Waves and Fields (PHYS 195) Course Syllabus

Spring 2012 v4.1

1. Introduction to Phys 195:

This semesters 195 material is in three (unequal) parts:

(1) Oscillations, Resonance and Waves
(2) Electric and Magnetic Fields
(3) Light as a wave: Optics, Interference, and Diffraction.

Building on your work of last semester, the course starts with a study of oscillations. The middle third of the course will focus on fields. Since electromagnetic fields support waves usually called "light", the course will finish with a study of the wave nature of light. Behind the physics is a set of mathematical methods including Taylor series, differential equations, partial differential equations, and Fourier series. Although we won't study each of these in depth, they will be introduced as we go along.

2. Course Information

Instructor: Seth Major – please call me "Seth."
email : smajor@hamilton.edu
web : academics.hamilton.edu/physics/smajor/
phone : x4919
office : Sci G052

Lectures: MWF 10:00-10:50 AM in Science Center G041

Office Hours: The "official" hours are Tuesday 2 - 5 PM in the tutorial area outside my office (drop-in help sessions). But feel free to drop by, call or send an email about a homework problem, questions on the text, or any other issue you'd like to chat about.

Texts: I strongly recommend that you read over the material before class and lab. The presentation in the texts is complementary to mine so, by reading, you will learn some of the required material not discussed in lecture.

- Halliday, Resnick, Walker, **Fundamentals of Physics** Extended, 9th Edition (same as Phys 190) henceforth referred to as HRW. Note: a copy of any edition, or even any good intro text, will also work for most cases.
- John Taylor, **An Introduction to Error Analysis**
- Schaums outline on **Mathematical Handbook of Formulas and Tables**

In addition the following books are useful:

- Mary Boas **Mathematical Methods in the Physical Sciences** (QA37.2 .B59 1983) Several copies are around in the Common Room and the tutorial areas.
- Kleppner and Kolenkow **An Introduction to Mechanics** An introductory text at a high level, on reserve in Burke (QA805 K62 1973)
- R. Reese **University Physics** (QC21.5 .R435 2000)
- G. Simmons, **Calculus with Analytic Geometry** readings on eReserves

Your physics education will be sadly impoverished if you do not drink deeply from these texts.

On learning physics: Learning occurs, and the seed of understanding is planted, when we think about a subject. This thinking happens when we actively confront a situation or a problem in a new way. Unfortunately, full understanding normally occurs only after iterating this process several times!

Such active engagement with the material is especially beneficial to learning physics. As much as is possible, this course is structured to foster active and productive learning: there are hands-on activities in the form of home experiments and labs which emphasize major topics in the course and there are problem sets which encourage thinking about the material. These will hopefully give you a chance to understand some of the complexity, beauty, and fun of working in physics.

Maple: We will sweeten our calculations with Maple software. The easiest method of accessing this program is through the Citrix server. I will send along instructions on setting this up. Alternately you can contact ITS for help setting this up.

Web page: Phys 195 Spring 2009 has a web page:
http://academics.hamilton.edu/physics/smajor/Courses/195.html
Or Google "195 good waves" This will be the source for "up-to-the minute" news about the course and as a repository for all course information. Please refer to it often.

Weekly Guides: Every week I will distribute a weekly Guide which includes information on the reading, other aspects of the course including special events, and the problems. Guides normally will be posted on the 195 site Monday morning. Your solutions will be due on the following Wednesday at the **beginning** of class. No late[1] problem sets will be accepted. However, if you know in advance, by Tuesday morning, that you have an emergency of some kind then I will normally grant an extension, until the solutions are posted. Your solutions will be normally graded 1 point per problem. Solutions will be will be generally be available by Thursday through the website (if all goes well).

The logic and methods employed in your solutions are **more important** than achieving the correct numerical or algebraic answer. Show your work in a logical, easy-to-read manner. The graders deduct points for solutions which are not clearly written up, even if you found the correct answer. So I strongly recommend that you copy over your solutions and hand in a readable final copy. Always check that you have included units and significant figures.

