Physics 150: Introductory Physics I *Spring 2024*

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	Room	Time
Lecture	Eaton 110	10:50-11:50 MWF
Laboratory Sec. 11	Eaton B13	1:10-4:10 M
Laboratory Sec. 12	Eaton B13	1:10-4:10 T

Texts & Materials

- Hugh Young, Roger Freedman, and A. Lewis Ford, *University Physics*, 15th Edition
- S.J. Ling, *et al.*, *OpenStax University Physics Vol. 3*, a free, open text
- Physics 150 Laboratory Manual, available in the College Store
- 5×5 Quad Ruled Laboratory Notebook Available in the College Store
- Homework Solutions, on reserve in the library
- Simple scientific calculator with one-variable statistics such as the CASIO *fx-260 II* or TI-30XIIS

Course Objectives

Physics is the fundamental study of the behavior of matter, energy, space, and time. It is a quantitative and mathematical science. By the end of the course, students should have a working knowledge of the elementary principles of mechanics and waves and their expression in mathematical form. Students should be able to apply these principles to simple problems stated in plain English.

About Your Professor

Prof. Allen is a theoretical physicist working on particle physics and gravitation. He received his Ph.D. from Caltech in 1988 for work in string theory. He has been teaching—at the University of Wisconsin, the California Institute of Technology, SUNY Utica/Rome, and now HWS—since 1980. Besides physics, some of his other interests are calligraphy, computers, electronics, herbology & natural health, watchmaking, yoga, and the martial art Aikido.

About Physics 150

The subjects covered in this class relate to phenomena that are common and objects that are visible. Most of what we'll study was well understood before the 20th century; this is perhaps the last "common sense" physics course, though we will study a little relativity and quantum mechanics, some of the more exciting developments of the 20th century.

This course is primarily a problem-solving course. There are only a few principles a week that we will study, however there are many ways to use the principles. Learning to use the principles is best accomplished through solving lots of problems. Working together in groups is a good way to learn this material. Just having a numerical answer is usually not very useful for understanding; it is much better to spend time first trying figure out how to get to the answer from what you know and *then* calculating the answer. To do well in this course, most students will need to study at least ten hours per week outside of class. Going to office hours, at least occasionally, is also necessary for most students and strongly recommended.

Syllabus Revisions

This syllabus is subject to revision, with grading policy limitations. Any revisions of the grading policy will not result in a lower grade for the course. Revised versions will be distributed on my website and notice of revision will be given in class or by email.

Office Hours
Office hours initially are Tuesday 11:00 – 12:00, and Friday 2:00 – 4:00, and by appointment. Participation credit is given for office hour visits. Be sure to sign in.

Course Requirements

- Laboratory
- Recitation
- Daily reading assignments in text
- Class attendance and involvement
- Homework
- Quizzes
- 2 Hour Exams
- Final Exam

Grading Policy
The class will be graded on a straight percentage with the following breakdown:

A: 88% – 100% B: 75% – 87% C: 60% – 74%
D: 50% – 59% F: < 50%

The exams are not graded on a "curve," unless there is evidence that the exams were inappropriately difficult. In that case, extra points will be added to each exam to bring the average up to the appropriate level. In other words, an exam score of 80% is guaranteed to be at least a "B−." The final grade will be composed of five elements, three of which are the quizzes and exams. The other two elements are the laboratory and participation. The numerical grade will be computed using two schemes and the course grade will determined by the higher of the two.

α	β	Element
10%	10%	participation
20%	20%	laboratory
30%	15%	hour exams
10%	5%	quizzes
30%	50%	final exam

Early & Late Policy
A student who misses a quiz and has a valid excuse may take a quiz the next day for 80% credit. A student who misses an hour exam and has a valid excuse (a note from your physician or an acceptable alternative), will be allowed to count the other hour exam for twice the weight. Any students must check with me **before** missing an exam unless they fall ill suddenly before the exam, in which case they should contact me as soon as they are well. **There will be no makeups for the hour or final exams and neither will exams be given early.** Athletes engaged in post-season play may take the final exam on the road **at the time set by the Registrar** if it will be closely proctored by a coach.

