PHYSICS 300 – – SPRING 2021
Vibrations, Waves and Optics

Lecture: MWF 12:00-12:53 TA:
Rm: Harriman-116 TA:
Lecturer: Harold Metcalf - S225
harold.metcalf@stonybrook.edu Lab: Tues. 8:30 - 10:20, 2:30 - 4:20,
632-8185 and Wed 2:30 - 4:20 - - - - Rm: A-124

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

SUBJECT TO CHANGE (as of December 29, 2020)

Week # Date of Monday	Monday	Wednesday	Friday	Lab	Reading	Homework
I 2/1	Complex Notation	Superposition and Beats	Harmonic Motion With Decay	none	T 3 - 39	T1: 1, 2, 5, 6 T2: 1-4
II 2/8	Driven Oscillators & Resonance	Coupled Oscillators and Normal Modes	Driven Coupled Oscillators	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 2/15	Waves as normal modes	More about Waves Fourier Ideas	Travelling Waves Superposition Sound and Music	Coupled Oscillators	T 118 - 158	T5: 1, 6, 7, 9, 10
IV 2/22	Music, Timbre Musical Instruments	Phase and Group Velocity Wave Packets		Speed of Sound	T 160 - 265	T6: 1, 2, 3, 9 T7: 1, 2, 3, 5, 8, 12, 15, 19
V 3/1	Electromagnetic Wave Equation	Phase & Grp Vel Fields and Waves Polarization	Jones Matrices		F 2 - 56	: T8: 3, 4 F1: 1, 2, 3, 5, 6, 11 F2: 2, 5, 8, 10, 12
VI 3/8	Interference Interferometers	Michelson Int. Fourier Transform Spectroscopy	Fabry-Perot in great detail	Polarization	F 58 - 103	F3: 2, 3, 6, 7 F4: 1, 7, 9
VII 3/15	Thin Films, Other Wave Phenomena	Diffraction ripple tank	Fresnel zones Arago's spot	Michelson & Fabry-Perot Interferometer	F 112 - 147	F5: 7, 8, 12, 13 **read** T 288 - 294
VIII 3/22	Ray Optics Ray Vectors	Ray Vectors again Ray Matrices Magnifying Glass	Optical Instruments Tele- & Micro scope	Diffraction	F 294 - 305 handout	F10: 1, 3*, 4 * should be: Prove Eq. 10.3 not 10.13
IX 3/29	Lens Aberrations	Paraxial Wave Eq. Review			TBA	TBA
	Everything below here is just a space holder. It will be changed.					
X 4/5	Gaussian Beam Optics	More Gaussian Beam Optics	Gaussian Optics yet again	Optical Instruments	Milonni & Eberly handout	F 10: 2, 7* (* see many texts) M&E 1a, 1c, 3, 4
XI 4/12	Nonlinear Optics Freq. Doubling	Nonlinear Optics 2 Phase Matching	Freq. Chain Self Phase Modulation		F 275 - 280 169 - 180	F 9: 6
XII 4/19	Intro. to Lasers!	Intro. to Lasers again	More Lasers! Locking Schemes	Gaussian beam optics	F 195 - 199 217 - 233	F 8: 1, 2, 3
XIII 4/26	and Fibers	Detectors Waveguides	deB. Waves Bohr View	Make up Missed Labs		
XIV 5/3	Symposium on human vision	Symposium on human vision	Symposium on human vision			

General Procedures for PHY-300 - Spring 2021

(Please note - this syllabus is a work in progress)

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 that 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 in the rightmost columns of the assignment sheet as 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: 25% for lab, 25% for homework, 50% for the short quizzes that will be given almost every week. There is no final exam (tentatively), 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 are expected to perform all of the experiments described in the lab manual available on Blackboard with sufficient grades to pass the lab. You will need a quality lab notebook with fixed, bound, numbered pages, and with each topic clearly marked and dated, and with a table of contents in front. You should number the pages and leave a few in front for the contents.

     Prior to your lab period you should read the writeup carefully to fully understand the experiment to be done. Before you can begin each experiment, you must provide a preliminary writeup for the TA's inspection and signature, and it will count at least 20% of your eventual lab grade (maybe more, TBA). A copy must be submitted with your lab writeup the following week. It should NOT just repeat the material in your lab manual, but should contain enough information so that we can see that you have studied and understood the contents of the material. It should be written neatly in your lab book to be submitted with your report, according to instructions from your TA. It is to be prepared well before the lab period, not during its early minutes.

     In the lab book, neatly record your raw data and measurements along with a description of them, including diagrams and your estimates of the errors. Your TA will sign your data page(s) at the end of the period. You need to prepare a writeup of the experiment, accompanied by a copy of your signed prelab and your separately signed raw data page(s), and it must be submitted at the start of the subsequent lab period. That is, you have one week to complete it. You will need to analyze your data and write a conclusion that should summarize your results and compare with previous expectations. If any analysis is done with a computer program, any graphs or tables that are relevant to your discussion should be printed and stapled into the lab book and a copy placed in your writeup. The writeup, *i.e.,* how well you perform and report on your work, will be the basis for your grade, which will NOT depend on whether you got agreement.
  2. **Homework** The homework will be submitted on lie on Monday following the week in which it is assigned. It will be graded, and late assignments 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. **Quizzes** To be defined in detail later. These 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 course material.

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