PHYSICS 0174: Basic Physics for Science and Engineering I

Fall 2022

Lecture: Mon: flipped lecture videos, Wed 2:00-3:50PM, Fri: 2:00-2:50PM
343 Alumni Hall

Recitation: As scheduled, with TA

Contact Information:

Instructor: Dr. Melanie L. Good
Virtual Office Hours: Mondays 2:00-3:00PM and Thursdays 4:00-5:00PM,
`https://pitt.zoom.us/j/99273627245`, or by appointment

Corequisites: CREQ: MATH 0220 or 0235

Textbook:

- **Required:** *Fundamentals of Physics* by Halliday, Resnick, and Walker, 12th edition, with WileyPLUS package
- **Suggested:** *University Physics, Volume 1* by OpenStax
  `https://openstax.org/details/books/university-physics-volume-1`

Other materials: Scientific calculator

COVID-19 Information: We will follow any and all University policies and updated policies regarding COVID-19. Your professor is vaccinated against COVID-19 but plans to continue wearing a mask while infection rates are high. You are expected to follow University guidelines regarding masks, including any changes to guidelines as the semester progresses. **If you have any symptoms of COVID-19, please do not come to class.** Your absence will be excused. In the meantime, promptly contact Student Health Service (SHS) at 412-383-1800 for further advice. If you have had any exposure to someone with COVID-19, you may need to isolate. Please inform your instructor if this is the case.

If you have not been vaccinated and boosted for COVID-19, your professor urges you to please consider getting vaccinated and/or boosted. For further information on COVID-19, vaccinations, University policy, and to learn about any important COVID-19 updates, please visit `https://www.coronavirus.pitt.edu`. You are responsible for knowing about any updates or revisions to University policy regarding COVID-19.

Should the University change its policy regarding in-person instruction, a revised syllabus will be created and shared as promptly as possible. Most aspects of the course were designed with this contingency in mind, so it is unlikely that there will be major changes to the material or assessments. However, the method of delivery and other class policy changes may be revised, if necessary, should we be required to move away from in-person instruction.

Email and Canvas Announcements and Messaging: The main means of communication from your professor will be through Canvas Announcements. You are responsible for assuring that you receive all pertinent Announcements given through Canvas. Please be sure your Canvas notifications are set in such a way to alert you to the fact that an Announcement has been made. Questions that have already been answered in an Announcement may not receive a response. ***Please follow this order of communication***: If you have questions for your professor that are not covered in the Syllabus, FAQ, or recent Announcements,

you should ask them in class and/or during office hours. If this cannot be done, you should direct your question to the TA, either during recitation, TA office hours, or via email with your TA. If this fails to resolve the question, then you can reach our to your professor via email at **mlgood@pitt.edu**, including the response you received from your TA in your email. Following this order of communication helps you most efficiently receive an answer to your question and avoids email backlogs which can slow down response time. Only email that includes a previous TA response or reference to an earlier conversation with the professor or TA about the matter can be expected to elicit a response.

Videos and Social Media: Video recordings of past and/or current lectures may be made accessible to you to enhance the learning process, and allow you to review previous material. Please discuss any concerns you may have regarding privacy and the sharing of recorded lectures with your professor. Recordings should not be edited, shared, taken out of context, or otherwise misused on social media or other outlets.

In an ever-connected world, it is important to maintain boundaries between personal social media and academic/professional life. Unfortunately, this has not always been the experience of your professor, and you may come across a satirical social media post from a personal account that was made years ago. At the time, this post was shared with less than 5 people, and meant purely as self-depricating satire to amuse close family and friends; however, it was discovered and misinterpreted by some students. The post was immediately deleted and student concerns were promptly addressed. Yet, each semester, this post resurfaces and is misinterpreted once more. To avoid misinterpretation that could lead to unpleasant feelings, please let this serve as pre-emptive clarification that, should you find this long-deleted post, it was meant as satire and that, in all seriousness, your professor considers herself an ally in your learning. No priority is higher to your professor than the education of her students.

Course Description: This is the first part of a two-term sequence that introduces students to the basic principles of physics. An effort has been made to achieve a better integration of physics with the first term of calculus, engineering, and chemistry. The course covers mechanics and waves. Students planning to major in physics are urged to take the equivalent honors course (Physics 0475).

Honor Code:

Students are expected to uphold the University's standard of conduct relating to academic honesty. Students assume full responsibility for the content and integrity of the academic work they submit.

