General Information

PHYS 375 : Experimental Physics III
Electromagnetic Waves, Optics and Modern Physics

Fall 2014

Instructors :

- Dr. Andris Skuja (Tuesday and Wednesday sections): PSC 3103; Phone : 301-405-6059 ; E-mail : skuja@umd.edu
- Dr. Carter Hall (Monday and Thursday section): PSC 2114; phone 5-6103, crhall@umd.edu

TAs :

- Nightvid Cole (Monday, Tuesday, and Wednesday sections), 0104 John S. Toll Physics Building, ncole1@umd.edu, phone 5-8577.
- Xi Chen (Thursday section), 2434 A.V. Williams Building, xchen128@umd.edu, phone 5-3681.

Course website: http://www.physics.umd.edu/courses/Phys375/Hall-Fall-2014/

- You will use ELMS to submit your lab reports.

Class Schedule:

- Monday Lecture, 2:00 – 03:00 pm; Room PHYS 1410
- Laboratory 3:00 – 5:50 pm : Room PHYS 3203
  - Section 101: Monday
  - Section 102: Tuesday
  - Section 103: Wednesday
  - Section 104: Thursday

Recommended Texts:

- "Introduction to Optics" (3rd Edition) by F.L. Pedrotti, L.S. Pedrotti, and L.M. Pedrotti. Suggested pre-lecture reading will be assigned from this textbook.
- Alternate Text: "Introduction to Modern Optics" (2nd Edition), Grant R. Fowles, This text is considerably older than the Pedrotti one and does not contain all modern applications. However it is considerably cheaper than the recommended text. If you buy a copy get the Dover edition.

Other Recommended Texts:

- "An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurement" by John R. Taylor (University Science Books, 1997)
- "Data Reduction and Error Analysis for the Physical Sciences" by Phillip R. Bevington and D. Keith Robinson (McGraw Hill, Inc., 2003)
- "Optics" (4th edition) by Eugene Hecht (Addison-Wesley)

Required Lab Notebooks: Two Computation Notebooks, 11 3/4" x 9 1/4", 4 x 4 Quad., ~ 75 sheets, bound, numbered pages that are not perforated for tear-out. **You will turn in your lab notebooks to be graded every other week.**

Course Overview: PHYS375 is a three (3) credit course that meets four hours a week. The primary

laboratory objective consists of learning physics through experimental investigation. Topics to be covered include electromagnetic waves, geometrical optics, polarization, interference and interferometers, diffraction, and atomic spectra. There will be six experiments, each lasting for two class periods. Each lab will include a substantial lecture component. This is one of the few opportunities in our undergraduate curriculum to learn some geometrical and wave optics. You will also learn how to carefully take data, analyze it, understand the origins and propagation of errors, and to better appreciate the subtleties of experimental physics. You will also learn how to make useful written presentations of scientific results.

Lectures: The lectures are a required component of this class. This is an excellent opportunity to learn optics and to make connections to your other courses (electromagnetism, quantum mechanics, etc.) and deepen your understanding of physics. Important topics directly related to the labs will be covered in the lectures. **You will not get full credit for the course if you do not attend the lecture.** Attendance will be taken via weekly hard copy submissions of assignments and lab reports during the lecture class. Note that no student shall be allowed into the lab unless they have participated in the week's lecture.

Experiments: You shall be doing 6 experiments during the semester, spending two weeks on each experiment, in addition to the introductory lab during the first week to learn some basic features of the MATLAB, LAB JACK, He-Ne laser and the photodiode.

Computers: Developing a working knowledge of computers in the context of physics problem solving is an important skill. You will accumulate and analyze data with a computer-based system using MATLAB. We will provide some elementary MATLAB code for use in data collection and analysis.

Lab Manual: Because the course emphasizes your own experimental design, we will not be using a traditional Lab Manual. Information necessary for each lab will be made available in the laboratory and will be posted on ELMS and the course website.

Lab Notebook: Keeping a detailed record of your experiments is important in Physics 375, and in experimental science in general. It is your responsibility to keep notes on all important aspects of your experiment, and these notes will be an important part of your grade. Remember that in order to do the analysis in this lab, you will often need a record of how you set up the experiment, including distances, angles, etc.; make sure you have this information recorded before you leave the lab.

Course Grading:

Lab Reports	:	30%
Lab Notebooks	:	30%
Homework 1 - 6 + lab 0	:	20%
Final Exam (exam week)	:	20%
Attendance (including Lectures):		instructor's discretion

Late submission of homework or lab reports: Loss of 20% of total points / day

Your coursework will be judged incomplete if missing any homework, lab report, or lab notebook. You must submit all required lab reports and notebooks to pass the course even if you do not get numerical credit for that assignment.

