

# University of Pennsylvania

School of Arts and Sciences  
Department of Physics and Astronomy

## Physics 140/150 – Fall 2022

### Course Overview

This calculus-based course is recommended for science majors and engineering students. Content includes classical laws of motion; interactions between particles; conservation laws and symmetry principles; particle and rigid body motion; gravitation, and harmonic motion. Four key concepts are force, conservation of energy, conservation of momentum, and conservation of angular momentum. These allow us to predict and understand the motion of many objects over an impressive range of length and time scales (e.g. tennis balls, roller-coasters, pendulums, and planets). Critical thinking skills developed during this course are explanation, analysis, and evaluation.

We begin by describing and predicting the motion of objects that move in one dimension in a straight line (Olympic sprinters and dropped stones) in terms of displacement, velocity and acceleration. Then we study the motions of objects that move in two dimensional curved paths (projectile motion, uniform circular motion). Newton's Three Laws of motion allow us to understand the forces causing these motions. Identifying all the force vectors acting on an object and drawing free-body diagrams showing their directions is a key technique. The general principle of Conservation of Energy states that energy is never created or destroyed but is merely changed from one form to another. Energy is an extremely useful concept for understanding situations with forces that are not constant, including objects moving on curved surfaces, masses interacting with springs, and elliptical satellite orbits. The general principle of Conservation of Momentum applies in all three dimensions, and relates the momentum vectors of objects before and after collisions and explosions.

In the second part of the course, we describe the rotational motion of extended objects in terms of angular displacement, angular velocity, angular acceleration, angular momentum, and rotational kinetic energy. The free-body diagram technique is generalized to indicate *where* each force is applied on an object in order to calculate a lever arm and thus a torque. Newton's Three Laws of motion, generalized to rigid body rotation, allow us to study angular acceleration as a response to applied torques. Conservation of Energy now includes rotational kinetic energy. Conservation of Angular Momentum is introduced as a new general principle. Rigid body collisions with rotational recoil are studied.

In the last part of the course, we extend these methods to study several important topics: rolling without slipping, the stability of bridges and ladders as states of static equilibrium with balanced forces and torques; the orbits of planets and other celestial objects; simple harmonic motion of mass-spring systems.

Math skills: addition of vectors and resolving components of vectors are essential from the start of the class. Multiplication of vectors and single variable calculus will also be used. First year Calculus (Math 1400 or equivalent) is co-requisite.

### Instructor

See your individual Site Canvas Web Page for information about your instructor's office and office hours, as well as the Combined Site Page that lists all instructors' office hours.

## TA

See your Section Canvas Web Page for information about your TA.

## Textbook

The textbook for the course is: **Hugh D. Young and Roger A. Freedman: *University Physics*, Addison-Wesley, 15<sup>th</sup> Edition.** The textbook is available in the Penn Bookstore. You are not required to purchase the additional electronic materials such as Mastering Physics. There is free access to ActivPhysics.

## Course Organization

**Masking Policy: Everyone in Physics 140/150 is required to wear a properly fitting facemask (e.g. KN95, KF94, N95 or surgical mask) in classroom settings. This applies to all students, faculty, and staff in lecture, active-learning sessions, recitations, exams, laboratories.**

Each section may organize its rostered meeting hours differently. The evening hour Tuesdays at 5:15-6:45PM, will be used twice during the semester for the two mid-term exams. This time may also be used for review sessions, make-up lectures or additional problem solving sessions, so you should keep it as “open.”

Class meetings will highlight the most important points in the weekly topics and work through a few detailed examples. Most sections are organized in an active learning (“flipped classroom”) format. In this mode small groups of students work collaboratively on assigned problems in class, with guidance from the instructor and TA. To prepare for active learning sessions you need to study selected sections of the text and/or notes and videos posted to the course website. In this course format the calendar of out-of-class asynchronous instruction (i.e. readings and video lectures) is supplemented by in-person discussion and interactive learning exercises.