Students shall be guilty of violating the honor code if they:

1. represent the work of others as their own
2. use or obtain unauthorized assistance in any academic work
3. give unauthorized assistance to other students
4. modify, without instructor approval, an examination, paper, record, or report for the purpose of obtaining additional credit
5. misrepresent the content of submitted work

Any student violating the honor code is subject to receive a failing grade for the course and will be reported to the Vice President of Academic Affairs.

Course Objectives:

The department has clearly-defined Learning Objectives for the course, listed at the end of the syllabus, and also available online: https://www.physicsandastronomy.pitt.edu/sites/default/files/PHYS_0174_Learning_Objectives_2017.pdf :

Course Structure: We will take a flipped instructional approach to this class. Flipped instruction means that the "lecture" content is offloaded to videos that students watch outside of class, while classroom time is spent on discussing and/or summarizing the lecture content and/or applying the concepts to endeavors such as problem-solving exercises. I am very excited to have the opportunity to offer both short pre-lecture video content that I developed for the latest version of your textbook (available through WileyPLUS), AND additional, longer lecture content available via the YouTube Playlist: https://youtube.com/playlist?list=PL_EUs7p6SsYwSa6hSsXUyn-69N_M2kYjv. The pre-lecture videos are the bare minimum requirement, while the YouTube videos go into greater detail and are strongly encouraged but optional content. To allow time for you to view the videos, Monday sessions will not take place unless indicated on the schedule or through Canvas announcements. Wednesdays will typically involve problem-solving exercises from this content; however, some Wednesdays will be when exams take place. Fridays will typically recap and summarize the main takeaways from the week and be open for Q&A, demos, and other activities to enhance your understanding of the lecture content. Exceptions to this structure will be indicated in the syllabus schedule, so please refer to the schedule below for a detailed breakdown. **You should always come to a problem-solving class having already viewed the relevant videos**, which are listed in the Course Topics below, so that you have enough understanding about the concepts in order to apply them to problem-solving examples.

WileyPLUS Disclosure: Please note that, although I worked as a consultant with the textbook company Wiley to develop the PreLecture video content featured in the WileyPLUS platform, I receive no commission or royalties on sales of WileyPLUS, nor do I have any other financial interest or benefit from sales of WileyPLUS.

Course Topics:

- Unit 1: Motion in One and Two Dimensions [Prelecture Videos Ch. 2-4, YouTube Lectures L1 through L5 (up to 10:15)]
- Unit 2a: Force and Motion I [Prelecture Videos Ch. 5, YouTube Lectures L5 (10:15 to end) through L6]
- Unit 2b: Force and Motion II [Prelecture Videos Ch. 6, YouTube Lectures L7 through L10 (up to 7:00)]
- Unit 3: Energy and Work [Prelecture Videos Ch. 7-8, YouTube Lectures L10 (7:00 to end) through L13]
- Unit 4: Linear Momentum [Prelecture Videos Ch. 9, YouTube Lectures L14 through L17]
- Unit 5: Rotational Kinematics [Prelecture Videos Ch. 10, YouTube Lectures 18 through L21 (up to 12:00)]
- Unit 6: Torque and Angular Momentum [Prelecture Videos Ch. 11, YouTube Lectures L21 (12:00 to end) through L24]
- Unit 7: Equilibrium and Elasticity [Prelecture Videos Ch. 12, YouTube Lectures L25 through L26 (up to 14:15)]
- Unit 8: Oscillations [Prelecture Videos Ch.15, YouTube Lectures L30 through L33 (up to 2:40)]
- Unit 9: Gravitation [Prelecture Videos Ch. 13, YouTube Lectures L26 (14:15 to end) through L29]
- Unit 10: Waves [Prelecture Videos Ch. 16-17, YouTube Lectures L33 (2:40 to end) through L35]

Tentative Schedule:

Wk	Wed	Fri
1	Aug 31 (Introduction and Vectors)	Sept 2 (Unit 1)
2	7 (Unit 1 problem-solving)	9 (Unit 1)
3	14 (Unit 2a)	16 (Unit 2a-problem-solving)
4	21 (Unit 2a and review for Midterm1)	23 (Unit 2b–virtual)
5	**28 (Midterm 1)**	30 (Unit 2b)
6	Oct 5 (Unit 2b–problem-solving)	7 (Unit 3)
7	12 (Unit 3–problem-solving)	14 (Unit 4)
8	19 (Unit 4–problem-solving)	21 (Unit 4–problem-solving)
9	26 (Unit 5 and review for Midterm 2)	28 (Unit 5–problem-solving)
10	**Nov 2 (Midterm 2)**	4 (Unit 6)
11	9 (Unit 6–problem-solving and Unit 7)	11 (Unit 7–problem-solving)
12	16 (Unit 8–problem-solving)	18 (Unit 9 and review for Midterm 3)
13	23 (Thanksgiving Break)	25 (Thanksgiving Break)
14	**30 (Midterm 3)**	Dec 2 (Unit 9–problem-solving)
15	7 (Unit 10)	9 (Review for Final)
16	Finals week	Date/time of Final TBA by the University

Grading Scheme:

- 10% Participation
- 10% Homework
- 40% Midterm Exams
- 10% Recitation Work
- 10% Adaptive Assignments
- 20% Final Exam

See below for description of each grading component.

