Physics 123 – Waves and Modern Physics
Spring term 2013, University of Rochester
Information, Syllabus, and Schedule

This course is designed to be the third semester of a three-course sequence for students planning to major in physics, engineering, or some other physical science. The topics covered include: wave motion, physical optics, special relativity, photoelectric effect, Compton effect, X-rays, wave properties of particles. Schrödinger's equation applied to a particle in a box, penetration of a barrier, the hydrogen atom, the harmonic oscillator, the uncertainty principle, Rutherford scattering, the time-dependent Schrödinger equation and radioactive transitions, many electron atoms and molecules, and selected topics in statistical physics, solid state physics, nuclear physics, particle physics and cosmology.

Course instructor:

Prof. Steven Manly e-mail: **Steven.Manly@rochester.edu**
Phone: 275-8473
Office: B+L 203E

Office hours: **Monday 2:05-3:30 pm *or by appointment.*** With my travel and your variable needs/schedules, I find that fixed office hours are not terribly practical. If I am out of town or if the time slots do not work for you, speak to me or send e-mail to find a mutually suitable time. Walk-in office visits (no appointment) are welcome with the understanding that if I'm in the middle of something else we might have to put off our discussion to a mutually acceptable time. Workshop leader office hours TBA.

Workshop leaders (tentative for now):

- Joe Murphree, jmurphre@z.rochester.edu
- Ryan Vogt, rvogt2@u.rochester.edu

Course web site:

Extensive use will be made of the web for distributing course materials, making announcements, etc. The class URL is
http://www.pas.rochester.edu/~manly/class/P123_2013/ **.**
If you have problems reaching this site (and you've verified it is not your problem), please contact me. Additional material, including your grades, will be distributed via BlackBoard.

Course e-mail:

I will use BlackBoard to email the class time-critical announcements, hints for problem sets, corrections for problem sets, exam location changes, etc. You will need to be registered formally for the course to receive these emails. Also, once registered for the course I advise you to check the appropriate email account with reasonable frequency, particularly if you miss the beginning of lecture when I will make general announcements.

Lectures:

Hoyt Hall, Monday and Wednesday 12:30 to 1:45 pm. Slides and audio will be posted on the class website in general … though sometimes technical issues (like me forgetting to start my audio recorder ☺) can arise.

Textbook:

- Douglas Giancoli, **Physics for Scientists and Engineers**, Volumes I-III, 4th edition (2009), Prentice-Hall (hard copy or the e-version okay).
- You are welcome to use previous editions of the text. Just be aware that the problem assignments will be referring to the problems in the 4th edition. Copies of the 4th edition will be on reserve in the Physics and Astronomy Library located on the 3rd floor of Bausch and Lomb Hall.
- Given the nature of this course, there will be times I will venture beyond what Giancoli covers well. When I do, I will attempt to provide suitable sources for the things beyond Giancoli

Books on reserve in Physics and Astronomy (PAS) library that might be useful:

- Douglas Giancoli, **Physics for Scientists and Engineers**
- Kenneth Krane, **Modern Physics**
- Hecht, **Optics**
- Eisberg and Resnick, **Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles**
- Griffiths, **Introduction to Electrodynamics**
- Tipler, **Physics**
- Haliday, Resnick, Walker, **Fundamentals of Physics**

Philosophy and goals:

I have a couple of goals in this course as far as each of you is concerned. One goal is to provide you with a basic survey of the principles of waves and modern physics and an appreciation of the importance of these principles to your world and the rest of physics/engineering. Another goal is to increase your repertoire of analytical skills and tricks that will serve you well in more advanced physics and engineering courses. I will expect you to be spending significant time working on this course outside of class, by yourself and with others. If that isn't happening, one or both of us is not doing our job.

Workshops:

An integral part of this course will be "physics workshop". You will meet once a week, for two hours, with a group of approximately twelve other students and a leader. During this time, you will work on a set of problems that I prepare. The problems will include simple questions, conceptual exercises, and quantitative problems relevant to the material covered the week before in class. Much of this will be review and practice. Some of it will be new and relevant material.

