Honors Physics 1 for Scientists and Engineers

Physics 0475, University of Pittsburgh *(Fall 2020)*

Syllabus – Version 4 – 2020-08-21

Course Information

Meeting Time: Mon, Tue, Wed, Thu, Fri: 11:05-11:55 AM
Meetings via Zoom

Instructor Information

- Lecturer: Prof. Michael Wood-Vasey, wmwv@pitt.edu
  Office Hours: Mon 3-4 pm. Thu 10-11 am.
- TA: Jared Hand, jsh89@pitt.edu
  Office Hours: Wed 3-4 pm. Thu 3-4 pm.

Course Description

This the first term of a two-term course in university physics. Familiarity with basic physics and calculus will be assumed. Physics 0475, 0476 is the honors version of Physics 0174, 0175. Physics 0475 will cover classical mechanics, oscillating systems, wave motion, and gravitation. Emphasis will be on those aspects of classical physics that underlie the main developments of modern physics and engineering.

Textbook, Videos, and References

1. "Fundamentals of Physics", 11th edition, Volume 1. 2018. Walker, Halliday, Resnick. ISBN-9781119455608

The print version of the 11th edition is the same as the 10th edition. (The bookstore lists the first author as "Halliday", but Jearl Walker has been writing and updating the editions since 1990.) The bookstore should be selling this for ~$140. While this is not cheap, it comes with an access code for the online version of the book, and the same book will see you through the next semester of physics as well.

2. I will provide videos to watch for each lecture. These will be a combination of videos recorded by me and additional videos from different excellent sources on the web.
3. I will provide some additional supplemental readings during the semester. Read them.
4. We are fortunate to live in a rich, interconnected time in human history. There is a wealth of information available online about each of the topics we will cover. I encourage you to pursue additional materials, particularly on issues that you are having trouble understanding initially.

Homework and Reading

Homework assignments are posted on Canvas.
Reading follows the schedule outlined in the Calendar below.

Course Structure

Lectures will be interspersed with short exercises and synchronous group work. While this course is formally structured as a lecture plus recitation, there's only one recitation, you're all in it, and it meets at the same time of day as lecture. On Tuesdays, the TA will lead recitation which will include a worksheet on that week's topics. In addition, On Thursdays, recitation will be devoted to working on the homework. Once to twice a week the TA will lead a recitation. The other days I will interactively lecture.

- Before each class you will be expected to complete:
  - Reading
  - Video
  - Concept Quiz
- Specifically there is reading+video+quiz to be completed *before* the first day of class.
- This class meets MTWThF 11:05-11:55 am via Zoom. The Zoom room will be open 15 minutes before and after each class. That's why the time listed in the Course Summary section of Canvas is before the class starts.
- Please let me know if your circumstances require you to participate largely asynchronously. I will work together with you to come up with an effective plan to supplement your experience.

Participation

In this course you will be responsible for both your own and your colleagues's learning. One way in which you can assist your colleague's learning is to ask questions. If you are confused about something, you are almost definitely not alone. Another key way is to fully participate in in-class interactive discussions, small-group discussions, and interactive voting.

Participation and engagement will be particularly challenging this semester as we will be participating remotely, both synchronously and asynchronously. But that makes it even more important. If you need to be asynchronous for some period of time, please let me know in advance. I will otherwise expect you to be present in every class meeting, wehther that be lecture or recitation.

We will use an interactive response system to provide concrete opportunities to commit to an idea and then evaluate your own understanding. There will also be short writing assignments in Canvas to explore understanding and ability to explain concepts. These will be graded primarily on the quality and thoughtfulness of the questions and answers, rather than on finding the correct answer.

Homework

Each week you will complete a homework assignment that uses the material for the current week and builds on previous material. Discussion with classmates is certainly encouraged, but solutions should be your own. Please list the names of your colleagues with whom you worked on each homework assignments. There is no particular credit assigned to such a list – this is for your own benefit to acknowledge credit and contributions.

Homework is an opportunity to develop your understanding of the course material. Be honest with yourself about whether or not you fully understand a problem. The exams will test this.

Assignments shall be uploaded to Canvas.

Exams

There will be six light exams and a cumulative final.

These exams will fall somewhere in between a "quiz" and a normal "midterm". Because we will all be remote, the format for exams will be a little different. For each exam, you will be randomly assigned to a group. You are allowed and encourage to collaborate within your group. Each student will still submit their own written (and scanned) exam. On the class day following each exam, you will be assigned one of the exam questions for which to record a video explanation of how to solve the problem. These recordings should be done and submitted within the first 30 minutes of class. I anticipate the exams will have around 3 questions; so if you prefer, you could pre-record answers to all of the exam questions and avoid the stress.

Final

To be completely honest: I am still trying to figure out the final.

The final will be given remotely during the week after Thanksgiving. It will be worth 20% of the grade.

