

PHY 431 Optics
Department of Physics and Astronomy
College of Natural Science, Michigan State University
COURSE SYLLABUS

Instructor:	Dr. Chih-Wei (C. W.) Lai	Term:	Fall 2011
Office:	4238 BPS	Class Meeting Days:	Tue, Thu
Phone:	(517) 884-5675	Class Meeting Hours:	3:00 – 3:50 pm
E-Mail:	cwlai@msu.edu	Class Location:	1308 BPS
Website:	http://www.pa.msu.edu/courses/PHY431/ http://angel.msu.edu/ http://www.masteringphysics.com/	Lab Meeting Hours:	S1 M 6:00-8:50 pm S2 W 6:00-8:50 pm S3 Tu 6:00-8:50 pm S4 W 3:00-5:50 pm
Office Hours:	Tue 4:00 – 5:00 pm, Wed 7:30 – 9:30 pm, and by appointment	Lab Location:	1250 BPS

Teaching Assistant:

Joseph Glick glickjos@msu.edu, Office Hours: Mon 1:00-2:00pm, 1250 BPS

Grader (homework assignments & lab reports):

Feng-kuo Hsu hufengk@msu.edu, Office Hours: Tue 1:00-2:00pm, 1250 BPS

I. Welcome

Let there be light!

II. Course Description

Physics 431 covers the fundamental properties of light propagation and interaction with matter under the approximations of geometrical optics and scalar wave optics. This is an intermediate Optics course with emphasis on applying lectured, theoretical principles in a hands-on setting. The lab will provide a correlation between theory and practice and should help explain how scientists arrive at their theories from experimental approaches within the laboratory setting. The course utilizes the Scientific Method to rationalize work performed and allows students to produce laboratory reports comparable to those found in scientific journals.

III. Course Credits

3 credits (2 hr lecture, 3 hr lab)

IV. Course Prerequisites

Two semesters of introductory physics, one semester of physics laboratory, and one semester of modern physics.

Specifically,

- PHY 183A or PHY 184 or PHY 184B or PHY 234B or PHY 294H (Introductory Physics)
- PHY 192 (Physics Laboratory)
- PHY 215 or PHY 215B (Thermodynamics and Modern Physics)
- Completion of Tier I writing requirement.

It is necessary that you are familiar with Euclidean geometry, calculus with complex numbers, Taylor series approximation. It is helpful, but not necessary, to know electrodynamics, wave propagation, and Fourier analysis, we will cover these.

If you haven't completed these prerequisites, you may still be permitted to take the course. You need to meet me to discuss this within the first two weeks.

V. Course Objectives

During this course, we expect you to:

- Relate theoretical concepts to real-world applications and experiments.
- Become familiar with optics laboratory experiments and procedures.
- Collect reliable data and Record your observations.
- Organize your measurements, Estimate uncertainties and errors, and Write a professional laboratory report.
- Develop an understanding of basic concepts of waves and harmonic oscillators.
- Develop an intuitive capability to research and to uncover the working principles of things that involve light.

VI. Required Texts and Materials

Introduction to Optics (3rd Edition), by Frank L Pedrotti, Leno M Pedrotti, & Leno S Pedrotti (Addison-Wesley).

You are allowed to use this textbook during the mid-term exam and final exam (i.e. open “text book”).

VII. Supplementary Texts and Materials

(free online text)

Physics of Light and Optics, by J. B. Peatross and M. Ware (click [here](#) to download)

Geometric Optics, by J. B. Tatum (click [here](#) to download)

(Copies of the following texts are available in the Optics Lab, 1250 BPS.)

Theory

1. *Optics, by E. Hecht, 4th Edition (Addison-Wesley).*
2. *Introduction to Modern Optics, by Fowles (Dover Book).*
3. *Schaum's outlines - Optics, by E. Hecht (McGraw-Hill).*

Experiment

1. *An introduction to error analysis, by J. R. Taylor (University Science Books)*

VIII. Course Requirements

➤ Homework Assignments:

During the semester, periodic assignments will be assigned and must be submitted on their associated due date. Normally homework assignments will be due on Thursdays.