Homework
It is very important to do the homework. Doing the homework thoroughly and correctly is the most important and valuable part of the course, at least insofar as learning the material is concerned. It is also helpful to do additional problems of your own choosing from the course text or any other source. Your grade is more a reflection of how much useful work you did outside of class than of how "mentally quick" you are.

Exams
There will be two hour exams and a final exam. The hour exams will be during the lecture period on February 28 and April 10. The final exam will be during the period set by the Registrar's office, which should be Wednesday, May 8, 2024 at 8:30 AM. The hour exams will each be at least three problem pages. Students are allowed to bring one **handwritten (not xeroxed)** 8.5″× 11″ page (one side) of notes in their own hand to each hour exam and two **handwritten (not xeroxed)** 8.5″× 11″ pages (two sides total) in their own hand to the final exam. Note sheets will be handed in with the exams. Bringing note sheets that do not conform to these specifications is academic dishonesty and will result in a lower grade in the course. **Smartphone calculator apps are not allowed on exams.**

Quizzes
There will be short quizzes in lecture or discussion labs every so often, announced in advance in lecture. They will usually be a single problem, sometimes two or three very short problems. Students are allowed to bring a **handwritten (not xeroxed)** $3'' \times 5''$ card (one side) of notes in their own hand to each quiz.

Laboratory Policies and Procedures
The laboratory is taught by Mr. Dan Dumitriu. A separate syllabus for the lab will be on Canvas. Students must bring their laboratory manual to each lab, along with a lab notebook, a pen, a pencil, a scientific calculator, and a laptop computer with a spreadsheet program. Smartphone calculator apps are not acceptable. A lab notebook should be a bound notebook that has graph ruled (quadrille) lines. Keeping a neat lab notebook is important, especially as a concise, neat notebook is very helpful for writing a lab report. Students must study the relevant sections in the lab manual before coming to each laboratory.

Students are allowed no more than one make-up lab, and only when a lab is missed because of illness or other involuntary event. It is the student's responsibility to inform their lab instructor of their intention to make up a lab, and this request must be made by the Friday of the week in which the lab was missed. The time and date of the make-up will be coordinated between the student and their lab instructor. Each missed lab that is not made-up will be entered as zero in the grade book.

As with exams and quizzes, all laboratory reports are subject to HWS community standards of academic integrity on plagiarism. In particular, any report submissions closely resembling those of other students or the lab manual **without attribution** will be subject to investigation and possible disciplinary action.

Physics Teaching Fellows Program
Assistance with course concepts and problem-solving is available through the Teaching Fellows Program. Time spent working with a fellow is time well spent. Note that the Fellows are not meant to replace the one-on-one tutoring offered through CTL, which remains available, nor to replace faculty-student interaction.

The Physics Teaching Fellows hold sessions in Eaton 111. Their hours will be posted outside the door. The physics department encourages you to take full advantage of this program. Visits to the Teaching Fellows earn participation credit. Please be sure to sign in.

Disability Accommodations
Students with a documented disability for which they may need accommodations that they have not yet obtained should self-identify by logging into the Accommodate Portal and complete the Accommodation Request Intake Form. Accommodations and services will only be provided once the registration and documentation process is complete. See the guidelines for documenting disabilities. Returning students may log in to the Accommodate Portal and request semester accommodation letters. Students who need to meet to add or discuss accommodations should schedule an appointment in the Accommodate Portal.

Direct questions about this process or Disability Services at HWS to Shanelle France or Thom Mascia (x3351), in Disability Services Administrator at CTL. Should you need to meet to add or discuss accommodations, please schedule an appointment in the Accommodate Portal.

