

University of Maryland Department of Physics

Fall 2009

Prof. Steven Anlage

Physics 375

Title: PHYS 375 Experimental Physics III: Electromagnetic Waves, Optics and Modern Physics. Third course in the three-semester introductory sequence. Methods and rationale of experimental physics. Experiments chosen from the areas of electromagnetic waves, optics and modern physics. In keeping with efforts to improve the department curriculum, this course is evolving into a hybrid Lecture/Laboratory optics course. It will nominally consist of lectures on topics in optics, and a series of six labs. **This is a 3 credit course.**

Prerequisite:

PHYS 273 and PHYS 276. *Credit will be granted for only one of the following: PHYS 375 or former PHYS 296*

Instructor:

Prof. Steven Anlage, Room 1363 (Physics / Center for Nanophysics and Advanced Materials). You can find the Center either by 1) going through the blue door labeled "Center for Nanophysics and Advanced Materials" in the basement of the physics building, or 2) entering from the plaza between the Math and Physics buildings.

Phone: 5-7321, e-mail: anlage@umd.edu, World-Wide-Web: <http://www.cnam.umd.edu/anlage/AnlageHome.htm>

Schedule:

One meeting weekly: M..... 2:00pm- 5:50pm ([PHY 3104](#)) **0101**
or Tu..... 2:00pm- 5:50pm ([PHY 3104](#)) **0301**

Required Texts:

Introduction to Optics (3rd Edition) by F. L. Pedrotti, L. S. Pedrotti, L. M. Pedrotti. ISBN: 0-13-149933-5.

2 Lab Notebooks (Computation Notebook, 11 3/4" x 9 1/4", 4x4 Quad., approx. 75 sheets, bound, numbered pages that are not perforated for tear-out)

Instructor's notes

Suggested Additional Reading:

An Introduction to Error Analysis by J. R. Taylor, ISBN: 0-935702-75-X.

Data Reduction and Error Analysis for the Physical Sciences (Second Edition) by P. R. Bevington and D. K. Robinson, ISBN: 0-07-005135-6.

Optics by Eugene Hecht, 4th Edition, ISBN 0-8053-8566-5.

Other books on optics and modern physics, including your Phys 171/272/273 texts.

Overview:

PHYS375 is a three (3) credit course that meets four hours a week. In a new configuration, it will include a substantial lecture component, so that students learn optics in a coherent fashion. 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, as well as lectures. This course will allow you to develop practical laboratory skills including experimental design and experimental uncertainty inherent in all measurement. You will be required to submit lab reports for each experiment completed, along with homework submitted on those weeks when a lab report is not due.

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 lab will be covered in lecture. Note that no student shall be allowed into the lab unless they have participated in that week's lecture.

Computers

Developing a working knowledge of computers in the context of physics problem solving is an important skill. You will accumulate data with a computer-based data acquisition system. We will provide some elementary Mathematica notebooks for use in data analysis.

Additional information:

Regular communication is essential in this laboratory. Besides face-to-face discussions during the required attendance on your scheduled lab day, email is the next easiest way to stay in touch. You are expected to check your email and the WEB page regularly for announcements.

Dropping the Course:

Note: the last day to drop without a "W" is September 14. The last day to drop with a "W" is November 9.

Grading:

Your final grade will be based on 1000 points determined by your lab reports, laboratory skill and homework according to the following scheme:

6 Lab reports @ 125 pts each	750 pts
Homework	250 pts
TOTAL	1000 pts

Phys 375 Lab Manual

Because the course is in transition, we will not be using a traditional Lab Manual (no more cookbooks!). Information necessary for each lab will be posted on the course website for download.

Lab Reports:

The emphasis in the lab reports will be to learn how to keep a laboratory notebook. This should be a record of what you did in the lab (including mistakes – never erase!). The lab report should consist to 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 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. The grading will be as follows

Laboratory record	50 pts
Data analysis	60 pts
Discussion of uncertainties and ways to improve	15 pts
TOTAL	125 pts

You have 1 week to turn in your lab report after completion of the lab. The reports will be due by at the beginning of class on the Monday/Tuesday following the completion of the lab. Any lab reports submitted after the deadline will suffer an automatic **50% reduction** if they are up to 1 week late, and a **100% reduction** if they are more than 1 week late. **No Exceptions!!!!** Given that you have at least a week to turn in all assignments, and the fact that this assignment due date schedule is given to you on the first day, makes this is a **ZERO EXCUSE CLASS**.

If you should miss any lab for any reason, you should contact the instructor as soon as possible to make an arrangement for makeup. **Any missing lab will result in failing the entire course.**

Homework:

Homework is assigned for every week that a lab report is not due. This material is designed to compliment the lecture and laboratory segments of the course. Late homework will not be accepted and will receive a grade of 0. As recompense, the single lowest homework grade will be dropped before the final homework grade calculation.

Lab Notebook:

You will be required to purchase two lab notebooks, so that you have one to work in while the other is graded. Purchase the quad-ruled coop-style notebooks (brown covers) but avoid those with carbon paper.

Academic Dishonesty (cheating):

Academic dishonesty is a serious offense that may result in suspension or expulsion from the university. In addition to any other action taken, the normal sanction is a grade of “XF”, denoting “failure due to academic dishonesty,” and will normally be recorded on the transcript of the offending student.

Office Hours

While I won't be scheduling regular office hours, please feel free to arrange a meeting time, or just stop by my office to ask questions, discuss the lab, and talk about physics in general. My office is right next to those of Profs. Lobb, Appelbaum and Paglione in the Center for Nanophysics and Advanced Materials. Please note that the doors to the Center lock after 6:00 PM on weekdays, and remain locked all weekend.

Course Web Site:

The course web site is located at:

http://www.physics.umd.edu/courses/Phys375/Anlage_Fall09/index.html.

All of the course notebooks are located there, along with helpful notes about error analysis, keeping a lab notebook, contact information, this syllabus, etc.

Nitty Gritty:

Please do not bring any food or drink into the lab under any circumstances.

This includes water, in any kind of container.

Before leaving the lab for the day, I would like to inspect your lab notebook and your Mathematica notebook to insure that your data is sound and valid. Please remember that the laboratory equipment is taken down each week and you have very limited opportunities to take the data again. Also please tidy up your lab bench at the end of the day so that the next student can start off quickly and efficiently.

Tips For Doing Well In This Course:

- 1) Read the lab description *before* the lab.
- 2) Freely ask questions in lab, and lecture. Also discuss problems with your friends and labmates.
- 3) Do the homework and turn it in on time.
- 4) Keep a neat and well-organized lab notebook. It is good to learn this now because you will be required to use one in PHYS 405.

What Should You Learn in this Class?

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. Finally, we hope to convince you that experimental physics is fun!