Physics 160: Introductory Physics II *Spring 2013*

URLs in the PDF version of this syllabus are clickable links *Version 1.0*

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Physics 160	Room	Time
Lecture	Eaton 111	10:10-11:05 MWF
Laboratory 11	Eaton B18	1:30-5:00 T
Laboratory 12	Eaton B18	1:30-5:00 W

Texts & Materials

- Hugh Young, Roger Freedman, and A. Lewis Ford, *University Physics*, 13th Edition
- Physics 160 Laboratory Manual, available at the College Store
- Hayden-McNeil Physical Sciences Lab Notebook, ISBN 978-1-930882-70-6
- Instructors' Solution Manual, on reserve in the library
- Simple scientific calculator with 1 variable statistics such as the CASIO *fx-260*

Objectives

Students in this course will obtain a working knowledge of electrical and magnetic phenomena, geometric and wave optics, and the old quantum theory. Students should be able to apply these principles to simple problems stated in plain English.

About Physics 160

The theory of electromagnetism is the crowning achievement of 19th century physics. James Clerk Maxwell provided the missing piece that joined magnetism with electricity. He also showed that there should be waves of electric and magnetic fields that traveled at the speed of light. Maxwell's theory also contained the seeds of the destruction of Newton's mechanics, which was finally replaced by Einstein's relativistic mechanics one hundred years ago. Within twenty years of Einstein's discovery, the whole classical picture was overthrown by the advent of quantum mechanics. We'll briefly touch on the old quantum theory. Quantum mechanics has yet to be replaced by a better theory.

I hope you'll agree that the second term of introductory physics is the beginning of the most interesting part of physics; physics starts to seem less mechanistic and more "mysterious," though it is still heavily grounded in mechanics. About half of the semester will be spent studying electricity and magnetism and we'll follow Maxwell by showing that electromagnetic waves travel at the speed of light. We'll also study the behavior of light. The end of the course will be an introduction to quantum physics as applied to atoms and their spectra.

This class satisfies both goal 3 (quantitative reasoning) and goal 4 (scientific inquiry).

About Your Professors

Prof. Allen is a theoretical physicist working on particle physics and gravitation. He has been teaching at the University of Wisconsin, the California Institute of Technology, SUNY Utica/Rome, and HWS since 1980.

Prof. Nollenberg is an astrophysicist working on gravitational lensing, galactic astrophysics, and the large scale structure of the universe. He has been teaching at the University of Minnesota, The University of St. Thomas, Hamline University, Macalaster College, and HWS since 1996.

Time Requirements

In addition to three lectures and one laboratory a week, students should expect to spend between eight and twenty hours per week on studying, homework, and writing laboratory reports.

Grading
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 your final 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

Late Policy
If you miss a quiz and you have a valid excuse, you may take a quiz the next day for 80% credit. If you miss an hour exam and have a valid excuse (a note from your physician or an acceptable alternative), you will be allowed to count the other hour exam for twice the weight. You must check with me **before** you miss the exam unless you fall ill suddenly before the exam, in which case you should contact me as soon as you are well. **There will be no makeup for the final exam.**

Homework
It is very important that you 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.

Quizzes
There will be short quizzes in lecture or discussion lab every so often, announced in advance. They will usually be a single problem, sometimes two or three very short problems. You will be allowed to bring a **handwritten** 3″× 5″ card (one side) of notes to each quiz.

Exams
There will be two hour exams and a final exam. The hour exams will be in lecture on February 20 and April 3. The final exam will be during the period set by the Registrar's office, which should be Saturday, May 11, 2013 at 8:30 AM. The hour exams will each be at least three problem pages. You will be allowed a calculator on the exams, but not a smartphone calculator app. You will be allowed to bring one **handwritten** 8.5″× 11″ page (one side) of notes to each hour exam and two **handwritten** 8.5″× 11″ pages (two sides total) to the final exam.

Laboratories
The laboratories are taught by Prof. Nollenberg. **All of the laboratories must be completed in order to pass the course. A laboratory is not complete until you have handed in a laboratory report.** You must have a laboratory manual and you must bring the lab manual, your lab notebook, and a calculator to each laboratory. Laboratory sections meet every week. Prof. Nollenberg will give you a schedule of what laboratory you are doing every week. You must have studied the lab

manual *before* entering the laboratory. All students in laboratory are expected to contribute to their lab group's efforts and to solve any problems that may arise by thinking about what they should do to get the experiment to work and trying it before asking for help. Keeping a neat lab notebook is important (especially since concise, neat notebooks are generally much more helpful when you are writing your lab report.) If you cannot state what you are doing or what you learned simply and concisely, then you probably need to think more about it!

