 6-8 pm)
<b>Course Grade</b>	16% homework assignments (drop the lowest); 4% discussion quizzes 10% labs (drop the lowest); 5% pre-class quizzes on TopHat 4% class participation; 1% total for pre- and post-tests; 5% Top Hat e-book 12% lower of test 1 + test 2, 20% higher of test 1 + test 2, and 23% final exam
<b>Absolute Scale (we reserve the right to be more generous than this)</b>	We will use an absolute grading scale, so you are not competing with your classmates. This is designed to encourage you to help each other learn. 90.00 – 100 for A– and A 75.00 – 89.99 for B–, B, and B+ 55.00 – 74.99 for C–, C, and C+ 45.00 – 54.99 for D ; < 45.00 for F

## Course web sites:

**1. For grades (and only grades), Blackboard Learn:** <http://learn.bu.edu>

Your login name is your regular BU login name and your password is your BU kerberos password. **It is your responsibility to check that your grades have been recorded correctly.** If any of your grades are missing or incorrect, contact your teaching assistant and your professor.

**2. For online homework and pre-class quizzes (see page 4):** <http://tophat.com>

**3. For discussion and announcements: Piazza, at** <http://piazza.com/bu/fall2019/pv105/home>

**4. For the e-book on TopHat (see page 9):** <http://tophat.com>

**Homework:** There are two kinds of homework assignments for this course. Most weeks there will be an on-line homework assignment that is turned in on TopHat. These assignments are due by 10 pm on the due date, which is usually a Tuesday (assignments due in midterm weeks are due on Monday). The numbers and/or variables in the on-line assignments can be randomized so everyone gets a unique version of each problem. For three weeks of the semester (once before each test/exam), assignments will be handed in on paper. Those are due on Wednesday at the beginning of your class. These assignments are designed to help prepare you for the format and grading system of our tests.

Homework counts for 16% of your course grade. Regular TopHat assignments are worth 20 points each; assignments #6 and #11 are worth 10 points each and will be combined and counted as one assignment out of 20 points; the three hand-in assignments will each be re-scaled to be out of 20 points. Thus, by the end of the course you will have 13 assignments grades, each out of 20 – the lowest of these grades will be dropped. You are strongly encouraged to obtain help during discussion sections and/or during office hours. You may discuss homework with classmates, but the work you turn in should be your own. Solutions will be posted on Piazza after the due date. To pass the course, **you must earn at least 50% of the maximum possible homework score.**

**Discussion sections:** In studio physics, discussions are integrated into the class time, and held in the studio classroom, typically on Monday. You will spend much of the discussion time working with other students in small collaborative groups. Some weeks there will be a quiz that is graded out of 5. These quizzes will count for 4% of the course grade.

**Laboratories:** In studio physics, labs are integrated into the class time, and held in the studio classroom, typically on Wednesdays. The complete schedule of experiments is included in the syllabus. Your best 7 (out of 8) lab scores count toward the lab grade, and **you must complete at least 6 labs to receive credit for the course.** A lab is only complete when your personal report is handed in during, or at the end of, the session.

The steps on how to write the lab report are detailed on page 9 of the syllabus. Lab reports are usually turned in at the end of the session, so you should be as prepared as possible when you start. To encourage you to prepare for the lab, each experiment has a pre-lab exercise that counts for 20% of the grade. These exercises are linked through our Piazza site, and must be turned in to your lab TF at the start of the lab. **Anyone turning in late pre-lab assignments, or completing them after arriving, will not receive credit for the pre-lab.** You are welcome to discuss the exercises with a TF or professor in advance.

**Studio:** To get the most out of class, you should read over the material ahead of time. The pre-class quizzes on TopHat count for 5% of your course grade, and grades for participation in class count for 4%. Studio physics may be different from what you're used to. You will be working together in groups for much of the time, so your presence in class is simply required. It is **in class** where you will be actively learning physics!

**Pre-tests and post-tests:** These are done online (links will be available), and count for a total of 1% of your grade. As long as you put forth your best effort, you get the full score on this component of the grade.

**Pre-class quizzes:** To encourage you to prepare for class, before most classes you will be expected to either read the book or view one or two videos, and then complete a short quiz on TopHat. This is graded out of 75% of the total possible score (e.g., 75 out of 100 points over the entire semester gets full credit). **Under no circumstance can there be resubmission, makeup or late submission of the pre-class quizzes.**

**Tests:** There are two closed-book midterm tests, and one cumulative final exam. The lower of the two midterms counts for 12% of your final grade, the higher of the two midterms counts for 20%, and the final exam counts for 23%. **No calculators or electronic devices are allowed on the midterms or final exam.** Concerns about grading must be brought to your professor's attention within one week after the tests are returned. To discourage cheating on re-grade issues, all tests are scanned before being returned.