The basic idea of the workshop concept is to institutionalize the study group with some leadership and supervision from the professor. The students in the workshop are expected to work through the questions each week. The

workshop leader will act as a facilitator, not a lecturer … and not an answer-giver. I *know* my workshop leaders can do the problems. Their job is to help you find it within yourself to do them! It is up to *you* to make your workshop section function well.

I have data from past courses that show consistent attendance of workshops strongly correlates with a better grade in the courses I teach. The workshops are the best way I know to help you understand physics concepts and learn to solve analytical problems. More importantly, I can tell you from personal experience that most successful physics and engineering majors work frequently with a study group of some sort. It's something you might as well get used to doing.

Workshop leaders will keep track of workshop attendance. This will be one of my gauges as to the level of effort you put into the course. This will be taken into account during the final letter grade assignment and will be the deciding factor for hairline grades.

Laboratory:

Currently, the laboratory is conducted independently of lecture. The only contact between the two (other than subject) is the lab grade contribution to the final course grade. You must do all the labs get a grade for this course. The laboratory grade will be averaged in as 15% of the course grade. All questions regarding the laboratory should be sent to the laboratory e-mail address (physlabs@pas.rochester.edu) or addressed to Professor Bodek. The physlabs e-mail address is appropriate for the majority of your questions, and is more likely to yield a timely response. It is only necessary to bring laboratory issues to my attention if you do not get a satisfactory response from physlabs and Prof. Bodek.

Problem sets:

I will ask you to do a set of problems each week that illustrate and/or enhance what we've discussed in the lecture. P123 is a quantitative, problem-driven course. I will work mostly on concepts and mathematical techniques in lecture … but the exams will consist of quantitative problems. It is absolutely *critical* that you work on these problems each week. For the vast majority of students, it is not possible to do well in this course without struggling with most of the homework problems throughout the semester.

A week after each problem set is assigned, I will release a solution set. Your job is to study these solutions, understand your mistakes, and correct any misperceptions or holes in your understanding.

You are encouraged to discuss the problems with others both before and after you turn in your assignment. However, I urge you to struggle with each problem on your own first. Otherwise your colleagues will carry you and you won't get much out of it. Most of you will find it easy to follow someone else's work. If you follow others too much as you do the problem sets, you will find that you are unable to begin problems on your own.

A fraction of your grade (9%) comes from your solutions to the problem sets. We will check each problem set to see that you made a reasonable attempt

to do the problems. That means your solutions should not be copies of the publisher's solutions and should consist of more than a page of final answers; show your work. You are allowed to work together and even look at the publisher's solutions on reserve in the library or tucked away online someplace. The point is to use the exercise to figure out the concepts and to understand how to solve the corresponding problems. In the end, while doing the problems or later, when looking at the solutions, be sure to come to closure and understand all the steps in the problems. If you don't understand something, you need to figure it out and/or get help.

Your solutions to each week's problem set must be handed in before 7 am on Friday. To turn them in, deposit them in the "P123" locker in the hallway by B&L 106. I will ask that your TA empty the locker when they come in on Friday mornings. If the problem set is not in that locker when the papers are picked up, it will count as a zero. Rather than negotiate or pass judgment about poor or good excuses, I will give you three problem set "drops", no questions asked. In other words I will only count 9 of the 12 (or so) assigned problem sets. In spite of that, you should do and come to closure on any problem sets you fail to hand in or your exam grades will suffer and that *will* affect your final grade.

Keep up with the class. Physics does not cram easily. Many concepts/techniques need time to gel.

Grades:

- To factor out unavoidable fluctuations in exam difficulty, all exam grades will be normalized such that the mean for each exam is 100%. For example, if the mean of the exam is 60%, I will scale each student's grade for that exam by 100/60 before I determine the overall grade as shown below.
- Your grade will be calculated via one of the three schemes shown in the table below taking the one that yields the highest average. The numbers represent the relative contribution of the item in that column to your final numerical grade.

Scheme	Exam 1	Exam 2	Final exam	Lab	Prob sets
1	23%	23%	30%	15%	9%
2	0%	35%	41%	15%	9%
3	35%	0%	41%	15%	9%

- You will not receive a grade in the course until you have completed the required laboratory work.
- Your initial relative position on the grading curve depends solely on the numerical grade as calculated above. I will then assign letter grades to the numerical scale. There is no fixed curve to be assigned … no grade quotas. If you all do "A" work in my eyes, you ALL get A's. It's a problem I would love to have!
- If you are one point below a grade boundary … and many of you will be … I will give you the higher grade near the boundary if you have attended more than half the workshops.