Academic Integrity
Students should familiarize themselves with the principles of academic integrity in the handbook of community standards. Work on an exam or quiz that is clearly not one's own will receive zero credit. **All future recommendation letters will mention any relevant academic dishonesty.** Deceit in the form of academic dishonesty is indicative of untrustworthiness and low moral character in general and therefore ought to disqualify a student from any future position of responsibility. Exams sometimes have several versions with subtle differences that are hard to discern at a glance but make it very easy to spot who received help, and often who gave that help.

Syllabus: Topics and Laboratories

This is the schedule of the subjects to be discussed in lecture and the laboratories and discussions that will be done that week in your laboratory section, on Monday or Tuesday. Following this table, there are tables of homework assignments and reading, keyed by lecture number. Your first reading assignment in any course should be the syllabus. Accordingly, you must email me before 5:00 pm Friday January 26 and tell me that you have read the whole syllabus. Reading the syllabus in a timely fashion will count toward your participation grade.

Date	**#**	**Lecture Topics**	**Laboratory**
[1] Mon 22 Jan	1	Space, Time, Mass · Units · Prefixes · Dimensional Analysis	*Discussion*
Wed 24 Jan	2	Newtonian World View · Displacement · Velocity · Acceleration	*Lab*
Fri 26 Jan	3	Motion with Constant Acceleration · Free Fall	
[2] Mon 29 Jan	4	Vectors · Components · Algebra · Geometry	*Measurement &*
Wed 31 Jan	5	Vector Multiplication · Scalar & Vector Products	*Uncertainty*
Fri 2 Feb	6	2D & 3D Motion · $(\vec{\mathbf{v}} \cdot \vec{\mathbf{a}})$ · Projectiles	*Lab*
[3] Mon 5 Feb	7	Circular Motion · Relative Motion · Frames of Reference	*Discussion*
Wed 7 Feb	8	Einsteinian Revolution · Simultaneity · Time Dilation	*Lab*
Fri 9 Feb	9	Forces · Newton's Laws · Weight · Free Body Diagrams	
[4] Mon 12 Feb	10	Using Newton's Laws	*Average &*
Wed 14 Feb	11	Friction	*Instantaneous*
Fri 16 Feb	12	Dynamics of Circular Motion · Fundamental Forces	*Velocity*
[5] Mon 19 Feb	13	Work · Kinetic Energy · Work-Energy Theorem	*Force*
Wed 21 Feb	14	Work & Energy in General · Power	*Table*
Fri 23 Feb	15	Gravitational Potential Energy · Elastic Potential Energy	
[6] Mon 26 Feb	16	Conservative Forces · Force & Potential Energy · Energy Diagrams	*Discussion Lab &*
Wed 28 Feb		**Exam 1**	*Exam Review*
Fri 1 Mar	17	Momentum · Momentum Conservation · Collisions	
[7] Mon 4 Mar	18	Inelastic & Elastic Collisions · Center of Mass	*Discussion*
Wed 6 Mar	19	Relativistic Energy & Momentum · Correspondence Principle	*Lab*
Fri 8 Mar	20	Rigid Bodies · Angular Motion · Angular Kinematics	