There will be about 12 assignments. The one with the lowest score will be dropped.

➤ Examinations:

Each student will be responsible for completing a mid-term and a final examination.

The final exam is cumulative.

No makeup examinations will be given.

All exams are “open book”. Materials allowed include

- (1) *Text, Introduction to Optics, by Pedrotti³,*
- (2) *Your own written laboratory reports,*
- (3) *A scientific calculator and a ruler (recommended), and*
- (4) *One sheet of double-sided notes (letter size, hand written) for the mid-term.
Two sheets of double-sided notes for the final exam.*

➤ Group Projects:

You will complete a research project on “How Things Work” in the areas of optical science and technology in groups of three. Each group will be responsible for delivering a 12-minute oral presentation. Everyone must take part for the presentation. All members of a group will receive the same score for the presentation; that is, the presentation is assessed as a whole and everyone receives this score. Your presentations will be ‘peer reviewed’. The average score after dropping the lowest and highest ones will account for 20% of your group project grade. The grade given by the instructor will account for 70%. The oral presentation is thus only 90% of your grade for this project.

The final 10% is individual, and refers to your teamwork. Every person in the group will provide the instructor with a suggested grade for every other member of the group, and the instructor will assign a grade that is informed by those suggestions.

In addition, extra credits will be given to individuals with outstanding performance.

Once formed, groups cannot be altered or switched, except for reasons of extended hospitalization. Further detailed guides and will be given later on in the semester.

➤ Pre-Labs/Lab Performance:

The experiments are all described in the laboratory instructions (available as pdf files on the course website). You are expected to print and read the material and prepare yourself before coming to class as there will not be sufficient time to start from scratch during the three-hour laboratory session. **You will be given a lab notebook for the labs in this course.** You are expected to demonstrate your pre-lab preparation in your lab book. The laboratory period for new experiments will start with us examining the printed lab instructions and the pre-lab preparation on your lab notebook.

You will lose 1 point out of 10 for that lab report if you do not bring a printed copy of the lab instruction.

The lab performance will be evaluated based on the coordination with our team members, the questions you raise, your skill in setting up the instruments and collecting meaningful data, and your problem-solving skills in particular when something is “NOT working”.

➤ Lab Attendance and Lab Reports:

There will be eight sets of regular experiments and one set of advanced experiments. You will do the experiments in groups of two for regular experiments and in groups of two or three for the advanced experiments.

Regular lab reports are due at the beginning of the following lab period. ONE regular laboratory report with the lowest score will be dropped. However, **lab attendance is mandatory.** If an occasional schedule conflict should arise, please contact me at least 24 hrs in advance. In most cases, you will be able to swap sessions.

You will perform a set of advanced experiments in the last three lab sessions. You will select one of the following topics: Optical Trapping, Photoelectric Effects/Planck Constant, Fourier Optics/Computer Generated Holograms, and Quantum Optics. Each student has to submit an advanced lab report containing further in-depth discussions of theory and applications for the chosen topic.

One unexcused absence from lab will result in a drop of 1 point for your course grade. If you are absent from TWO labs without a legitimate reason, your course grade will drop by 3 points. If you are absent from more than three labs, you will receive another drop of 5 points for each additional lab you miss.

➤ Class Attendance and Participation:

Regular class attendance is strongly advised and is necessary for students to fully grasp many of the concepts. Students in attendance are expected to be active participants in the course. This participation includes: contribution to class discussions, providing insights into the class discussion topics, raising questions, and relating class material to personal experiences and other course topics. **I will reward extra credit to in-class participation throughout the semester.**

Please be on time to class and labs.

If you miss a class session, it will be your responsibility to find out the materials that were covered.