I encourage you to discuss the problems and methods of solution with fellow students, clinicians at the Quantitative Literacy Center, and professors. The written work you hand in must be your own, must reflect your own understanding, and you must cite classmates or anyone else who contributes significant ideas. Of course the Honor Code applies. You absolutely must cite anything you find online, even if you only used an idea.

Finally, starting early will be of great help!

Grades: Your semester grade will be determined by the following scheme:

Quizzes (2)	20%
Problem Sets	30%
Labs	25%
Final (cumulative)	25%

Several times during the semester (such as after the first Quiz) I will send out a Excel spreadsheet – the "Grade Calculator" – that will allow you to calculate your grade.

There will be opportunities to earn extra credit during the semester. These will be labeled with **Bonus**. The credit must be earned by the due date. There will be one extra credit extravaganza later in the semester which will call on your inventive, creative, and physics skills.

Quizzes and Final: There will be two quizzes and a final. The final will be during the scheduled time: Monday, May 7 at 7-10 PM. The exams include material in the reading, lecture, and labs.

Labs: Physics is a science of quantitative observation and so we have labs. They start January 18 (in the first week). The labs are available on the course web page. You should also bring a bound composition book to use as your lab notebook.

[1] "Late" means after the beginning of class.

The second text by John Taylor is a devoted to a careful treatment of uncertainties. Although you have already encountered these in Phys 190 (or 100) this book is a great source for introductory through advanced material such as you might use in research. It will make a good reference for later courses.

The lab sessions are mandatory. It will generally not be possible to make-up labs. You may be able, however, to switch labs to help with conflicts you might have. Please see your lab instructor in advance to arrange a switch.

Lab Instructors:
Wed: Seth Major
Thurs: Gordon Jones

Colloquia: On Monday afternoons, several times during the semester, there will be talks by physicists and astronomers from other institutions. These talks are a wonderful way to see what physics is done in "the real world. These events begin with **free food** at about 4 PM. The talks are often at 4:10 PM. Please join us!

Enjoy!

THE FINE PRINT: The maximum number of bonus points will be 2π.

3. Syllabus

What follows on the next page is preliminary. HRW is for Halliday, Resnick, and Walker. KK is for Kleppner and Kolenkow - reading on eReserves. Details will be given in the weekly Guides.

Phys 195: Waves and Fields Spring 2012 Syllabus				
Part	Topics	Reading	Week	Labs and Events
Oscillations	As Newtonian Dynamics Energy and examples As universal motion	HRW 15 Taylor 1 KK eRes	1	Energy Cons. & Uncert.
Resonance	As a differential equation Damping & driving Q and phase Attaching oscillators	Taylor 2	2	Exploring Pendula
Waves	Traveling waves Mathematical description	HRW 16	3	Resonance
	Wave equation for string Energy and momentum Superposition & Reflection Standing waves	HRW 17 Taylor 3	4	Pendula and g
	Sound: Derivation Beats, 2D Superposition Doppler Effect Interference Fourier's insight	HRW part of 14	5	**Quiz I** in Lab
Fields	Charge Electric field and Force	HRW 21	6	Waves on a string *Tape Experiments* *Coulomb in a Box*
	Field lines Electric Potential	HRW 22 HRW 24	7	*Kelvin Water Dropper* Speed of Sound *Van de Graaff*
	Moving charges	HRW part of 26	8	Electroscopes
Spring Break, March 9-26				
	Magnetic Field $q\mathbf{v} \times \mathbf{B}$ Torque on a loop	HRW 28	9	*Motor Kits* **E**&**B** Field mapping
			10	**Quiz II** in Lab
Light: Optics	Physical and Geometric Snell's Law Mirrors and Lenses Ray tracing Optical instruments	HRW 34	11	Snell's Law
Interference	Young's double slit Phasors LIGO and Michelson	HRW 35	12	Thin Lenses
Diffraction	Single slit diffraction Double slit Intensity	HRW 36	13	Interference
	Many slits Polarization Review	HRW 36	14	Diffraction
Final Monday, 7 May 7-10 PM				