Date	#	Lecture Topics	Laboratory
[8] Mon 11 Mar	21	Relating Linear & Angular Motion · Kinetic Energy · Moment of Inertia	*Newton's*
Wed 13 Mar	22	Torque · Newton's 2nd Law for Rotation	*Second*
Fri 15 Mar	23	Rotation about a moving axis · Angular Work & Power	*Law*
		Spring Break	
[9] Mon 25 Mar	24	Angular Momentum · Gyroscopes & Precession	*Discussion*
Wed 27 Mar	25	Equilibrium · Center of Gravity	*Lab*
Fri 29 Mar	26	Deformations · Stress · Strain · Elasticity	
[10] Mon 1 Apr	27	Fluids · Density & Pressure · Hydrostatic Pressure	*Discussion*
Wed 3 Apr	28	Buoyancy · Describing Fluid Flow	*Lab*
Fri 5 Apr	29	Bernoulli's Equation	
[11] Mon 8 Apr	30	Universal Gravitation · Potential Energy · Spherical Mass Distributions	*Discussion Lab &*
Wed 10 Apr		**Exam 2**	*Exam Review*
Fri 12 Apr	31	Kepler's Laws · Satellites · Black Holes	
[12] Mon 15 Apr	32	Simple Harmonic Motion · Governing Differential Equation · Energy	*Simple*
Wed 17 Apr	33	Pendula · Damped Oscillations · Resonance	*Harmonic*
Fri 19 Apr	34	Waves · Wave Equation & Solutions · Sinusoidal Waves	*Motion*
[13] Mon 22 Apr	35	Waves on a String · Energy & Power in Waves	*Standing*
Wed 24 Apr		**HWS Day – No class**	*Waves*
Fri 26 Apr	36	Superposition · Interference · Boundary Conditions	
[14] Mon 29 Apr	37	Standing Waves · Normal Modes	*Discussion Lab &*
Wed 1 May	38	Sound Waves · Sound Speed · Sound Intensity · Normal Modes of Pipes	*Final Exam Review*
Fri 3 May	39	Resonance · Interference · Beats · Doppler Effect	
Wed 8 May		**Final Exam in Eaton 110 8:30 AM**	

Reading and Homework Problems

Your reading and homework assignments are from Young and Freedman 15th Edition, **except for Lectures 8, 19, and 38, which are in Ling *et al.*, OpenStax Physics Vol. 3, denoted "OS" below**. *The reading assignments are to be done before lecture* on the day in which they are assigned.

Homework assignments are to be *done* by the lecture following the one in the table in which they are assigned. Homework assignments should be *attempted* by the lecture before they are to be done. Problems that are daggered† require integral calculus, which is not a requirement of the course.

Prof. Walter Lewin's MIT lectures, while not required, are strongly recommended. Hearing his excellent explanation of the material is very helpful. These web-accessible resources are linked into the PDF version of this syllabus. Note that they are only available to those on the internal HWS network and they will not play until they are completely downloaded, so be patient.

If the webserver is down, or if you are not on the campus network, you can also find the lectures on `YouTube` or `Archive.org`.

Lec #	Reading & Suggested Viewing	Homework Assigned
1	Ch 1; §*1-6*; Lewin's Lec 1	Q1.1, Q1.6, Q1.8, Q1.9; 1.1, 1.6, 1.11, 1.16, 1.19
2	Ch 2: §*1-3*; Lewin's Lec 2	Q2.3, Q2.5; 2.1, 2.3, 2.8, 2.9, 2.15, 2.53
3	Ch 2: §*4,5*	Q2.15, Q2.18; 2.19, 2.23, 2.29, 2.39, 2.80
4	Ch 1: §*7-9*; Lewin's Lec 3	Q1.15, Q1.22; 1.25, 1.29, 1.33, 1.39
5	Ch 1: §*10*	1.41, 1.43, 1.46, 1.74, 1.86
6	Ch 3: §*1-3*; Lewin's Lec 4	Q3.5, Q3.6; 3.4, 3.13, 3.19, 3.45, 3.61
7	Ch 3: §*4,5*	Q3.10, Q3.11, Q3.12; 3.31, 3.34, 3.38, 3.41, 3.53†, 3.65
8	**OS** Ch 5: §*1-4*	**OS** 1, 5, 23, 28, 31
9	Ch 4: §*1-6*; Lewin's Lec 7	Q4.4, Q4.13, Q4.25, Q4.28, Q4.37, Q4.38; 4.1, 4.4, 4.6, 4.24, 4.35, 4.37
10	Ch 5: §*1,2*; Lewin's Lec 6	Q5.1, Q5.3; 4.46, 5.6, 5.15, 5.60, 5.91
11	Ch 5: §*3*; Lewin's Lec 8	Q5.14; 5.23, 5.34, 5.37, 5.87, 5.95
12	Ch 5: §*4,5*; Lewin's Lec 5	Q5.19; 5.45, 5.48, 5.49, 5.51, 5.107
13	Ch 6: §*1,2*; Lewin's Lec 11	Q6.1, Q6.4, Q6.12; 6.3, 6.8, 6.19, 6.20, 6.24
14	Ch 6: §*3,4*	Q6.16, Q6.20, Q6.22; 6.34, 6.35, 6.37, 6.56, 6.71, 6.81
15	Ch 7: §*1-3*	Q7.1, Q7.5, Q7.16; 7.5, 7.9, 7.12, 7.15, 7.28†, 7.51
16	Ch 7: §*4,5*; Lewin's Lecs 12 & 13	Q7.15, Q7.20; 7.32, 7.35, 7.36, 7.41, 7.55
17	Ch 8: §*1-3*; Lewin's Lec 15	Q8.2, Q8.9, Q8.10; 8.3, 8.7, 8.24, 8.30, 8.41
18	Ch 8: §*4,5*; Lewin's Lec 16	Q8.22, Q8.24; 8.46, 8.49, 8.82, 8.92, 8.99
19	**OS** Ch 5: §*8-9*	**OS** 55, 57, 67
20	Ch 9: §*1,2*	Q9.4, Q9.6, Q9.7; 9.5, 9.10, 9.14, 9.15