IX. Course Grading

Course Item	Points
<i>Pre-Labs/Lab Notebook</i>	5 pts
<i>Regular Lab Reports</i>	20 pts
<i>Advanced Lab Report</i>	5 pts
Homework	15 pts
Midterm Exam	15 pts
Group Project	15 pts
Final Exam	25 pts
Extra Credit	Up to 6 pts
*Best 5 lab notebooks (1-2); In-class participation	
	106 pts

Grading Scale (points)	
>=93	4.0
88 - 93	3.5
82 - 88	3.0
76 - 82	2.5
70 - 78	2.0
60 - 70	1.5
50 - 60	1.0
<50	0

X. Grade Dissemination

You can access your scores of assignments using "Grade Report" at <http://angel.msu.edu/>. Please note that grades returned mid-semester are unofficial grades. If you need help accessing Angel.msu, you may contact me or submit a request via ANGEL's homepage.

The final exam will be held in the week of December 12.

Final grades will be posted on Angel and the bulletin board next to my office, 4238 BPS, by 5 pm, Fri, Dec 16.

XI. Course Policies: Grades

Extra Credit Policy:

Extra credit will be granted for the best five laboratory notebooks, and in-class participation. You will be awarded extra credit for raising good questions, answering questions, providing insights, in-class problem solving, to name but a few. It is thus to your advantage to study the relevant reading in advance. Of course, you also must show up in class to earn these extra points. If extra credit is granted, the additional points are added to your overall accumulative grade. You cannot earn more than 6 points for extra credit; any points over 6 are not counted.

Late Work Policy:

Homework assignments and lab reports turned in late will be assessed a penalty: 1 out of 10 point if it is one day late, and 1.5 out of 10 for each additional days. Assignments and reports will not be accepted if overdue by more than seven days.

If an emergency arises and you cannot submit assigned work on or before the schedule due date or cannot take an exam on the scheduled data, you MUST give notification to me NO LESS than 24 HOURS BEFORE the schedule date/time and NOR MORE than 48 HOURS AFTER the scheduled date/time

Grading Objections:

All objections to grades should be made IN WRITING WITHIN ONE WEEK of the work in question. Objections made after this period has elapsed and will NOT be considered.

Grades of "Incomplete":

The current university policy concerning incomplete grades will be followed in this course. Incomplete grades are given only in situations where unexpected emergencies prevent a student from completing the course and the remaining work can be completed the next semester. Your instructor is the final authority on whether you qualify for an incomplete. Incomplete work must be finished by the end of the subsequent semester or the "I" will automatically be recorded as an "F" on your transcript.

Group Work Policy:

This course relies heavily on teamwork and cooperation throughout the semester. Early on in the semester, you will be assigned into groups of two or three to accomplish various experiments in a group effort. You will work with different team members for the labs. Later on in the semester, you may form groups with members of your choice for advanced labs and group projects.

If you are having difficulties with working in groups, please feel free to discuss this with me.

You are encouraged to study together and to discuss information and concepts covered in lecture and labs with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an email, and email attachment file, a diskette, or a hard copy. You must produce your work independently unless a team output is specified. Should coping occur, both parties involved are accountable and will automatically receive a zero for the assignment. Penalty for violation of this Code can also be extended to include failure of the course and University disciplinary action.

During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way.

XII. Course Policies: Technology and Media

Computer Skills/Usage:

Students are expected to have frequent access to a computer, and the internet/email as online homework assignments will be given.

Students are also expected to be familiar with:

- a word processing application or productivity suite (e.g., Microsoft Office – Word/Powerpoint or Apple iWork Pages/Keynote or Open Office) OR a document preparation system (LaTeX) as many assignments may require its use;
- Adobe Acrobat Reader to view course documents.
- <http://googleapps.msu.edu/> :
Google Calendar iCAL – PHY 431 Optics @MSU
http://www.google.com/calendar/ical/msu.edu_tgej3gh8qrl3qkba95req8a3d0%40group.calendar.google.com/public/basic.ics
Google Docs: Share documents, spreadsheets, and presentations.