In exceptional circumstances, an arrangement may be made to take a make-up test. Such an arrangement must be approved and finalized by your professor ONE WEEK IN ADVANCE OF THE ORIGINALLY SCHEDULED TEST DATE.

**Makeup policy:** It is your responsibility to take all quizzes/exams and do all homework and labs according to the posted schedules. There are no makeups. In exceptional circumstances, please contact your professor as soon as possible.

**Getting help:** The PY105 professors and discussion teaching fellows hold about 20 office hours per week (most in SCI 121) - please come and see any of us to get help. The schedule is on Piazza.

**On-line help through Piazza:** Unless you have a personal question for your professor, please ask questions about the course through the PY105 site on Piazza. You should also feel free to answer any questions posted by other students – but you should be careful to be helpful without simply giving away answers to homework questions. With all PY105 students, Learning Assistants, Teaching Fellows, and professors monitoring the Piazza site, this should be the best way to get questions answered quickly.

**Who Is Responsible for What:** Your teaching fellows will answer questions about lab and discussion grades. If they cannot answer your question, contact your professor. Professor Duffy is primarily responsible for homework assignments and online components; Professor Mohanty is primarily responsible for Piazza; Professor Roberts and Professor Trunfio are sharing responsibility for the labs and discussions.

**Ethics Policy:** You are expected to be familiar with and adhere to the College of Arts and Sciences Academic Conduct Code. In particular, cheating on exams and quizzes or unauthorized collaboration on lab work will not be tolerated. Evidence of cheating will be reported immediately to your Academic Conduct Committee. Students found guilty of cheating on exams may be penalized by suspension or even expulsion.

Link to the code: <https://www.bu.edu/academics/policies/academic-conduct-code/>

## BU Hub Learning Outcomes for PY105

**Scientific Inquiry I:** *Students will identify and apply major concepts used in the natural sciences to explain and quantify the workings of the physical world.*

In PY105, you will apply the principles of physics to understand the world around you. Examples include:

- Sketching free-body diagrams and applying Newton's laws of motion to understand why things move the way they do.
- Using conservation laws, such as conservation of energy and conservation of momentum, to gain insight into the behavior of physical systems using energy transfer, or to understand what happens in a collision.

**Quantitative Reasoning I:** *Students will (1) demonstrate their understanding of core conceptual and theoretical tools used in quantitative reasoning; (2) interpret quantitative models and understand a variety of methods of communicating them; (3) communicate quantitative information symbolically, visually, numerically, or verbally; (4) recognize and articulate the capacity and limitations of quantitative methods and the risks of using them improperly.*

In PY105, you will employ mathematical tools such as equations and graphs to gain insight into the way the world works. You will be expected to show expertise in setting up and solving equations to predict the outcomes in physical situations; to interpret and draw graphs representing changes in quantities over time or as position changes; to communicate your understanding to your fellow classmates. PY105 will equip you with various tools to apply to understand the world, and you will learn how to apply these tools, which tools to use in a particular situation, and what the limitations of these tools are.

**Critical Thinking:** *(1) Students will be able to identify key elements of critical thinking, and (2) drawing on skills developed in class, students will be able to evaluate the validity of arguments, including their own.*

Although the PY105 curriculum is intended to prepare students for careers in the health sciences (and more narrowly, the MCAT), the development of critical thinking skills is one of its fundamental goals. Critical thinking is required for the effective use of technical skills in a professional setting and it is equally important to the development of the citizen scientists who will help shape public policy over the years to come. In PY105, you will learn how to identify, construct and evaluate arguments that deal with physical phenomena. You will master the fundamental laws that govern mechanics. You will receive extensive training in both deductive and inductive reasoning, and learn how to solve problems systematically and to avoid common mistakes in reasoning.

Limitations on the application of fundamental physical laws will be a recurring theme in PY105 – both practical considerations, such as friction in mechanical systems, and deeper problems, such as the shortcomings of classical physics itself. In PY105 laboratory exercises, you will collect data and weigh evidence, and construct models to explain your observation. These models will be tested against new evidence and, if necessary, new models are constructed or the original model is refined. In fact, you will be challenged to think about limitations on physical laws in the pre-class videos, the in-class activities, and in the worksheets and the homework as well.

Assessment: Although most of the problems that you will be asked to solve are, of necessity, highly idealized, homework assignments and examinations will also feature conceptual problems that focus on the assumptions and inevitable limitations of our simple physical models. Other conceptual problems will probe your understanding of the investigations and arguments that have been used to establish physical laws.

## Using TopHat

We will use TopHat for four different things this semester, all of which count toward your grade:

1. Pre-class quizzes, due one hour before your class.
2. In-class quizzes (graded on participation only, not correctness) to promote discussion.
3. On-line homework.
4. An interactive e-book (see page 9 for more info on this component)

Even if you have an existing TopHat subscription, there will be an extra fee for TopHat for our course because of everything we're doing with it. At the start of the semester, you will get an e-mail invitation to join your PY105 section on TopHat. Here are the pricing options – note that, if you don't yet have an existing TopHat subscription, the full year option is cheaper in the long run if you are planning to do PY106 with us.

