PHYSICS 300 – – SPRING 2011
Waves and Optics

Lecture: MWF 10:40 - 11:35 Rm: PP-112 Lecturer: Harold Metcalf - S225 hmetcalf@notes.cc.sunysb.edu 632-8185 or 8100	TA: Peter Sandor Room: S-138 psandor@ic.sunysb.edu 632-4088 Lab: Tues. 12:50 - 2:50 and 5:20 - 7:20 Rm: A-124 except lab 2 - TBA

Texts: French [T], *Vibrations and Waves*, Norton; Fowles [F], *Modern Optics*, Dover

SUBJECT TO CHANGE (as of January 27, 2011)

Week # Date of Monday	Monday	Wednesday	Friday	Lab	Reading	Homework
I 1/31	Complex Notation	Superposition	Harmonic Motion With Decay	none	T 3 - 39	T1: 1, 2, 5, 6 T2: 1-4
II 2/7	Introduction to Laboratory Peter Sandor	Driven Oscillators & Resonance	Coupled Oscillators and Normal Modes	Resonance (Vibrating Steel Spring)	T 40 - 91 96 - 107, 118-134	T3: 1, 2, 3, 4, 6, 9 T4: 1, 3, 8ab, 10, 13
III 2/14	Driven Coupled Oscillators	Waves as normal modes	More about Waves Fourier Ideas	Coupled Oscillators	T 118 - 158	T5: 1, 6, 7, 9, 10
IV 2/21	Travelling Waves Superposition Sound and Music	Music and Harmony	**FIRST HOUR EXAM** (in class)	Waves in One Dimension (Speed of Sound)	T 160 - 216	T6: 1, 2, 3, 9 T7: 1, 2, 3, 5, 8
V 2/28	Wave Packets Phase and Group Velocity	Brillouin Zones Energy and Momentum	TBA	Waves in Periodic Structures	T 216 - 265	T7: 12, 15, 19 T8: 3, 4
VI 3/7	Electromagnetic Wave Equation	Fields and Waves Polarization	Jones Matrices	Polarization	F 2 - 56	F1: 1, 2, 3, 5, 6, 11 F2: 2, 5, 8, 10, 12
VII 3/14	Interference Interferometers Michelson	Fabry-Perot in great detail	Fourier Spect. Thin Films	Michelson Interferometer	F 58 - 103	F3: 2, 3, 6, 7 F4: 1, 7, 9
VIII 3/21	Diffraction ripple tank	Fresnel zones Arago's spot	**SECOND HOUR EXAM** (in class)	Fabry-Perot Interferometer	F 112 - 147	F5: 7, 8, 12, 13 **read** T 288 - 294
IX 3/28	Ray Optics Matrices	Optical Instruments Microscope Telescope	Magnifying Glass Aberrations	Diffraction	F 294 - 305 handout	F10: 1, 3*, 4 * should be: Prove Eq. 10.3 not 10.13
X 4/4	Paraxial Wave Eq. Paraxial sol'ns	Gaussian Beam Optics	More Gaussian Beam Optics	Optical Instruments	Milonni & Eberly handout	F 10: 2, 7* (* see many texts) M&E 1a, 1c, 3, 4
XI 4/11	Gaussian Optics yet again	Nonlinear Optics Freq. Doubling	Nonlinear Optics 2 Phase Matching	Gaussian beam optics	F 275 - 280 169 - 180	F 9: 6
	SPRING	**VACATION –**	**YIPPEE ! !**			
XII 4/25	Intro. to Lasers!	More Lasers! Locking Schemes	Freq. Chain Self Phase Modulation	Laser Speckle	F 195 - 199 217 - 233	F 8: 1, 2, 3
XIII 5/2	**THIRD HOUR EXAM** (in class)	Detectors Waveguides and Fibers	deB. Waves Bohr View	Make up missed labs		
XIV 5/9	Symposium on human vision	Symposium on human vision	Symposium on human vision			

General Procedures for PHY-300 - Spring 2011

This course is a sequel to your introductory sequence of two or three courses. The purpose of its first part is to amplify and expand on the ideas of vibrations and resonance that were introduced in your previous courses. This topic is chosen because it is so very fundamental to all the physics that follows in your future education. Perhaps the most important example is the physics of wave motion which follows naturally from vibrations and resonance. Understanding wave motion is vital for several areas of advanced physics, including optics and quantum mechanics. Thus the second part of the course is devoted to optics, and culminates with one of the most spectacular applications of modern optics, the invention of the laser. Of course, you need to know *some* quantum mechanics for this, and it is also introduced where needed, in the context of what you have already been taught about waves.

The assignments for each week constitute both reading and homework problems from the assigned texts, and are designated the rightmost columns of the assignment sheet in French [T] and Fowles [F]. In addition to the contents of each chapter, ALL the problems are REQUIRED reading. Furthermore, the problems that are not assigned are also *not* forbidden! You can always gain some new insights and understanding by working extra problems. If you choose to simply do the assignments and keep up with the reading, you may very well earn an honor grade, but the true rewards come from deep investigation stimulated by a healthy skepticism. We can't "assign" enthusiasm!

- **CLASSES** We are scheduled to meet for five hours each week. Three hours will be devoted to class where the main material of the course will be presented. Your ability to understand many of these classes will depend on your familiarity with the subjects, so come prepared. This means do the reading **ahead** of time. The lab periods are each two hours and are held in Rm. A-124.
- **GRADES** The grades will be based on credit given approximately as follows: 20% for lab, 20% for homework, 20% for each of three hour exams. There is no final exam, but you **MUST** pass the lab or you will NOT pass the course. Be aware that these percentages are both flexible *and* subject to change. It's **your** responsibility to be aware of announced changes.

1. **Laboratory** You will be required to perform the experiments described in the lab manual distributed in class. You will need to have TWO lab notebooks with fixed, bound pages. These will alternate from week to week as you submit reports. Each of these two lab notebooks should have lab data and writeups clearly marked and dated, preferably with page numbers and a table of contents in front.

   Before you can begin these experiments, you must provide a preliminary writeup as you enter the lab - nobody can perform an experiment without submitting this **FIRST** for Peter's signature. It will be loose sheets to be stapled into your lab book later. It is to be prepared well before the lab period, not during its early minutes. Each report section should begin with a blank page where you will staple this writeup, while Peter is grading the previous experiment's report in your other lab notebook. This writeup must describe the physical ideas you plan to explore, the way you will go about exploring them, and your anticipated results. It need not be more than a page or two, but is not length limited either.

   There should be a place for your measurements and a description of them, including your estimates of the errors. Then you need to analyze your results and compare with your previous expectations. The lab book with both parts must be submitted at the start of the subsequent lab period. That is, you have one week to complete it, so you need to be well-prepared beforehand. The combination of your preliminary and lab writeups will constitute your lab report and will be the basis for grading. The grade will **NOT** depend on whether you got agreement, but only upon how well you perform your work.
2. **Homework** The homework will be collected in class on Monday following the week in which it is assigned. It will be graded, and late papers will be severely penalized. You may work together on solving the problems, but cannot hand in the same solutions. We have a small class, and we'll be on the watch for this kind of problem.
3. **Exams** There will be three one-hour exams. Exams are "closed book", but formulae will be given. We are allowed to ask anything that is in the reading, the lectures, the homework problems, and the labs. You are always responsible for *all* the previous material in the course. Information about a possible term paper will be distributed later.

SPECIAL NEEDS If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room 128, (631) 632-6748. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential. Students requiring emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information, go to the following web site: http://www.ehs.sunysb.edu/fire/disabilities/asp