Prof. Allen's Office Hours
Office hours are Monday 2:00 – 3:00, Thursday 10:30 – noon, Friday 2:30 – 4:00, and by appointment. You may stop by outside of regular office hours to see if Prof. Allen is available. If his office door is closed, he is very likely to be busy. *Going to office hours will count toward your participation grade. Be sure to sign in.*

Prof. Nollenberg's Office Hours
Office hours are Monday 2:30 – 4:00, Tuesday 10:30 – noon, and by appointment. You may stop by outside of regular office hours to see if Prof. Nollenberg is available. If his office door is closed, he is very likely to be busy. *Going to office hours will count toward your participation grade. Be sure to sign in.*

Physics Teaching Fellows Program
Assistance with course concepts is available through the Teaching Fellows Program. The Teaching Fellows Program provides a collaborative approach to teaching and learning. The Fellows are accomplished majors and minors nominated by the Physics Department and selected jointly by the Center for Teaching and Learning (CTL) and the department. The Fellows have been trained by the CTL.

The Teaching Fellows act as learning facilitators, helping their peers adapt to a subject's discourse and promoting academic interaction between students and faculty as well as among students. Time spent working with a Fellow is time well spent.

The Physics Teaching Fellows hold sessions in Eaton 105. Their hours will be posted outside the door. The Physics Department recommends that you take full advantage of this program by attending at least once a week. *Going to sessions with the Teaching Fellows will count toward your participation grade. Be sure to sign in.*

Disability Accommodations
Students with a documented disability for which they may need accommodations should self-identify and register for services with Mr. David Silver (x3351), the Coordinator of Disability Services at the CTL. Accommodations and services will generally not be provided until the registration and documentation process is complete. See the guidelines for documenting disabilities.

Academic Integrity
Students should familiarize themselves with the principle of academic integrity in the handbook of community standards.

Syllabus Revision Policy
This syllabus is subject to correction and revision. Any revised version will be distributed on my website and notice of revision will be given in class. The grading policy is only subject to revisions that cannot result in a lower letter grade for any set of scores. The latest version will always be at http://people.hws.edu/tjallen/Physics160/Syllabus160-2013S.pdf.

Syllabus: Lecture Topics

This is the schedule of the subjects to be discussed in lecture. Following this table, there is a table of homework assignments and reading, keyed by lecture number.

Date	**#**	**Lecture Topics**
Wed 23 Jan	1	Charge – Conductors & Insulators – Coulomb's Law
Fri 25 Jan	2	Electric Field – Field Calculations
Mon 28 Jan	3	Electric Field Lines – Dipoles
Wed 30 Jan	4	Electric Flux – Gauss's Law – Applications
Fri 1 Feb	5	Electric Potential Energy – Electric Potential
Mon 4 Feb	6	Calculating Electric Potential – Equipotentials
Wed 6 Feb	7	Capacitors – Capacitance – Series & Parallel
Fri 8 Feb	8	Electric Field Energy – Dielectrics
Mon 11 Feb	9	Current – Resistivity – Resistance – Ohm's Law
Wed 13 Feb	10	Electromotive Force – Energy & Power in Circuits
Fri 15 Feb	11	Series & Parallel Resistors – Kirchhoff's Rules – Electrical Instruments
Mon 18 Feb	12	RC Circuits – Power Distribution
Wed 20 Feb	**Exam 1**	
Fri 22 Feb	13	Magnetic Field – Field Lines – Magnetic Flux
Mon 25 Feb	14	Motion of Charges in Magnetic Fields – Applications
Wed 27 Feb	15	Magnetic Forces on Currents – Torque on a Current Loop
Fri 1 Mar	16	Direct Current Motors – Hall Effect
Mon 4 Mar	17	Magnetic Field of a Moving Charge – Magnetic Field of a Current Element
Wed 6 Mar	18	Magnetic Field of a Wire – Force Between Parallel Conductors – Current Loop
Fri 8 Mar	19	Ampère's Law – Applications

Date	#	Lecture Topics
Mon 11 Mar	20	Electromagnetic Induction – Faraday's Law – Lenz's Law
Wed 13 Mar	21	Motional EMF – Induced $\vec{\mathbf{E}}$ Fields – Displacement Current – Maxwell's Eqns
Fri 15 Mar	22	Mutual Inductance – Self-Inductance – Magnetic Field Energy
Spring Break March 16 – 24		
Mon 25 Mar	23	R-L Circuit — L-C Circuit — L-R-C Circuit
Wed 27 Mar	24	Maxwell's Eqns & EM Waves – Plane EM Waves – Sinusoidal EM Waves
Fri 29 Mar	25	Energy & Momentum in EM Waves – Standing EM Waves
Mon 1 Apr	26	Light – Reflection – Refraction – Total Internal Reflection
Wed 3 Apr		**Exam 2**
Fri 5 Apr	27	Dispersion – Polarization – Scattering – Huygen's Principle
Mon 8 Apr	28	Geometric Optics – Planar Reflection & Refraction – Spherical Reflections
Wed 10 Apr	29	Spherical Refraction – Thin Lenses
Fri 12 Apr	30	Cameras – The Eye & Eyeglasses
Mon 15 Apr	31	Magnifiers – Microscopes – Telescopes
Wed 17 Apr	32	Interference – Two Slit Interference
Fri 19 Apr	33	Intensity in Interference – Thin Films I
Mon 22 Apr	34	Thin Films II – Michelson Interferometer – LIGO
Wed 24 Apr	35	Fresnel & Fraunhofer Diffraction – Single Slit Diffraction – Intensity
Fri 26 Apr	36	Multiple Slits – Diffraction Grating – X-Ray Diffraction – Circular Apertures
Mon 29 Apr	37	Photoelectric Effect – Photons – Bremsstrahlung
Wed 1 May	38	Wave-Particle Duality – Uncertainty & Diffraction
Fri 3 May	39	Bohr Model – Atomic Spectra
Mon 5 May	40	**Summary & Final Exam Review**
Sat 11 May		**Final Exam 8:30 AM**

