Syllabus: Optics I, PHY431, Spring 2017

3 credits *(2 hr lecture, 3 hr lab)* Prerequisites: PHY 183 or PHY 184 or PHY 184B or PHY 234B or PHY 294H, PHY 192, PHY 215 or PHY 215B, and completion of Tier I writing requirement.

We will cover geometric optics: e.g., lenses, mirrors, ray tracing, aberrations, apertures, and stops, and wave optics: e.g., diffraction, interferometry, polarization, spectroscopy, fiber optics etc… The course integrates lectures/homework/group work/exams with a lab. The lab focuses on practical optics experience and experience with basic scientific practice including 'formal' lab write-ups and rigorous error analysis.

INSTRUCTOR:

Prof. Matt Comstock, Rm: 4238 Biomedical & Physical Sciences, Telephone: 4-5645
Email: comstock@pa.msu.edu. Office Hours: Wednesday, 1-2 PM

TA's:

David Witalka (witalkad@msu.edu)

Avik Sarkar (sarkarav@msu.edu)

Text: *Introduction to Optics, by (Pedrotti)^3, Third Edition (Addison-Wesley).*

Course Structure: 2 lectures per week in room 1300 of the Biomedical and Physical Sciences Building. Tuesday and Thursday; 9:10 am - 10:00 am. One lab of about 3 hours every week starting the week of January 24.

Homepage: http://d2l.msu.edu

Grading:

Homework: We will have graded homework problems during the semester. Successfully working the homework problems is a key part of learning the material. Normally problems will be posted online on the class D2L site on a Thursday and are due the following Thursday in class (problem sets will be available at least a week before they are due). There will be 10 homework sets altogether of which the best 8 will count at 10 points each towards your final grade. The first homework assignment is due on Thursday, January 19 in class. Late homework will not be accepted.

Group Work: Some special topics will be covered as group work. The groups are composed of pairs of students who will give a 15 minute presentation on the topic assigned. Each group member will have to contribute to the presentation, and the grade is individual. Topics will be posted on D2L and students can sign up individually or as a pair on a first-come-first-served basis. Students may also suggest topics. Additional information on the project format and grading expectations are in the D2L document.

Midterm Exams: There will be two midterm exams, on Tuesday February 7 and on Tuesday March 21. You should bring a calculator and you may bring one 8.5" x 11" sheet with anything written on both sides that you might find useful. There are no midterm makeups -- If you miss either or both the midterms and provide a valid excuse (a written note from a doctor, dean etc.) your final exam score will be multiplied by 1.75 if you miss one midterm, and by 2.5 if you miss both midterms.

Final Exam: The final exam will be on Friday May 5 from 7:15 am until 9:15 am (sorry!). The final exam will cover everything we have done, but with a slight emphasis on the last third of the course. You should bring a calculator and you may bring two 8.5" x 11" sheets with anything written on both sides that you might find useful. You must take the final and if you miss it due to a valid excuse (see above) you will have to take a make-up, otherwise you will get a 0.0 for the course.

Optics Lab: The lab will be run by the two TA's in room 1250 Biomedical & Physical Sciences. The lab grades count for 40% of the total grades. The first lab will be the week of January 24. There will be a total of 10 labs. See the attached lab syllabus for details.

Final Grades:

The final class grade is based on the following formula:

	%
First Midterm	**10**
Second Midterm	**10**
Homework	**10**
Group Work	**10**
Final Exam	**20**
Laboratory Total	**40**
TOTAL	**100**

The guaranteed grading scale may be lowered in your favor but not raised:

Total point percentage	Final grade
>90%	**4.0**
85%-90%	**3.5**
80%-85%	**3.0**
75%-80%	**2.5**
70%-75%	**2.0**
65%-70%	**1.5**
50%-65%	**1.0**
<50%	**0.0**

LABS

Here is a list of the labs. The lab protocols will be placed in a folder on D2L. You need to read through the lab protocols *before* each lab. Lab reports are due the following week in lab. The last lab is due Thursday, April 27 in class.