Particpation (worth 10% of grade): Participation will take place through Canvas. The question statements themselves will be asked during class, so your attendance in class will be essential in order to know how to answer these questions.

Homework (worth 10% of grade): Homework assignments will be completed through the WileyPlus system. Students will be expected to note the due dates and complete their assignments on time.

Midterm Exams (worth 40% of grade): Midterm 1 will primarily cover material from the beginning of the semester through Unit 2, Midterm 2 will primarily cover material from Units 3-4, and Midterm 3 will primarily cover material from Units 5-8. However, this does not mean that earlier material is irrelevant or could not be included in some way. You will be expected to retain some understanding of all preceding Units, as we build upon prior knowledge.

Midterm exams could include multiple choice and/or open-ended questions. There is no one-size-fits-all recipe to follow which will guarantee a good score on the exams; however, to best prepare for midterm exams, you should focus on achieving the following goals: 1). ability to solve relevant problems **independently** and efficiently, and 2). ability to identify underlying physics principles and apply them appropriately. Solving vast quantities of problems will not help you prepare, if, when solving problems, you rely on solutions to get you through and/or if you do not develop a good grasp of what physics principle(s) underlie a problem and how to identify these principles in a different problem. Two problems which use the same principle may appear superficially to be very different–identifying how they are the same is a key step in developing physics understanding. Many students have found that creating and giving themselves mock exams can help test their understanding and ability to work under pressure.

In addition, reading your textbook and going through textbook examples is an important step in building understanding. According to recent research, 80% of students do not read their textbook, but you cannot expect to perform well on exams if you skip this step. It is a necessary (though not sufficient) part of studying. Thus it is recommended that you read as you go, rather than putting off reading for when you are preparing for an exam. Because textbooks and departmental curriculum do not always evolve in sync with each other, material in the textbook may not flow in the same exact order as what is covered in class. The best way of ensuring that you have read the relevant material is to make use of the index and/or table of contents to find the topics and learning objectives that go with each module. Likewise, it is essential that you view all Prelecture videos (and highly recommended you view all YouTube lectures) on schedule in order to properly build your understanding. Do not wait to view these when studying for exams!

Finally, lecture slides, homework, and recitation problems should be reviewed when preparing for an exam, but remember that you have more resources to draw upon when solving homework and recitation problems, and that these problems are often easier to understand in retrospect. Most students will have extremely high scores on homework and recitation problems, as these can best be seen as "warm up" activities compared with exams, rather than predictors of exam performance. Recitation and homework scores are usually 95% or higher; whereas, exam averages, department-wide, are typically around 60%. Remember,

however, that your letter grade is determined by a composite of all graded components, as well as any curving needed to produce a reasonable letter grade distribution. The end result is typically that at least half of students receive As and Bs. So try to remember the big picture if you tend to find yourself feeling stressed about exams.

A helpful resource for preparing for exams is the Pitt Study Lab:`https://www.asundergrad.pitt.edu/study-lab`. In addition, the Physics Department maintains a list of free and for-hire resources and tutors: `https://www.physicsandastronomy.pitt.edu/resources-current-students`.

Once exams are graded, it is helpful to reflect upon what you missed and why, in order to avoid similar mistakes in future exams. Every effort will be made to give you the results of your exam within one week of when the exam was taken.

Recitation work (worth 10% of grade): Recitation work will be completed during recitation and graded by your TA.

Adaptive Assignments (worth 10% of grade): These assignments will allow you an opportunity to prepare for exams. They will be conducted through the WileyPLUS system.

Final Exam (worth 20% of grade): Your Final Exam will be comprehensive, and the same preparation techniques listed above under Midterm Exams can serve to guide you in preparing for the Final Exam.

Code of Conduct:

Communication is key to a productive learning environment, and we can maintain productive communication by exhibiting respect for one another. The success of the course for yourself and others depends on all of our commitment to behavior that demonstrates respect for differences, understanding towards others and a willingness to listen and learn. For these reasons, it is unacceptable to harass, discriminate against, or abuse anyone because of race, ethnicity, gender, disability, religious affiliation, sexual orientation, or age. If you witness or are subject to such harassment, please report it to the instructor or to the Office of Diversity and Inclusion.