Lec #	Reading & Suggested Viewing	Homework Assigned
21	Ch 9: §*3,4*; Lewin's Lec 19	Q9.9, Q9.10, Q9.14; 9.25, 9.45, 9.67, 9.77
22	Ch 10: §*1,2*	Q10.2, Q10.7, Q10.8; 10.1, 10.5, 10.7, 10.9, 10.59, 10.69
23	Ch 10: §*3,4*	Q10.14, Q10.25; 10.21, 10.22, 10.34, 10.79
24	Ch 10: §*5-7*; Lewin's Lec 20	Q10.16, Q10.22; 10.42, 10.45, 10.63
25	Ch 11: §*1-3*; Lewin's Lec 25	Q11.4, Q11.5, Q11.7; 11.7, 11.13, 11.16, 11.74
26	Ch 11: §*4,5*; Lewin's Lec 26	Q11.14, Q11.17; 11.27, 11.36, 11.44, 11.80, 11.89
27	Ch 12: §*1,2*	Q12.4, Q12.5, Q12.16; 12.5, 12.10, 12.54, 12.63
28	Ch 12: §*3,4*; Lewin's Lec 27	Q12.13, Q12.18, Q12.20; 12.33, 12.41, 12.72
29	Ch 12: §*5,6*; Lewin's Lec 28	Q12.23, Q12.25, Q12.29; 12.45, 12.48, 12.81, 12.83
30	Ch 13: §*1-4*; Lewin's Lec 14	Q13.1, Q13.6, Q13.9, Q13.18; 13.4, 13.5, 13.25, 13.64
31	Ch 13: §*5,6,8*; Lewin's Lecs 22 & 24	Q13.14, Q13.17, Q13.20; 13.26, 13.30, 13.43, 13.61, 13.74†
32	Ch 14: §*1-4*; Lewin's Lec 10	Q14.1, Q14.3; 14.4, 14.11, 14.18, 14.21, 14.27
33	Ch 14: §*5-8*; Lewin's Lecs 24 & 21	Q14.12; 14.41, 14.53, 14.66, 14.87
34	Ch 15: §*1-3*	Q15.1, Q15.6; 15.3, 15.5, 15.8, 15.9. 15.12, 15.47
35	Ch 15: §*4,5*	Q15.4; 15.15, 15.22, 15.23, 15.24
36	Ch 15: §*6,7*	Q15.12; 15.35, X.1, X.2
37	Ch 15: §*8*; Lewin's Lec 31	15.36, 15.39, 15.72
38	Ch 16: §*1-4*	Q16.1, Q16.5, Q16.6; 16.3, 16.8, 16.18, 16.24, 16.28
39	Ch 16: §*5-8*	Q16.11, Q16.18; 16.33, 16.36, 16.39, 16.40, 16.59, 16.61