

# **Syllabus: Optics I, PHY431, Spring 2018**

3 credits (2 h lecture, 3 h 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.

## **INSTRUCTORS:**

Lectures: Carlo Piermarocchi, Rm: 4263 Biomedical & Physical Sciences, Telephone: 5-5631, Email: [carlo@pa.msu.edu](mailto:carlo@pa.msu.edu). Office Hours: Wednesday 1-2 pm

Laboratory: Pawel Danielewicz, Room 2101, Cyclotron Bldg, Telephone: 5-9672x330 or 517-908-7330, Email: [danielew@msu.edu](mailto:danielew@msu.edu). Office Hours: Tuesday 2-3 pm or by appointment

TAs: Steve Hemmerle ([hemmerle@msu.edu](mailto:hemmerle@msu.edu)) & Avik Sarkar ([sarkarav@msu.edu](mailto:sarkarav@msu.edu))

**Text:** *Introduction to Optics*, by (Pedrotti)<sup>3</sup> (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 23.

**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 9 homework sets altogether, of which the best 8 will count on 10 point scale each towards your final grade. The first homework assignment is due on Thursday, January 18 in class. Late homework will not be accepted.

**Group Work:** Some special topics will be covered as group work. The groups will be 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 will be 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 will be available in a D2L document.

**Midterm Exams:** There will be two midterm exams, on Tuesday February 6 and on Thursday March 29. You should bring a calculator and you may bring your course textbook. There are no midterm makeups -- if you miss either one or both midterms and provide a valid excuse (a

written note from a doctor, dean etc.), then your final exam score will be multiplied by either 1.75 or 2.5 depending whether if you miss one or both midterms.

**Final Exam:** The final exam will be on Tuesday May 1 from 3:00 pm until 5:00 pm. The final exam will cover everything we get done, but with a slight emphasis on the last half of the course. You should bring a calculator and you may bring your course textbook. You must take the final and if you miss it due to a valid excuse (see before) 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 TAs and Prof. Danielewicz in room 1250 Biomedical & Physical Sciences. The lab contributes 40% to the total class score. The first lab will take place during the week of January 22. There will be a total of 10 labs. See the attached lab syllabus for details.

### **Final Grades:**

The final class score is based on the following formula:

	%
<b>First Midterm</b>	<b>10</b>
<b>Second Midterm</b>	<b>10</b>
<b>Homework</b>	<b>10</b>
<b>Group Work</b>	<b>10</b>
<b>Final Exam</b>	<b>20</b>
<b>Laboratory Total</b>	<b>40</b>
<b><u>TOTAL</u></b>	<b><u>100</u></b>

The required scores for the final grades listed below may be lowered in your favor, but not raised:

<b>Total point percentage</b>	<b>Final grade</b>
<b>&gt;90%</b>	<b>4.0</b>
<b>85%-90%</b>	<b>3.5</b>
<b>80%-85%</b>	<b>3.0</b>
<b>75%-80%</b>	<b>2.5</b>
<b>70%-75%</b>	<b>2.0</b>
<b>65%-70%</b>	<b>1.5</b>
<b>50%-65%</b>	<b>1.0</b>
<b>&lt;50%</b>	<b>0.0</b>

## 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 26 in class.

WEEK	LAB	DUE DATE (in your section the week of)
Jan 22	<a href="#">L1: Thin Converging Lens</a>	Jan 29
Jan 29	L2: Thin Divergent Lens	Feb 8 (in class)
Feb 12	L3: Periscope, Telescope and Microscope	Feb 19
Feb 19	L4: Lens Aberrations	Feb 26
Feb 26	L5: Polarization	Mar 12
Mar 12	L6: Interference Fringes & Newton's Rings	Mar 19
Mar 19	L7: Michelson Interferometer	Apr 2
Apr 2	L8: Diffraction Slits and Gratings	Apr 9
Apr 9	L9: Holography	Apr 16
Apr 16	L10: Laser Tweezers	Apr 26 (in class)

**Requirements:** You are required to attend one 2.8 hour lab per week (your section). We require you to maintain 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 inspected by instructors for a variety of reasons. Digital cameras are available in the labs, but you may also use your own. A phone is fine too, if providing sufficient quality. 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. Danielewicz 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 attends. Of course, you should divide the labor with your partner. For example, one person might read the measurement values while the other record those values in their notebook, etc. Although each group must perform the experiment independently, you are encouraged to observe and discuss experimental issues with the other groups. Group members will be determined by the TA and will vary from one week to another.

**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 the lab table before). We will have 10 experiments in all. Each group must perform its 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 style to aim at is that of a Physical Review article. Each report is worth a total of 10 points. The following sections must be included (point values are 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  $5.9 \pm 0.2 \text{ \AA}$  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. Always provide error estimates to make your statements meaningful. Do not recopy all the raw data for your report. Rather, give examples and/or the range of the numerical values where appropriate. Present data in terms of graphs as much as sensible. Do the measurements agree with theory within your estimated errors? 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 instructor to read and grade? Does your report look 'professional'?

It can still be unclear what a 'good' lab report looks like. Prof. Danielewicz has a number of top-scoring example lab reports from previous classes, available for inspection. Check them out. The instructors will also grade a little more leniently 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 (additional consultation with TAs and/or Prof Danielewicz is encouraged), the student will revise the report to address previous imperfections. Special attention will be paid to polishing of the report, especially that 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  $9 \times 10 = 90$  (plus possible revision extra credit). At the end of the semester your point total will be scaled to base 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. Danielewicz within 48 h following the lab. In most cases Prof. Danielewicz 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 delay is due to a legitimate reason, once again you should notify Prof. Danielewicz within 48 hours. In most cases Prof. Danielewicz will ask for some documentation, such as a doctor's note.