Disability Services:

If you have a disability that requires special testing accommodations or other classroom modifications, you need to notify both the instructor and Disability Resources and Services no later than the second week of the term. You may be asked to provide documentation of your disability to determine the appropriateness of accommodations. To notify Disability Resources and Services, call (412) 648-7890 to schedule an appointment. The Disability Resources and Services office is located at 140 William Pitt Union, and is open Monday-Friday from 8:30AM to 5:00PM.

Title IX:

Legal text: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance." As a professor I am a mandatory reporter, and I am required to report violations of Title IX that I observe or am made aware of to the Title IX office, Title IX violations include, but are not limited to, sexual harassment, sexual violence and verbal or sexual abuse. Within the classroom, behavior in violation might appear as: suggestive jokes or innuendos, inappropriate touching, and unwanted sexual behavior or advances, but my capacity and obligation to report does not end at the classroom.

PHYS 0174 Learning Objectives

1. Make a graph of the instantaneous displacement, velocity, and/or acceleration of a system based on a description of the motion or using another graph.
2. Apply the equations of 1-D kinematics to one or more objects with constant acceleration. Examples include free-fall, two objects that meet one another, and an object that has different constant acceleration at different times.
3. Add or subtract two or more vectors. (Relative velocity problems are an application of this category.)
4. Find the dot product or cross product of two vectors.
5. Describe the behavior of an object undergoing projectile motion based on the equations of 2-D kinematics.
6. Apply a conceptual understanding of Newton's first and third law.
7. Draw a free-body diagram and solve for an unknown force or acceleration of a system under the influence of two or more forces.
8. Calculate the force of static/kinetic friction or the coefficient of friction.
9. Calculate the drag force or terminal speed of an object.
10. Identify the centripetal force that acts on a system undergoing circular motion.
11. Find the work done by a force in cases were integration is not required (perhaps by inspecting a graph of force versus displacement). Alternately, find the force given work and displacement.
12. Calculate the average power provided by a force.
13. Apply conservation of mechanical energy to describe the motion of a system.
14. Use the work-energy theorem to identify the amount of mechanical energy that has been lost.
15. Calculate the average force or impulse during a collision or series of collisions.
16. Apply conservation of momentum to an explosion or collision. Be able to identify whether a collision is elastic, inelastic, or completely inelastic.
17. Answer a conceptual question about momentum, rockets, and/or the motion of the center of mass.
18. Apply kinematics to a rotating system. Be able to convert between the tangential values of s, v, a and θ , ω,

    using the radius r.
19. Distinguish between angular, tangential, and centripetal acceleration.
20. Determine the net torque acting on a body about a given axis and/or the angular acceleration of that body. Doing so may require the use of one or more moments of inertia.
21. Use the definition of static equilibrium to solve for one or more unknown forces or torques acting on a system.
22. Calculate the motion of a rolling object using torques and/or energy conservation. "Rolling" could be caused by a cord wrapped around the object, like in a yo-yo.
23. Find the rotational kinetic energy of an object.
24. Identify whether angular momentum is or is not conserved, and if appropriate, apply conservation of angular momentum to a rotating system.

25. Calculate the gravitation acceleration for an object inside or outside of a planet, given some combination of mass, radius, and density.

26. Apply energy conservation to a system with gravity to describe the motion of an object in a case where $U = mg$ is *not* an appropriate assumption.

27. Use Kepler's laws of planetary motion to describe the motion of a planet, moon, or satellite about its parent body.

28. Apply the concepts of stress, strain, and ultimate strength to a deformed object.

29. Calculate a spring constant given the elastic properties of a material.

30. Identify when a system (spring, simple pendulum, or physical pendulum) is undergoing simple harmonic motion, and find the amplitude, period, frequency, angular frequency, phase angle, displacement, velocity, and/or acceleration.

31. Apply conservation of mechanical energy to a simple harmonic oscillator (spring, simple pendulum, or physical pendulum). Damping may be involved.

32. Determine the amplitude, period, frequency, angular frequency, wave number, wave length, and/or propagation speed of a transverse traveling wave. If the wave is on a string, be able to calculate the propagation speed using the tension and linear density.

33. Predict the result of interference between two waves with identical amplitude and frequency. Specifically, be able to identify constructive, destructive, and intermediate interference—determining the amplitude and/or phase difference in the later case.

34. Identify the resonant frequencies and/or harmonics of a string or open/closed pipe.

35. Apply the equation for the Doppler effect to determine the shift in frequency caused by motion.