WEEK	LAB	DUE DATE (in your section the week of)
Jan 24	**L1: Thin Converging Lens**	**Jan 31**
Jan 31	**L2: Thin Divergent Lens**	**Feb 9 (in class)**
Feb 14	**L3: Periscope, Telescope and Microscope**	**Feb 21**
Feb 21	**L4: Lens Aberrations**	**Feb 28**
Feb 28	**L5: Interference Fringes & Newton's Rings**	**Oct 26**
Mar 14	**L6: Michelson Interferometer**	**Mar 23 (in class)**
Mar 28	**L7: Diffraction Slits and Gratings**	**Apr 4**
Apr 4	**L8: Spatial Filters**	**Apr 11**
Apr 11	**L9: Holography**	**Apr 18**
Apr 18	**L10: Laser Tweezers**	**Apr 27 (in class)**

Requirements

You are required to attend one 2.8 hour lab per week (your section). We require you to use a lab notebook to assist you in organizing your experimental notes and for recording raw data. This notebook will not be turned in with your write-ups, but may be checked for a variety of reasons. Digital cameras are available in the labs, but you may also use your own. Please also bring a pocket USB flash memory drive to allow you to bring home digital images. There will be no opportunities to make up missed labs. Please consult Prof. Comstock for cases where more than one lab is missed for legitimate reasons (such as an extended illness).

Partners

The experiments will be performed in groups of two. Groups of three should only occur if an odd number of students attend. Of course, you should divide the labor with your partner. For example, only one person need record the data in their lab book. Although each group must perform the experiment independently, you are encouraged to observe and discuss experimental points with the other groups. Group members will be determined by the TA and will vary each week.

Write-ups

Each partner is required to write their own formal report for each experiment performed, normally due at the beginning of the following lab (see lab table above). We will have 10 experiments in all. Each group must perform their own analysis, and the write-ups must be written independently. Hand written reports will not be accepted. The write-ups must be prepared using a word processor, such as MS Word, with imported graphics and images when applicable. The ideal format to follow should be like the style of a Physical Review article. Each report is worth a total of 10 points. The following sections must be included (point values shown in brackets):

Title [0]
Title of experiment. Please include your name and the name of your partner at the top of the title page.

Abstract [1]
Briefly state the major goals and results of the experiment. For example: "A Michelson interferometer has been used to determine the difference in wavelength of the sodium D lines. A value of 5.9 ± 0.2 Å was found, which agrees with the accepted value."

Introduction [2]
This summarizes the main ideas of the experiment and the conclusions of appropriate theory. A clear sketch of the experiment should be included.

Analysis & Discussion [4]
Present your results. Quantitatively compare your data with expectations. Error estimates must always be given. Do not recopy all the raw data for your report. Give examples and/or the range of the numerical values where appropriate. Present data by graphs as much as possible. Do the measurements within the error estimation agree with theory? If not, can you suggest possible sources of the discrepancy?

Conclusion [2]
A brief statement summarizing your results is required. Did you find what you expected? What improvements would you make if you were to repeat the measurements?

"Polish" [1]
How cleanly and clearly overall has the report been prepared? How clear is the writing? How clear are the figures? How easy is it for the TA to read and grade? Does it look 'professional'?

It can still be unclear what a 'good' lab report looks like. Prof. Comstock has a number of top-scoring example lab reports from previous classes that are available for inspection. Check them out. We will also grade a little more leniently for the first report or two while giving style feedback.

Lab report revision (Tier II writing requirement):

One lab report will be selected by the student for revision (unless all grades were perfect). Using the feedback from the original grading (and consultation with TA's and/or Prof Comstock is encouraged), the student will revise the report to address previous imperfections. Special attention will be paid to the polish of the report: bonus points may be assigned for an exceptional product. This revision MUST be cleanly produced on a computer with clean computer produced figures (unless you are a professional level artist). The revised lab report grade will replace the original grade.

Grades

Your score will consist of the highest 9 of the 10 write-up scores (with one replaced by the revised report score). Hence the maximum point total is 10 x 10 = 100 (plus possible revision extra credit). At the end of the semester your point total will be scaled to count 40% toward your final grade.

Absence / Late Policy

There will be no opportunities to make up a missed lab. If only one lab is missed, there is no need to provide an excuse, as only the highest 9 of 10 labs count toward the final grade. If more than one lab is missed with a legitimate excuse such as an extended illness, you should inform Prof. Comstock by email (comstock@pa.msu.edu) or phone (884-5656) within 48 hrs following the lab. In most cases Prof. Comstock will ask for some documentation, such as a doctor's note.

Students who arrive late may not be allowed to do the lab, at the instructor's discretion. Labs that are turned in after their due date will be penalized by one point per day. For example, a lab turned in a week late will be penalized by seven points. If the lab was turned in late for a legitimate reason, once again you should notify Prof. Comstock within 48 hours. In most cases Prof. Comstock will ask for some documentation, such as a doctor’s note.