PHYSICS 15c, Fall 2011
WAVES
SYLLABUS
(updated Sept 1, 2011)

PROFESSOR

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USEFUL TEXTBOOKS

Introduction to Wave Phenomena, by Hirose & Lonngren
Krieger Publishing 2003, ISBN 1-57524-231-1
The Physics of Waves, by Howard Georgi
available **free** online: http://www.people.fas.harvard.edu/~hgeorgi/new.htm
waves, by Frank Crawford
The Physics of Vibrations and Waves, 6th ed., by H. J. Pain
Vibrations and Waves, by A. P. French
Optics, 4th ed., by Eugene Hecht

PREREQUISITES

Physics 15b or 153, or written permission of Dave Morin or Prof. Georgi.
Mathematics at least at the level of Mathematics 21b taken concurrently is required. Linear algebra and differential equations are used extensively. Students taking Mathematics 21b concurrently will likely find that some concepts are introduced in Physics 15c before they have seen them in Mathematics 21b. Some students may wish to postpone Physics 15c until they have completed Mathematics 21b.

LECTURES

Tuesday and Thursday, 1:30-3pm, Science Center D.

You are encouraged to read through the material in advance and bring questions to the lectures. In case you do miss a lecture, the course will be videotaped, and you may contact the teaching staff for access to a particular lecture video.

LABS
The lab component will consist of four 3-hour labs in the first half of the semester, and a final project in the second half. The topics will include driven oscillation and musical instruments, interferometry, Fourier optics and holography. The labs will give you an opportunity to experience a broad range of wave phenomena and learn modern optics. Understanding wave optics is a great basis for a more intuitive understanding of quantum physics in later semesters. In the final project you will take on a small independent project. With plenty help provided, you will explore a topic of your choice, such as trapping particles with a laser beam, holographic measurements, measuring the "aether wind", optical communication, etc. The projects will be presented in a poster session near the end of the semester.

SECTIONS
Sections are taught by the TF, Jon Bittner.
Sections will begin the week of September 5-9. Attendance is strongly advised.

WEBSITE
Course website: http://isites.harvard.edu/icb/icb.do?keyword=k80273
Problem sets, solutions, labs, announcements, and other useful material will be posted on the web site. You are responsible for checking the website regularly.

PROBLEM SETS
There will be one problem set each week, due Friday at 4pm in the boxes outside Science Center 108-112. Solutions will be posted on the website as soon as problem sets are collected. Except in *very unusual* circumstances, we will not accept late problem sets. Any requests for extensions should be made to your TF.

Eleven problem sets will be given during the semester. The 11th problem set is optional and will be due during the Reading Period. If you do complete the 11th set, you may use it to replace the lowest score among the earlier problem sets.

MATHEMATICA
Some problem sets will refer to Mathematica animations which are posted on the course website. You should download, install, and obtain a license for Mathematica ***now***, so that you don't find yourself in a last-minute panic if the licensing takes 24 hours. Download for free from: http://downloads.fas.harvard.edu/download

STUDY GROUPS
You are encouraged to work together on problem sets (but the work that you hand in should be your own, of course). The best way to find a study group is to attend office hours. If in doubt, please ask your TF for assistance finding a study group.

EXAMS
There will be two midterm exams (during the regular 1.5-hour class) and a final exam (3 hours). The midterms will be on Tuesday, October 4 and Tuesday, November 22. The final will be on Thursday, December 13.

GRADING
Problem Sets 30% (for 10), Labs 20%, Midterms 10% each, Final exam 30%.

TENTATIVE SCHEDULE

	Date	Lecture topic	Homework	Lab
1	Thurs, 9/1	Harmonic oscillators, differential equations		
2	Tues, 9/6	Inhomogeneous diff. eqns, forced oscillator, energy, resonance		
3	Thurs, 9/8	Coupled oscillators, Georgi symmetry	HW#1: due Fri, 9/9	
4	Tues, 9/13	Continuous wave equation		
5	Thurs, 9/15	Dispersion relations, phase & group velocities	HW#2: due Fri, 9/16	driven SHO
6	Tues, 9/20	Fourier analysis		
7	Thurs, 9/22	Sound waves & ears	HW#3: due Fri, 9/23	interferometer
8	Tues, 9/27	Doppler effect, shock waves		
9	Thurs, 9/29	wrap-up & review	HW#4: due Fri, 9/30	
	Tues, 10/4	**MIDTERM EXAM (covers through lecture #8, HW#4, lab#2)**		
10	Thurs, 10/6	Musical instruments, standing waves, strings, reflections		Fourier
11	Tues, 10/11	Boundaries, higher dimensions		
12	Thurs, 10/13	Can you hear the shape of a drum?	HW#5: due Fri, 10/14	holography
13	Tues, 10/18	LC transmission line		
14	Thurs, 10/20	E&M waves, polarization	HW#6: due Fri, 10/21	project
15	Tues, 10/25	Reflection, refraction & Brewster's angle		
16	Thurs, 10/27	Accelerating charges	HW#7: due Fri, 10/28	project
17	Tues, 11/1	E&M waves in materials		
18	Thurs, 11/3	Interference	HW#8: due Fri, 11/4	project
19	Tues, 11/8	Diffraction		
20	Thurs, 11/10	Geometrical optics		presentations
21	Tues, 11/15	Microscopes, telescopes		
22	Thurs, 11/17	wrap-up & review	HW#9: due Fri, 11/18	
	Tues, 11/22	**MIDTERM EXAM (covers through lecture #21, HW#9, lab#4)**		
	Thurs, 11/24	*Thanksgiving*		
23	Tues, 11/29	Coherence		
24	Thurs, 12/1	Quantum mechanics	HW#10: due Fri, 12/2	
	Tues, 12/6	review session		
	Thurs, 12/8	review session	HW#11: due Fri, 12/9	
	Tues, 12/13	**FINAL EXAM**		