TopHat pricing options	Price (possibly with tax extra)
No existing TopHat subscription, one semester access	\$50
No existing TopHat subscription, full year access	\$88
Existing TopHat subscription, one semester access	\$20
Existing TopHat subscription, PY105+PY106 access	\$40

Note that the total price for required PY105 materials (TopHat + the workbook) is almost \$20 less than last year, because we have eliminated our separate online homework system.

### Getting the most out of TopHat

You only have two chances to submit each pre-class quiz answer, but you have **five** chances to submit each answer on each online homework assignment. Use your submissions wisely. Note that you can submit the answers to each question individually - you do not need to fill in answers for the whole assignment first. Each time you submit, TopHat tells you whether you are right or wrong, and then (on the homework, not the pre-class quizzes) you get more chances to correct anything you got wrong.

Things to keep in mind when using TopHat:

- Start early.
- Come to office hours for help.
- Feel free to work together with other students, but try to do as much as you can on your own. Do not hit the refresh button on your browser - that can count as a submission.
- TopHat offers several advantages over traditional paper homework. These include:
  - Numbers and variables can be randomized, so nobody can simply copy answers from anyone else.
  - Grading is done automatically, so everyone is treated equally and your grade is recorded soon after the assignment deadline.
  - The teaching fellows spend less time grading and more time in office hours helping you.

In general, TopHat expects numerical answers to be within 1% of the correct answer, so do not round off until the very end and use at least three significant figures in your answers.

## PY105 Fall 2019 Course Schedule (3-hour classes) - Page 1

	Date	Topic	Sections (Essential Physics)
1	Wed. 9-4	Pre-test, 1-D motion activity, Vectors,	Chapter 1, 2.1-2,2
2	Mon. 9-9	Motion in 1 Dimension, Constant Acceleration	2.1- 2.8
3 L1	Wed. 9-11	LAB – Forces between Carts ; Forces	3.1 - 3.2
4	Mon. 9-16	Free-body diagrams; Forces in 1 Dimension, Motion in 2 Dimensions; discussion	3.3 - 3.9, 4.4 - 4.9
5 L2	Wed. 9-18	LAB – PhET Projectile Motion Projectile Motion	4.6 - 4.9
6	Mon. 9-23	Projectile Motion, Friction; discussion	5.1 - 5.3
7 L3	Wed. 9-25	LAB – Constant Acceleration Applying Newton's Second Law	5.4
8	Mon. 9-30	Newton's laws; review for Test 1	Chap. 1 – 5.4
!	Tues. 10-1	<b>TEST 1: 6:30 – 8:15 pm</b>	Chap. 1 – 5.4
9 L4	Wed. 10-2	LAB – PhET Friction Uniform circular motion	5.5 – 5.8
10	Mon. 10-7	Impulse and Momentum; discussion	6.1 - 6.3
11	Wed. 10-9	Center-of-mass; Collisions, Work and Energy	6.4- 6.7, 7.1 – 7.3
!	Mon. 10-14	Holiday – Columbus Day	
12	Tues. 10-15	(Mon. sched.) Energy conservation; discussion	7.4 - 7.5
13 L5	Wed. 10-16	LAB – Momentum and Collisions Energy Conservation; Poppers; Collisions	7.6 – 7.7
14	Mon. 10-21	Rotational kinematics; Torque, discussion	10.1 - 10.5
15	Wed. 10-23	Torque and Static Equilibrium, Rotational dynamics	10.6 - 10.12

**PY105 Fall 2019 Course Schedule (2-hour classes) - Page 2**

	<b>Date</b>	<b>Topic</b>	<b>Sections (Essential Physics)</b>
16	Mon. 10-28	Angular Momentum; Rot. KE; discussion	11.6 – 11.9
17 L6	Wed. 10-30	LAB - Simple harmonic motion Simple harmonic motion	12.1 - 12.7
18	Mon. 11-4	Fluids; Review for Test 2	5.5-5.8, 6, 7, 10, 11
!	Tues. 11-5	<b>TEST 2 : 6:30 – 8:15 pm</b>	5.5-5.8, 6, 7, 10, 11
19 L7	Wed. 11-6	Pressure + Fluids LAB Fluid Dynamics	9.1 - 9.9
20	Mon. 11-11	Discussion; Viscosity, Human Circulatory System	9.10-9.11
21	Wed. 11-13	Temperature and Heat	13.1 - 13.5
22	Mon. 11-18	Heat Transfer; Ideal Gases + Diffusion discussion	13.6, 14.1 - 14.4, 14.6, 14.7
23	Wed. 11-20	First Law of Thermodynamics ; discussion	15.1 - 15.4
24	Mon. 11-25	Thermodynamic Processes, Thermodynamic cycles	15.5-15.6
!	Wed. 11-27	<b>Thanksgiving Break</b>	-
!	Fri. 11-29	<b>Thanksgiving Break</b>	-
25	Mon. 12-2	Thermodynamic cycles; discussion	15.6
26 L8	Wed. 12-4	LAB – Calorimetry; Post-tests; Human thermodynamics	15.6-15.8
27	Mon. 12-9	Gravitation	8.1 – 8.7
28	Wed. 12-11	Review	
!	TBA	<b>Final Exam</b>	<i>cumulative</i>