But there are still details I don't know. Most relevantly, will there be a specific time slots for synchrounous exams? If so, then I'll likely adapt a similar group-based + individual explanation model similar to the exams. But if not, I have to adapt a different model.

Grading

Percentage	Component
25%	Participation
25%	Homework
30%	Exams (at 5% each)
20%	Final

Calendar

Week of	Reading	Planned material
08/17	Chp 1	Dimensional Analysis and Estimation
		First class is Wednesday, August 19
08/24	Chp 2, 3	Motion and Vectors
08/31	Chp 4	Kinematics
		Exam 1, Fri, Sep 4
		Add/drop period ends Sep 4
09/07	Chp 5, 6	Dynamics, Friction and Viscosity
		We will *meet on Sep 7, Labor Day.*
09/14	Chp 7, 8	Work and Energy
		Exam 2, Fri, Sep 18
09/21	Chp 9	Momentum
09/28	Chp 10	Rotational Kinematics
10/05	Chp 11	Rotational Dynamics & Angular Momentum
		Exam 3, Fri, Oct 9
10/12	Chp 11	More on Rotational Dynamics & Angular Momentum
		Self-Care Day, Wed, Oct 14
10/19	Chp 12	Equilibrium and Elasticity
		Exam 4, Fri, Oct 23
10/26	Chp 13	Gravity
11/02	Chp 15	Springs and Harmonic Motion
		Exam 5, Fri, Nov 6
11/09	Chp 16	Waves
11/16	Chp 17	Sound Waves
		Exam 6, Fri, Nov 20
11/23		*No class (Thanksgiving)*
11/30	FINAL EXAM	Details to be announced later.

Acknowledgments

Attribution and credit is the core currency of respect and recognition in science.

The structure, lectures, assignments and other material in this course are based on an extensive history of physics education over the past 50 years, with roots extending beyond that. More specifically, my resources for this course are based on previous editions of this course taught by Prof. Adam Leibovich and Prof. Arthur Kosowsky.

Similarly, please credit your colleagues with whom you discuss and work with on homework.

Technology Needs

This course will be entirely online. Full participation will require a high-speed internet connection and a device that can connect to Zoom. Submission of assignments will require scanning or taking pictures of assignments and uploading to Canvas. If you do not have reliable access to any of these, please email me mailto:wmwv@pitt.edu and I will work out a solution with you.

Health and Safety Statement

In the midst of this pandemic, it is extremely important that you abide by public health regulations and University of Pittsburgh health standards and guidelines. While in class, at a minimum this means that you must wear a face covering and comply with physical distancing requirements; other requirements may be added by the University during the semester. These rules have been developed to protect the health and safety of all community members. Failure to comply with these requirements will result in you not being permitted to attend class in person and could result in a Student Conduct violation. For the most up-to-date information and guidance, please visit https://coronavirus.pitt.edu and check your Pitt email for updates before each class.

The above is the required statement in syllabi for this semester. Our class will not be physically meeting in person this term so these don't directly apply to our class experience. However, I certainly completely agree with the spirit of these precautions and requirements. A successful semester for everyone will depend on the actions of each person.

Disabilities

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the Office of Disability Resources and Services, 140 William Pitt Union, 412-648-7890/412-383-3346 (Fax), as early as possible in the term. Disability Resources and Services will verify your disability and determine reasonable accommodations for this course.

MWV: Particularly for this semester, please do contact me right away. The nature of assignments, participation, and assessments in the course mean that making appropriate accommodations will require advanced planning and thinking on my part.

Email and Canvas Communication Policy

Each student is issued a University email address (username@pitt.edu) upon admittance. This email address may be used by the University for official communication with students. Students are expected to read email sent to this account on a regular basis. Failure to read and react to University communications in a timely manner does not absolve the student from knowing and complying with the content of the communications. The University provides an email forwarding service that allows students to read their email via other service providers (e.g., Hotmail, AOL, Yahoo). Students that choose to forward their email from their pitt.edu address to another address do so at their own risk. If email is lost as a result of forwarding, it does not absolve the student from responding to official communications sent to their University email address. To forward email sent to your University account, go to http://accounts.pitt.edu, log into your account, click on Edit Forwarding Addresses, and follow the instructions on the page. Be sure to log out of your account when you have finished. (For the full email Communication Policy, go to www.bc.pitt.edu/policies/policy/09/09-10-01.html.)

You are responsible for following announcements on Canvas. By default these are sent to your Pitt email account. If you choose to change these notification settings, you remain responsible for understanding the content in Canvas notifications.

Academic Integrity

Cheating/plagiarism will not be tolerated. Students suspected of violating the University of Pittsburgh Policy on Academic Integrity, noted below, will be required to participate in the outlined procedural process as initiated by the instructor. A minimum sanction of a zero score for the quiz, exam or paper will be imposed. (For the full Academic Integrity policy, go to www.provost.pitt.edu/info/ai1.html.)

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.