Problem solving skills are best developed by lots of practice. Outside of class you should review the lecture examples and active learning exercises and work up solutions to the assigned homework problems. Try to manage your time to do this on a regular schedule each week, trying 4 or 5 problems every other day to master the material. It is likely that you will not be able to solve all of the homework problems on your first attempt. Don't be discouraged by this: it is an opportunity to ask questions and learn new ideas. Rushing before homework submission deadlines or cramming for exams is unproductive.

## Exams, Quizzes, and Homework

There are two midterms and one final exam:

**1<sup>st</sup> Midterm Exam: Tuesday October 11 @ 5:15 PM**

**2<sup>nd</sup> Midterm Exam: Tuesday November 15 @ 5:15 PM**

**Final Exam: During Final Exam Week (Date and Time TBA)**

Exams will take place simultaneously for all sections in separate lecture halls. You will be assigned to a lecture hall based on your section or surname. Your assigned exam room will be announced a few days prior to each exam. You must go to your assigned room. **During all exams and quizzes, the use of cell-phones – even just as calculators – is forbidden.** Bring an actual calculator with no communication or note storage capability!

**There will be no make-up exams for the midterms for any reason.** Please inform your Professor during the first week of the semester if you have a conflict with the midterm dates. If you are ill or have a serious family emergency before the midterm, then please inform your professor **before** the midterm exam and see the instructions below on registration of absences. In the event of an excused absence, the course grade will be based

on the **remaining exam and quizzes scores**. If you fail to take a mid-term exam and the absence is not excused, you will receive a score of zero for that exam.

**There is a make-up in January 2023 for the final exam.** You may choose to take this make-up exam only if you have three final exams on the same calendar day as the Physics 140/150 final exam *and* the Physics exam is the middle exam. You must inform your instructor one month *in advance* of the final exam if you wish to exercise this option. If you are ill or have a serious family emergency that prevents you from taking the final exam, again you must inform your instructor before the final exam, and if your absence is excused, you must make up the final exam in January 2023.

**Homework:** Homework will be assigned each week, and in some sections it will be collected and graded. Homework should be submitted to an upload portal on Canvas by the date and time posted to the Canvas assignment page (usually this will be Fridays at 11:59 PM). **Note that homeworks are uploaded to a portal on the combined Canvas site and not the Section sites.** The lowest homework grade will be dropped. Late homework will receive zero credit. After the weekly homework is collected, solutions will be posted on Canvas.

You are encouraged to collaborate with your colleagues on the homework and to come to office hours with questions about the homework. During the collaborative active learning sessions you will have direct opportunity to do this. Collaboration is encouraged. But *copying* homework solutions from your colleagues or from on-line resources is cheating, not collaboration. Needless to say this is strictly forbidden (and is a violation of the Penn Code of Academic Integrity ([http://www.upenn.edu/academicintegrity/ai\\_codeofacademicintegrity.html](http://www.upenn.edu/academicintegrity/ai_codeofacademicintegrity.html)))

**Quizzes:** If quizzes are given in your section, there will be about 10 quizzes during the semester. A calculator may be required and you are expected to bring a calculator for every quiz. No cell phones may be used during quizzes even as a calculator. The quizzes will be held during class at a time announced by your instructor. The lowest quiz score will be dropped in determining the final quiz average; you cannot be excused from additional quizzes due to illness, athletic events etc. If you miss a quiz, you will receive a score of zero for that quiz. **There are no make-ups.** Each section will have different quizzes, and the quiz and homework scores of each section will be normalized so that the average quiz/homework score of all of the sections are identical. Each section may also have other components that enter the class participation grade, such as active learning scores, etc., and these will be treated in the same way.

