Waves and Fields (PHYS 195) Course Syllabus

Spring 2009 v3.2

1. Introduction to Phys 195:

This semesters 195 material is in three 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
email : smajor@hamilton.edu
web : academics.hamilton.edu/physics/smajor/index.html
phone : x4919
office : Sci G052

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

Office Hours: Generally the best times to ask questions are Monday afternoon and Thursday morning. The "official" hours are Monday 1 - 5 PM in the tutorial area outside my office (drop-in help sessions). Feel free to 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.

- Halliday, Resnick, Walker, **Fundamentals of Physics** Extended, 8th Edition (same as Phys 190) henceforth referred to as HRW
- 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 (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 dip into 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. 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
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. You will need a pdf reader such as Adobe Acrobat.

Weekly Guides: Every week I will distribute a weekly Guide which includes information on problems, reading, and other aspects of the course including special events. Guides normally will be posted on the 195 site by Monday morning. Your solutions will be due on the following Monday. No late[1] problem sets will be accepted. However, if you know in advance, say by Monday morning, that you have an emergency of some kind then I will normally grant an extension. Your solutions will be normally graded 1 point per problem. Solutions will be will be generally be available by Wednesday through electronic reserves (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. When you receive substantial help, cite your source in your written solutions.

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

Quizzes (2)	20%
Problem Sets	35%
Labs	25%
Final	20%

I will use an absolute grading scheme; there will be no "curving". Several times during the semester (such as after the first Quiz) I will send out a Excel spreadsheet - the "Grade Calculator" - which will allow you to calculate your grade.

There will be opportunities to earn extra credit during the semester. These will be labeled as "**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: Thursday, May 14 at 9 AM. The exams include material in reading, lecture, and labs.

Labs: Physics is a science of quantitative observation and so we have labs. They start January 21 (in the first week). The labs are available on the course web page. Please read over the lab and complete any of the preliminary work before coming to class. You should also bring a bound composition book to use as your lab notebook.

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

[1] "Late" means Tuesday morning. In practical terms, since I will post solutions on Tuesday or Wednesday it does not make sense for me to accept problems after then.

through advanced material such as you might use in research. It will make a good reference for later courses. Much of Chapter 1 and 2 will be review for 190 alums.

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: Ann Silversmith
Thurs: Seth Major

Enjoy!

THE FINE PRINT: The maximum extra credit will be 0.6 times a letter grade.

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 2009 Syllabus				
Part	Topics	Reading	Week	Labs and Events
Oscillations	- As Newtonian Dynamics - Energy and examples - As universal motion	HRW 15 Taylor 1&2 KK eRes	1	Energy Cons. & Uncert.
Resonance	- As a differential equation - Damping - Q and phase	Taylor 3	2	Pendula and g
Waves	- Traveling waves - Mathematical description	HRW 16	3	Resonance
	- Wave equation for string - Energy and momentum - Superposition	HRW 17 Taylor Ch 4	4	Waves on a string
	- Sound: Derivation - Beats, 2D Superposition - Doppler Effect	HRW part of 14	5	**Quiz I** in Lab
Fields	- Charge - Force	HRW 21	6	Speed of Sound *Tape Experiments* *Coulomb in a Box*
	- Field lines - Electric Flux and Gauss - Electric Potential	HRW 22 HRW 24	7	*Kelvin Water Dropper* Electroscopes *Van de Graaff*
	- Capacitors and bateries - Moving charges	HRW 25-27	8	**E** Field Mapping
Spring Break, March 14-29				
	- Magnetic Field - $q\mathbf{v} \times \mathbf{B}$ - Torque on a loop	HRW 28	9	*Motor Kits* Simple Circuits
			10	**Quiz II** in Lab
	- Intro to Induction - Intro to Faraday - Energy in **B** - Maxwell's E&M - Radio Signals	HRW 33	11	*Thomson's Jumping Ring!* **B** field mapping *Light is a Wave*
Light: Optics	- Geometric - Snell's Law - Mirrors and Lenses - Ray tracing - Optical instruments	HRW 34	12	Snell's Law
Interference	-Young's double slit - Phasors -LIGO and Michelson	HRW 35	13	Thin Lenses
Diffraction	- Single slit diffraction - Double slit Intensity - Many slits - Polarization - Review	HRW 36	14	Interference & Diffraction *Interference Workshop*
Final Thursday May 14 9-12 AM				