### PY105 Fall 2019 Lab Schedule

Date	Experiment
Sept. 11	Forces Between Carts - MBL
Sept. 18	PhET Projectile Motion
Sept. 25	Constant Acceleration - MBL
Oct. 2	PhET Friction
Oct. 9	<i>No lab</i>
Oct. 16	Momentum and Collisions – MBL
Oct. 23	<i>No lab</i>
Oct. 30	Simple Harmonic Motion – MBL
Nov. 6	Fluids
Nov. 13	<i>No lab</i>
Nov. 20	<i>No lab</i>
Nov. 25 - 29	<i>No lab - Thanksgiving</i>
Dec. 4	Calorimetry

### PY105 Fall 2019 Homework Schedule

Date	Homework	Date	Homework
*Sept. 13	Assignment 1 (TopHat)	Oct. 29	Assignment 8 (TopHat)
*Sept. 18	Assignment 2 (Hand-in)	*Nov. 4	Assignment 9 (TopHat)
Sept. 24	Assignment 3 (TopHat)	Nov. 12	Assignment 10 (TopHat)
*Sept. 30	Assignment 4 (TopHat)	*Nov. 20	Assignment 11 (Hand-in)
Oct. 8	Assignment 5 (TopHat)	Nov. 26	Assignment 12 (TopHat)
Oct. 15	Assignment 6 (TopHat)	Dec. 3	Assignment 13 (TopHat)
*Oct. 23	Assignment 7 (Hand-in)	*Dec. 11	Assignment 14 (TopHat)

\* The first assignment is due on a Friday. Assignments due just before Tests 1 and 2 are due on Mondays. The very last assignment is due on the last day of classes, which is a Wednesday.

Homework assignments are generally due at 10 pm on Tuesday evenings (unless noted otherwise above with an \*). Most of the homework assignments are turned in on-line using TopHat (see the one-page description of TopHat on page 5 in this syllabus), but three assignments will be handed in at the start of class on Wednesdays. Each assignment (besides #5 and # 10, which are each worth 10 points) is worth 20 points (the hand-ins are re-scaled to be out of 20), and your lowest assignment grade is dropped.



## Top Hat e-book

The e-book on TopHat counts for 5% of the course grade. A significant fraction of this grade will be based on participation. The goal of the Top Hat assignments is to give you some incentive to read and practice outside of class. This also reduces the emphasis on the tests and the final exam (these still count for a total of 55% of the grade, down from 60%).

The Top Hat assignments are split into three parts, which match the topics that are the focus of the tests and final exam. **The best way to use the e-book is to keep up with the class material, rather than waiting until just before the due dates to do it.**

	Available	Due by
Part 1 (modules 1-4)	Start of semester	Oct. 2
Part 2 (modules 5-9)	Oct. 3	Nov. 6
Part 3 (modules 10-14)	Nov. 7	Last day of classes

## LABS

You will not need to write a detailed procedure for the labs. Instead, there will be a handout available when you start the lab describing what you should hand in for that particular experiment. The focus will be on analyzing and interpreting your data.

Here are some things to keep in mind:

1. The pre-lab assignment (which counts for 20%) must be completed before you arrive on a lab day. These are available through Piazza. The pre-labs help you prepare for the lab session. Labs are generally due at the end of the lab session (usually a Wednesday).
2. Data analysis: While it is important that results be neatly tabulated and calculations performed correctly, it is equally important that you understand the point of each measurement and the connection between the data obtained and the theory under examination.
3. Think critically, and question everything. Pay attention to the subtle details. If, for instance, your numbers are consistently lower than what you expect, can you come up with a good explanation?
4. Conclusions should follow from the data! We are less concerned with the results than the quality of your argument. For example, if your data indicates that momentum is not conserved in a collision, you should state this whether or not your result agrees with the theory. Whenever possible, a quantitative estimate of the uncertainty should be included.
5. Don't blame things on "human error." If you make a mistake in the lab then you can correct it and repeat the measurement. Work carefully, trying to minimize sources of error, and really think about whether the theory applies 100% to the real world where you're taking measurements.