General Information

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

Spring 2015

Instructor: Dr. Wendell Hill
IPST Rm. 2120
301-405-4813
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Section 0101: Mondays 15:00 to 17:50
Section 0301: Wednesdays 15:00 to 17:50

Instructor: Dr. Andris Skuja
PSC 3103
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Section 0201: Tuesdays 15:00 to 17:50

TA: Nightvid Cole
Phys 0104
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All sections

Office Hours: You may stop by Prof Hill's and Skuja' offices any time, but it is usually best to make an appointment via email. TA office hours to be determined and by appointment.

Meeting locations (All Section):
Lectures: Rm. PHYS 1402, Monday 14:00 to 14:50
Labs: Rm. PHYS 3203

Required Text:
Introduction to Modern Optics, 2nd Ed., Grant R. Fowles, Dover Books

Plus one of the following:
An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurement, John R. Taylor, University Science Books.
or
Data Reduction and Error Analysis for the Physical Sciences, Phillip R. Bevington and D. Keith Robinson, McGraw Hill.

Recommended Texts:
Introduction to Optics, 3rd Ed, F.L. Pedrotti, L.S. Pedrotti, and L.M. Pedrotti, Pearson.
Optics, 4th Ed., Eugene Hecht, Addison-Wesley.

Prerequisites:
PHYS273 and PHYS276

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 take data carefully, analyze it, understand the origins and propagate errors appropriately. In addition, you will gain an appreciation for the subtleties of experimental physics. You will also learn how to make useful written presentations of scientific results.

Lectures:
Lectures are a required component of this class. This is an excellent opportunity to learn optics and to make connections to your other courses (quantum mechanics, electromagnetism, 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 lectures. Attendance will be taken via weekly hard copy submissions of assignments and lab reports during the lecture class. Note, without a compelling reason, students not participating in the week's lecture run the risk of not being allowed to perform the week's lab activity. This determination is at the discretion of your instructor.

Experiments:
You shall do six (6) experiments during the semester, spending two weeks on each experiment, in addition to the introductory lab during the first week (Week 0) to learn some basic features of MATLAB, the LAB JACK, diode lasers and photodiodes.

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 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. 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. It is often helpful to take photos of your setup with your phone camera. This semester in lieu of the usual Computation Notebook, which can be quite expensive (~ $60 for two that have typically been required), you will us a web-based electronic notebook hosted by LabArchives. Your cost will be $10 for the semester.

While all of your notes and data can easily be uploaded to LabArchives, please understand that **everything** stored in your electronic notebook can be viewed by your instructor, the TA and the lab coordinator! One advantage of using LabArchives is that when you have a problem you can show us your data electronically, which allows us to respond and offer help quickly, even off hours or if we are away. In addition, you will be able to copy items stored in your electronic notebook in any form (images, computer programs, data files, etc.) into your reports easily, as everything will be stored in one place. LabArchives can be accessed at https://mynotebook.labarchives.com/login once you have an account. Students enrolled in the class will receive an email with instructions for creating an account and paying your $10. As usual, the email will be sent to your official university email address.

Experiment Instructions (Lab Manual):

The course emphasizes your own experimental design. Consequently, we will not use a traditional Lab Manual. Information necessary for each lab will be made available via LabArchives.

Course Grading:

50% Lab Reports (two Full + four Summary) – all will count
20% Homework (Lab 0 report + seven) – all will count
25% Exams
5% Lecture Attendance

Late lab report submissions are subject to a loss of 20%/day!
Late homework assignments are not accepted because solutions will be posted!

Guidelines for Lab Reports:

Lab reports must be written using either MS Word or Latex and must be submitted as a **pdf file** to **ELMS by the due date**. A hard copy of the Lab Report must also be turned in **at the beginning of lecture** on the due date indicated on the schedule. **Reports turned in after lecture starts will be deemed one (1) day late!** Reports should be complete with embedded data and figures and appear as professional documents; hard copies must be printed using color ink. There are six experiments in this course plus an introductory lab. You are required to submit a written report of your results for each experiment. Most of these will be short **Summary Reports** (i.e., ~5 pages); two will be extended **Full Report** (~10-20 pages) as explained below. Note, the report for the introductory lab (Lab 0) will count as an additional homework assignment and is due at the beginning of the second lecture.