Schedule of Experiments:

Week	Date	Lab number	Lecture topics	Reading (Pedrotti)	HW due	Lab notebooks and reports due
1	Sept 8 - 11	Lab 0	Error analysis, Waves	(Ch 1, 4-1:4-5)		
2	Sept. 15 – 18	Lab 1a: Reflection and Refraction	Fermat's principle, Snell's Law, total internal reflection	2-0:2-5 and 3-3	HW 1	Lab 0
3	Sept. 22 - 25	Lab 1b: Reflection and Refraction	Imaging, spherical surfaces	2-6:2-8	HW 2	
4	Sept 29 – Oct. 2	Lab 2a: Geometric Optics	Thin lenses, optical instruments, the eye	2-9:2-10, 3-5:3-7, 19-3:19-5		Lab 1
5	Oct. 6 – 9	Lab 2b: Geometric Optics	Waves in three dimensions, Polarized light, Malus' Law	4-8:4-9, 15-1	HW 3	
6	Oct. 13 - 16	Lab 3a: Polarization of Light	Brewster's angle, Fresnel equations	15-2:15-3, 23-1		Lab 2
7	Oct. 20 - 23	Lab 3b: Polarization of Light	Two-beam interference, Young's double slit exp,	7-0:7-2	HW 4	
8	Oct. 27 - 30	Lab 4a: Michelson Interferometer	Michelson interferometer, Coherence	8-1:8-2		Lab 3
9	Nov. 3 - 6	Lab 4b: Michelson Interferometer	Fraunhofer Diffraction	11-0:11-3	HW 5	
10	Nov. 10 - 13	Lab 5a: Diffraction of Light	Double slit diffraction, Babinet's principle	11-4:11-5		Lab 4
11	Nov. 17 - 20	Lab 5b: Diffraction of Light	N-slit diffraction, diffraction gratings	11-6, 12-0:12-4	HW 6	
12	No class	Thanksgiving		6-0:6-1, 6-4		
13	Dec 1 - 4	Lab 6a : Atomic Spectra	Light quanta, Einstein coefficients	6-5:6-7		Lab 5
14	Dec 8 - 11	Lab 6b: Atomic Spectra	Population inversion, Lasers			
15	Thurs. Dec. 18 1:30 – 3:30 pm (tentative)	**Final exam – (in class, written)**				Lab 6

Guidelines for Lab Reports and Notebooks:

- **Lab notebooks:** You are required to purchase two computational notebooks, so that you can turn your lab notes for grading along with your lab reports at the end of each lab. The purpose of your lab notebook is to create a running and permanent record of your time in the lab. Write the date and time next to each entry in your notebook. You may print out data plots and tape them into your notes. Your notes should be thorough enough that the grader can understand what you were doing during the entire three-hour lab period. For example, imagine that you must return to your notes two years later and re-analyze your data and write the report. What information will you need to reconstruct your experiment, once your memory of your labwork is mostly gone? Lab notebooks will be graded on clarity and thoroughness. Your grade will suffer if the grader cannot read your notes! **You will turn in your lab notebooks in your lab section the week following each lab.**

- **Lab reports:** The lab reports for Phys 375 should be lightweight and focused on the analysis of the data and the statistical and systematic uncertainties, and should include a discussion of how the results could be improved. You do not need to write a description of the apparatus or the experimental procedure. Summary plots of experimental data should also be included. Lab reports will be graded following this rubric: 80% data analysis, 20% discussion of uncertainties and possible improvements. **You must submit your lab reports on ELMS before your lab section the week following each lab.**

Late Reports: Lab reports submitted after the deadline will receive a 20% penalty for each day they are late, and therefore a 100% penalty for >1 week late -- ***No Exceptions!!!!***

Missed Labs: If you should miss any lab for any reason, contact the instructor as soon as possible to make an arrangement for makeup. Labs may be missed only for valid reasons as specified by the University rules book. If you plan to **miss any of the six labs for a valid reason it should be *PRE-APPROVED* by the instructor.** The instructor will attempt to let you take the lab in the same week that it was originally scheduled (if possible). If it proves not possible to do so, you will be able to make-up the lab during one of the designated make-up times (primarily Thanksgiving week). You will get credit for missed labs only if you have made appropriate arrangements with the instructor.

Homework: Homework material is designed to complement the lecture and laboratory segments of the course. Homework is assigned every two weeks, with due dates that fall in between the lab report due dates. **Homework will be collected in the Monday lecture period. Late homework must be submitted to pass the course, even if it received zero credit.** The homework assignment will be posted on ELMS and the course website one week prior to the due date.

Tips for Doing Well:

- Read the lab instructions carefully **before** you go to the lab and attempt an experiment.
- During class, keep a neat, well-organized and **complete record** in your lab notebook of the experiment including diagrams of measurement configurations actually used to obtain data, your results, and the analysis used to obtain the results
- When something in the lab isn't making sense or isn't working raise your hand and discuss with your instructor - **do not hesitate to ask** even the most trivial questions if you are not sure!
- Do not leave class until you understand how to do the data analysis and have discussed your results with your instructor or TA.
- Do the assigned homework and submit it for grading **on time**.

Final Exam: There will be a two hour final exam on Thursday, December 18, during the exam week. It will consist of questions related to your homework and the labs.

In case of Bad weather: Should the university be closed due to weather, we will reschedule the lab for the following week.

Academic Integrity: "The University of Maryland has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism." For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.studenthonorcouncil.umd.edu/whatis.html.