

**Syllabus**  
**Physics 375 - Fall 2008**  
**Prof. Michael Fuhrer**

**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. Michael Fuhrer, Room 2308 Physics, Phone: 5-6143, e-mail: [mfuhrer@umd.edu](mailto:mfuhrer@umd.edu). WWW: <http://www.physics.umd.edu/mfuhrer/>

**Schedule:**

One meeting weekly in Room 3112 Physics (lecture) and 3104 Physics (lab)  
Section 0201 meets Wednesday 2:00pm- 5:50pm

**Required Texts:**

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

1 Lab Notebook with at least 100 duplicate pages (i.e. carbon-copy pages), quad ruled. The University Book Center sells a carbon-copy lab notebook (Roaring Spring Paper Company #77649) which will work, but any quad-ruled carbon-copy lab notebook is OK.

**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.

Other books on optics and modern physics, including your 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. There will be a final exam, but no midterm exams.

**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. 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 course web page regularly for announcements. (Course web page is <http://www2.physics.umd.edu/~mfuhrer/course/fall08/>)

**Dropping the Course:**

Note: the last day to drop without a "W" is September 13. The last day to drop with a "W" is November 8.

**Grading:**

Your final grade will be based on 100 points determined by your lab reports, homework, and final exam, according to the following scheme:

Lab 0 report (5 pts for complete report)		5 pts
6 Lab reports	@ 10 pts each	60 pts
6 Homeworks (drop lowest of 7)	@ 2.5 pts each	15 pts
Final exam		20 pts
TOTAL		100 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 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. **You must use a notebook which makes carbon copies of each page, and turn in the copies at the end of each lab period.** 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. Follow these guidelines:

1. Write in a real lab notebook: notebook should be quad ruled, with numbered pages.
2. Use a lab notebook that makes carbon copies of each page.
3. Write in ink. If you make a mistake, draw one line through it - don't erase it, scratch over it, or use white-out.
4. Staple/past/tape all graphs and analysis in notebook. Label axes. Include any formulas, derivations, etc. needed to understand your graph.
5. Provide the actual experimental setup you used to do the experiment (do not photocopy lab manual).
6. Provide a clear description of the procedure used to take data.
7. Provide the units of all numbers.
8. Provide and explain your estimate of the random and systematic errors in all important quantities affecting your final result. You must use proper error analysis techniques.
9. Pay attention to significant figures.
10. Analyze your data. Write down the methods you used. If you use Mathematica, do not simply paste your Mathematica notebook into your lab notebook - write down in your lab notebook your analysis steps.
11. Quote your results with final total error (including systematic errors).
12. When appropriate, compare your answer to the expected value and discuss discrepancies.
13. Be sure you have done all the experiments you were asked to do.

The grading will be as follows:

Procedure	2 pts
Analysis of data	3 pts
Error analysis	3 pts
Everything else on above list	2 pts
Total	10 pts
<b>Late reports</b>	<b>-5 pts /week!</b>
<b>No report</b>	<b>F in whole class</b>

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 week 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. 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. (Note that if you have a lab report which is more than 1 week late, you still must turn it in - and receive a zero - to avoid failing the class.)

**Homework:**

Homework is assigned for every week that a lab report is not due. This material is designed to complement 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 a carbon-copy lab notebook. You will turn in the copies of your notes after each lab session. You will also turn in a lab report which may also be written by hand in your lab book (you may turn in the carbon copy), or typed up on the computer.

**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:**

Regular office hours will be announced, but feel free to stop by at any time to discuss the lab, homework, physics, or just to chat. Office is 2308 Physics.

**Course Web Site:**

The course web site is located at:

<http://www2.physics.umd.edu/~mfuhrer/course/fall08/>

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.*

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.

**Tips For Doing Well In This Course:**

- 1) Read the pre-lecture reading and lab description before class.
- 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!