Where's the prof?:

You are my priority. However, in spite of this, I must travel frequently for my research. I will do all I can to schedule my travel so that it has a minimal impact on P123. However, I won't be able to completely avoid it. Class will go on. I'll do my best to arrange a decent guest lecturer or I'll post lecture slides and an accompanying mp3 audio track. I will usually be in e-mail contact when out of town. Please accept my apologies in advance.

Makeups/missing exams, problem sets:

If you miss one of the term exams *for any reason* (no matter how good or frivolous), that exam will be dropped and the grade calculated via scheme 2 or 3 above. I do not need or want to hear about it. If a good reason is forcing you to miss a second term exam, contact me. Please do not miss the final exam. That would likely mean you'd need to take an incomplete in the course and finish it in Spring 2014.

Exam regrade policy:

We will do our best to grade your exams fairly. That said, mistakes will happen. It is your responsibility to look over the solutions to the exam and your exam paper when it is returned. Once you are sure you understand the problem and solution, if you feel the grading for your work is inappropriate, please write on the front of the exam which problem you'd like me to examine again and give me the exam. The best ways to give me the exam paper for a regrade are to put it in my B&L mailbox (in the B&L lobby) or slide it under my office door. Do not put the exam for a regrade in the box outside my office door that I use to return your papers … that's outgoing, not incoming.

Schedule:

This course schedule is tentative and subject to change as we go. The exam dates are fixed. Exam subject matter will change as appropriate for the material covered and you will be notified of the coverage well ahead of time.

Lecture	Date	Topic	Chapter
1	Jan 16 (W)	Organizational stuff, relativity	36
2	*Jan 23 (W)	Relativity	36
3	Jan 28 (M)	Relativity	36
4	Jan 30 (W)	SHO, waves	14, 15
5	Feb 4 (M)	Waves	15, 16
6	Feb 6 (W)	Waves	15, 16
7	Feb 11 (M)	Waves, Maxwell's equations	31
8	Feb 13 (W)	Electromagnetic waves	31
9	Feb 18 (M)	Optics from EM waves	other
10	Feb 20 (W)	Geometrical optics	32-33
11	Feb 25 (M)	Geometrical optics, physical optics	32-33
12	Feb 27 (W)	Physical optics	32-35
Exam 1	Feb 28 (Th)	0800-0930 location TBA	
13	Mar 4 (M)	Physical optics	32-35
14	Mar 6 (W)	Birth of quantum mechanics	37
15	Mar 18 (M)	Quantum mechanics	37-38
16	Mar 20 (W)	Quantum mechanics	38
17	Mar 25 (M)	Quantum mechanics	38
18	Mar 27 (W)	Quantum mechanics (H atom)	38-39
19	Apr 1 (M)	Atoms (multi-electron)	39
20	Apr 3 (W)	Molecules and solids	40
21	Apr 8 (M)	Solids, magnetic spectroscopy	40
22	Apr 10 (W)	Nuclear physics	41
Exam 2	*Apr 11 (Th)	0800-0930 location TBA	
23	Apr 15 (M)	Nuclear physics	41-42
24	Apr 17 (W)	Nuclear physics	41-42
25	Apr 22 (M)	**Topics	TBA
26	Apr 24 (W)	**Topics	TBA
27	Apr 29 (M)	**Topics	TBA
28	May 1 (W)	**Topics	TBA
Final Ex.	May 7 (Tu)	0830, location TBA	cumulative

**I will be out of town on these days (possibly others, but these I know about now). For Jan. 23, I plan to post pdf files with detailed slides and an mp3 audio file to stream for the lecture. The class will not be meeting in Hoyt that day unless you are notified by me otherwise.*

*** I hope to cover some subset of the topics: particle physics (43 and other), cosmology (44 and other), multiverse concepts (44 and other), fluids (13), and statistical physics (17-20). What we do will depend on the interests of the class and the time available.*