The University of Pittsburgh does not tolerate any form of discrimination, harassment, or retaliation based on disability, race, color, religion, national origin, ancestry, genetic information, marital status, familial status, sex, age, sexual orientation, veteran status or gender identity or other factors as stated in the University's Title IX policy. The University is committed to taking prompt action to end a hostile environment that interferes with the University's mission. For more information about policies, procedures, and practices, see: https://diversity.pitt.edu/affirmative-action/policies-procedures-and-practices.

Because of the increased online nature of participation in the course this term, more of your interactions with classmates with occur more clearly under the auspices of this course.

Use of Class Recordings

Course meetings will be recorded primarily for the benefit of students who are not able to participate synchronously. These will also be useful for review of the material afterward. These recordings are not to be used or distributed outside the context of this course.

Natural Science General Education Requirement

This course fulfills one Dietrich School of Arts and Sciences Natural Science General Education Requirement (GER) as described for the GERs starting Fall 2018 (term 2191). That GER reads as follows:

Three Courses in the Natural Sciences These will be courses that introduce students to scientific principles and concepts rather than offering a simple codification of facts in a discipline or a history of a discipline. The courses may be interdisciplinary, and no more than two courses may have the same primary departmental sponsor.

Learning Objectives

Learning objectives are the list of things that you should be able to demonstrate that you can do by the end of this course. You might thus choose to call this section the "Study Guide". After completion of course students will be able to:

1. Evaluate, using dimensional analysis, which key parameters are needed to understand a new problem.
2. Create an estimate for an approximate answer when faced with an unfamiliar problem.
3. 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.
4. Apply the equations of 1-D kinematics to one or more objects with constant acceleration. E.g., free-fall, two objects that meet one another, and an object that has different constant acceleration at different times.
5. Add or subtract two or more vectors. (Relative velocity problems are an application of this category.)
6. Calculate the dot product or cross product of two vectors.
7. Describe the behavior of an object undergoing projectile motion based on the equations of 3-D kinematics.
8. Apply a conceptual understanding of Newton's first and third law.
9. Draw a free-body diagram and solve for an unknown force or acceleration of a system under the influence of two or more forces.
10. Apply the equations of 3-D kinematics to one or more objects. E.g., when are the forces in a system balanced? where will an object impact a wall given an initial position, velocity, and force?
11. Integrate a specified time-dependent force, together with specified initial position and velocity, to determine the position of an object over time.
12. Calculate the force of static/kinetic friction or the coefficient of friction.
13. Calculate the drag force or terminal speed of an object.
14. Identify the centripetal force that acts on a system undergoing circular motion.
15. Evaluate when the limits of a system are reached. E.g., when does a rope go slack, when does an object stop/start accelerating, how quickly can an car make a turn on an inclined bank?
16. Find the work done by a force.
17. Calculate the average power provided by a force.
18. Apply conservation of mechanical energy to describe the motion of a system.
19. Use the work-energy theorem to identify the amount of mechanical energy that has been lost.
20. Calculate the average force during a collision or series of collisions.
21. Apply conservation of momentum to an explosion or collision. Identify whether a collision is elastic, inelastic, or completely inelastic.
22. Use the rocket equation to design a rocket capable of delivering a payload to orbit, another planet, or another star system.
23. Apply kinematics to a rotating system. Covert between the tangential values of s, v, a and θ, ω, and α using the radius r.
24. Distinguish between angular, tangential, and centripetal acceleration.
25. 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.
26. Use the definition of static equilibrium to solve for one or more unknown forces or torques acting on a system.

27. Calculate the motion of a rolling object using torques and/or energy conservation. “Rolling” could be due to external contact or caused by a cord wrapped around the object, like in a yo-yo.
28. Calculate the rotational kinetic energy of an object.
29. Identify whether angular momentum is or is not conserved, and if appropriate, apply conservation of angular momentum to a rotating system.
30. Analyze equilibrium for a specific real-world example and determine its range of stability.
31. Calculate the deformation of a structure using the Young’s modulus.
32. Apply the concepts of stress, strain, and ultimate strength to a deformed object.
33. Calculate a spring constant given the elastic properties of a material.
34. Calculate the gravitation acceleration for an object inside or outside of a planet, given some combination of mass, radius, and density.
35. 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.
36. Use Kepler’s laws of planetary motion to describe the motion of a planet, moon, or satellite about its parent body.
37. 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.
38. Apply conservation of mechanical energy to a simple harmonic oscillator (spring, simple pendulum, or physical pendulum) with damping.
39. 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, calculate the propagation speed using the tension and linear density.
40. Predict the result of interference between two waves with identical amplitude and frequency. Specifically, identify constructive, destructive, and intermediate interference - determine the amplitude and/or phase difference in the later case.
41. Identify the resonant frequencies and/or harmonics of a string or an open or closed pipe.
42. Apply the equation for the Doppler effect to determine the shift in frequency caused by motion.