All reports are due at the start of each lecture on the dates indicated on the schedule! Reports will be submitted both electronically using the ELMS system and by hard copy. 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!!!!*

Homework:
Homework material is designed to complement the lecture and laboratory segments of the course. Homework is assigned every two weeks, with due dates falling between the lab report's due dates. Typically, each homework problem will be worth 5 pt with the total number of points varying per assignment. **Assignments are due at the beginning of the lecture period before the lecture begins. Late homework assignments (submissions attempted after lecture begins on the due date) will not be accepted and will receive a score of zero!** You have at least a week to complete each assignment; the assignment due dates are given on the course schedule. If you are planning to be late or miss a lecture on a due date plan ahead and get your assignment in early. Late homework will not be accepted because solutions will be posted and possibly discussed in lecture.

All homework is due at the start of the lecture period on the dates indicated on the schedule. Assignments will be submitted both electronically using the ELMS system and by hard copy. Late homework will not be accepted!

Final Exam:
There will be a final exam, the time and place of which to be determined. The exam will consist of questions related to your homework and labs.

Missed Labs
If you should miss any lab for any reason, contact the instructor as soon as possible to make an arrangement and appear as professional documents 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. You will get credit for missed labs only if you have made appropriate arrangements with the instructor.

In case of Bad weather:
Winter in the Washington Metro area can bring large snowstorms that make travel dangerous. Should this happen and the University is closed as a result during a scheduled lab, class will be canceled, and we will most likely reschedule the lab for the following week. Closing is announced over local radio and TV as well as on the University's homepage.

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://shc.umd.edu/SHC/Default.aspx

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 unless you have finished your data analysis and discussed your results with your instructor or TA.
- Do the assigned homework and submit it for grading **on time**.

➢ **FULL REPORTS** (labs 2 and 6) consist of two main parts – the record of what you did in the lab, including notes on the apparatus, how you acquired data, and the raw data. The second part is data analysis, including plots, extraction of the actual quantities to be measured, and uncertainty analysis. It should end with a discussion of ways to improve the measurement. This may be a different form for a lab report than what you are used to – rather than having you repeat the material we already know (what the problem is, what the equipment is, …) you should focus on what you did and what conclusions you drew. ***This type of report serves as a full record of your experiment and results, and should be directed to a scientific audience not familiar with the lab.***

Every Full Report must have:

- title page, with name, title, abstract etc.
- introductory material, explaining the theory required to understand the reason for the experiment and the analysis used to arrive at conclusions.
- record of experiment (description of actual experimental setup **you** used)
    - schematics and diagrams of equipment and experimental setup
    - notes on experimental procedures, attempts, success/failures, etc.
    - raw data (provide units!)
    - comments about experimental conditions/ discoveries
    - referrals to appendices, tables, electronic files etc with raw data
- experimental results, including raw data plots, tables etc., as well as summary plots.
- data analysis
    - plots of analyzed data
    - formulae used to extract measured quantities
    - uncertainty analysis/propagation, sources of error, methods of error assignment
- discussion of results and conclusions
    - final results with uncertainties
    - comparisons to expected/known/previous results and other sources
    - identification of predominant source of uncertainty
    - discussion of ways to improve measurement and other possible measurements

Full Reports will constitute 50% of the Lab Reports score.

- **SUMMARY REPORTS** (labs 1, 3-5) are abbreviated versions of a full report, consisting of a summary of the procedures used, a record of the data required for analysis and discussion about analysis, results and conclusions. ***This report serves as a record of your lab performance and results, and should reflect that fact.***

  Every Summary Report must have:

  - title page, with name, title, abstract etc.
  - brief summary of experimental setup and procedures
  - summary plots of experimental results and data analysis
  - data analysis summary and brief discussion of uncertainty assignment, analysis, etc.
  - discussion of results, including values, comparisons, uncertainty, improvements, conclusions, etc.

  The grading of lab reports will follow the following rubric:

Laboratory skill	20 %
Organization and logic of report	20 %
Data analysis	50 %
Discussion of results, uncertainties and methods for improvement	10 %
TOTAL	100 %

Summary Reports will constitute 50% of the Lab Reports score.

Last update January 23, 2015