**Absences:** Please enter any absences in the Course Absence Report system using Penn-In-Touch. *“The Course Absence Report (CAR) system has been designed to provide a consistent way for students to notify course instructors of short term absences for one or more courses. It also provides a method for advising offices to track absences and coordinate support for students who miss classes. **The submission of a CAR does not excuse you from your course obligations, students are still responsible for following up with each professor directly and adhering to course policies and procedures as outlined in the syllabus.**”* For more information on CAR, see <http://www.upenn.edu/registrar/CIT/CIT-CAR-User-Guide.pdf>.

## Physics 150 Labs

The schedule of labs is posted outside DRL 3N18. It, and other related information, is also available online at: <https://www.physics.upenn.edu/index.php/undergraduate/undergraduate-physics-labs>.

The laboratory experiments are intended to supplement the lectures in the course by providing concrete demonstrations of the specific physical principals and by giving some insight into how those principles operate in practice. The rooms in which the experiments will be performed change from week to week, and will be posted on bulletin boards located outside DRLB 3W5 and 3N18.

## Grading Rubric

Final Examination	40%
Midterm Exam 1	20%
Midterm Exam 2	20%
Homeworks/Quizzes/Worksheets	20%

**To pass Physics 150, you must complete all the labs and obtain a passing grade in the labs.**

## Academic Integrity

All students in Physics 140 and 150 are expected to comply with the University of Pennsylvania's Code of Academic integrity: [http://www.upenn.edu/academicintegrity/ai\\_codeofacademicintegrity.html](http://www.upenn.edu/academicintegrity/ai_codeofacademicintegrity.html).

## Syllabus

We will cover approximately one chapter per week. The course is fast moving so be careful not to fall behind! Sections that are "omitted" may be discussed in class but will not show up directly on exams. Please prepare by reading Chapters 1 and 2 before the course commences.

### Week beginning:

Tues Aug 30	Ch. 1+2: Kinematics: Motion in One Dimension
Tues Sep 6	Ch. 3: Kinematics: motion in two dimensions (projectiles) not including 3.4
Mon Sep 12	Ch. 4: Force and Newton's Laws of Motion
Mon Sep 19	Ch. 5.1 through 5.3: Applying Newton's Laws
Mon Sep 26	Ch. 3.4, 6: Uniform Circular Motion, Work, Kinetic Energy
Mon Oct 3	Ch. 6, Ch.7 Kinetic and Potential Energy (1/2 week: fall break 6-9 October)
Mon Oct 10	Last day to drop the course
Mon Oct 10	Ch. 7: Conservation of Energy
<b>The first midterm exam is on Tuesday October 11 at 5:15pm on Ch. 1-6</b>	
Mon Oct 17	Ch. 8: Impulse and Momentum; Conservation of Momentum
Mon Oct 24	Ch. 9: Rotational kinematics, Rotational Kinetic Energy
Mon Oct 31	Ch. 10: Torque and Angular Acceleration (1/2 week: exam week)
Mon Nov 7	Ch. 10: Angular Momentum
Mon Nov 7	Last day to withdraw from a course
Mon Nov 14	Ch. 11: Static Equilibrium
<b>The second midterm exam is on Tuesday November 15 at 5:15pm on and Chapters 7-10.</b>	
Mon Nov 21	Ch. 13: Gravity (1/2 week: Thanksgiving)
Mon Nov 28	Ch 13-14: Gravity and Kepler's Laws; Periodic Motion
Mon Dec 5	Ch. 14: Periodic Motion (continued)
Mon Dec 12	Last Day of Class

**The final exam is scheduled by the registrar during the exam week (time and place TBA). It is cumulative with emphasis on Chapters 10, 11, 13 and 14.**

Sections in the chapters that are specified above as omitted will not be covered on exams; some of the content of these sections may be covered in lecture.

Also not examinable on quizzes, midterms, and final exams are the following: We skip Ch.12.

Although exams may emphasize more recent material, all exams are cumulative – they may have problems that require knowledge of all of the course material covered up to that point in the course.