Syllabus: Reading and Homework Problems

The assigned readings and homework are in Young and Freedman. *The reading assignments are to be done before lecture* on the day in which they are assigned.

Homework assignments are for the material covered in the lecture listed in the table and are to be *completed* by the following lecture. Homework assignments should be *attempted* by the lecture before they are to be done.

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.

Lec #	**Reading & Suggested Viewing**	**Homework**
1	Ch 21; §*1-3*; Lewin's Lec 1	1, 5, 7, 63
2	Ch 21: §*4,5*; Lewin's Lec 2	25, 31, 52, 55
3	Ch 21: §*6,7*	57, 60, 67, 89, 104
4	Ch 22: §*1-5*; Lewin's Lec 3	1, 3, 6, 8, 11, 29, 47
5	Ch 23: §*1,2*	1, 3, 11, 17, 23
6	Ch 23: §*3-5*; Lewin's Lec 4	27, 31, 37, 46, 53, 63
7	Ch 24: §*1,2*; Lewin's Lec 7	1, 5, 13, 16, 21, 57
8	Ch 24: §*3-5*; Lewin's Lec 8	24, 27, 39, 60, 72
9	Ch 25: §*1-3*; Lewin's Lec 9	1, 8, 10, 13, 18
10	Ch 25: §*4,5*; Lewin's Lec 10	29, 33, 38, 41, 47a,c, 65
11	Ch 26: §*1-3*	1, 7, 12, 17, 25, 29
12	Ch 26: §*4,5*	40, 41, 43, 53, 74, 91
13	Ch 27: §*1-3*	1, 3, 10, 14
14	Ch 27: §*4,5*; Lewin's Lec 11	15, 21, 26, 28, 30
15	Ch 27: §*6,7*	37, 41, 45, 66, 74
16	Ch 27: §*8,9*; Lewin's Lec 13	51, 53, 58, 61, 65, 67
17	Ch 28: §*1,2*	1, 2, 8, 10, 16
18	Ch 28: §*3-5*; Lewin's Lec 14	17, 24, 27, 30, 37, 39
19	Ch 28: §*6-8*; Lewin's Lec 15	42, 45, 51, 62, 72, 79

Lec #	Reading & Suggested Viewing	Homework
20	Ch 29: §*1-3*; Lewin's Lec 16	1, 3a, 7, 17, 21
21	Ch 29: §*4-8*; Lewin's Lec 17	24, 27, 37, 42, 60, 61
22	Ch 30: §*1-3*; Lewin's Lec 18	1, 5, 7, 11, 12, 19
23	Ch 30: §*4-6*; Lewin's Lec 20	23, 29, 35, 37, 39, 49
24	Ch 32: §*1-3*	3, 4, 5, 7, 11, 13
25	Ch 32: §*4,5*	16, 17, 30, 33, 38, 40, 51
26	Ch 33: §*1-3*; Lewin's Lec 29	1, 5, 11, 13, 17 , 24
27	Ch 33: §*4-7*; Lewin's Lec 30	25, 29, 35, 38, 53, 55, 57
28	Ch 34: §*1,2*; Lewin's Lec 33	3, 5, 7, 9, 13, 74
29	Ch 34: §*3,4*	15, 19, 21, 25, 29, 94
30	Ch 34: §*5,6*	39, 43, 49, 52, 53, 55, 57
31	Ch 34: §*7,8*	58, 59, 61, 63, 65, 67, 112
32	Ch 35: §*1,2*	5, 6, 11, 15
33	Ch 35: §*3,4*	21, 25, 27, 29, 34
34	Ch 35: §*5*	35, 39
35	Ch 36: §*1-3*	1, 3, 9, 13, 17, 55
36	Ch 36: §*4-7*; Lewin's Lec 34	21, 25, 33, 35, 41, 43
37	Ch 38: §*1,2*	1, 2, 15
38	Ch 38: §*3*	17, 21, 23, 25
39	Ch 39: §*1-3*	1, 3, 7, 17, 25, 29
40		