The software you use to write your reports is irrelevant, as long as you follow the guidelines for the laboratory report. The instructor accepts Microsoft Office, Apple Pages, PDF, and LaTeX electronic files. When submission of an electronic file is required, please convert your electronic file into one of these. In many cases, you can analyze your data in a spreadsheet (eg. Microsoft Excel). However, a scientific

graphing and data analyzing application is needed for some experiments and lab reports. You may use IGOR Pro or KaleidaGraph installed on the lab computers. IGOR Pro runs on Macintosh and Windows computers. You may use IGOR Pro on your PC/laptop at no charge for assigned coursework in the Physics Department. Please contact me or Mark Olson to obtain such a course license.

MasteringPhysics.com:

You will complete several homework assignments online, in particular early on in the semester. Please follow the instructions given in a separate handout to register.

Email:

When sending e-mail to the instructor, please begin the "Subject:" of the message with the following:

PHY 431: <space>

An email without a proper "Subject:" line might be discarded. I will respond to emails typically within 24 hours. If concerns require special attention or are of a sensitive nature and you do not feel like submitting your request via email, please see me in person during the office hours.

ANGEL (Grade Reports and Course Blog):

You may check the scores for individual homework assignments, lab reports, and exams on ANGEL. Scores will be posted within a week after grading your work. A course Blog is available for students to discuss homework assignments, lab reports, exams, and other course related issues freely. You should not post the answers of homework problems, which will be considered as a violation of our Group Work Policy. We may also utilize the discussion forums for selecting exam problems, group project topics, and special topics/issues raised in class.

Classroom Devices:

You are encouraged to use calculators and rulers in class and exams. No audio/video recording is permitted.

Online meeting:

The instructor's FaceTime name is cwlai@msu.edu; Skype name is *cwlaimsu*. You may make online video calls during the office hours without making an appointment. Otherwise, you should email me first.

XIII. Course Policies: Student Expectations

University Writing Center:

The Writing Center (WCMSU) is a free resource for MSU undergraduates and graduates. At the WCMSU, a trained writing consultant will work individually with you on anything you're writing (in or out of class), at any point in the writing process from brainstorming to editing. For more information or to make an appointment, visit the WCMSU website at <http://writing.msu.edu>.

Professionalism Policy:

Per university policy and classroom etiquette; mobile phones, iPods, *etc.* **must be silenced** during all classroom and lab lectures. Those not heeding this rule will be asked to leave the classroom/lab immediately so as to not disrupt the learning environment. Please arrive on time for all class meetings. Students who habitually disturb the class by talking, arriving late, *etc.*, and have been warned may suffer a reduction in their final class grade.

Disability Access:

Students with disabilities who need accommodations in this course must contact the professor at the beginning of the semester to discuss needed accommodations. No accommodations will be provided until the student has met with the professor to request accommodations. Students who need accommodations must be registered with the Resource Center for Persons with Disabilities (RCPD) at MSU, before requesting accommodations from the professor.

Academic Conduct Policy:

Academic dishonesty in any form will not be tolerated.

Academic dishonesty at Michigan State University is defined by the General Student Regulations (<http://splife.studentlife.msu.edu/regulations>) as conduct that violates the fundamental principles of truth, honesty, and integrity. The following conduct is specifically cited:

Supplying or using work or answers that are not one's own.

Providing or accepting assistance with completing assignments or examinations.

Interfering through any means with another's academic work.

Faking data or results.

If you are uncertain as to what constitutes academic dishonesty, please consult the General Student Regulations for further details. Violations of these rules will result in a record of the infraction being placed in your file and receiving a zero on the work in question AT A MINIMUM. At the instructor's discretion, you may also receive a failing grade for the course.

Plagiarism:

When necessary, we may utilize turnitin.com, an automated system which instructors can use to quickly and easily compare each student's assignment with billions of web sites, as well as an enormous database of student papers.

XIV. Important Dates to Remember

Dates and assignments are tentative, and can be changed at the discretion of the instructor.

Group Project Choices w/o team members Due	Thu, Oct 6 th 2011
Mid-Term Examination	Tue, Oct 11 th 2011
Advanced Lab Choices w/ team members Due	Thu, Oct 27 th 2011
Group Project Presentations	Tue, Nov 15 th 2011 & Thu, Nov 17 th 2011
Final Examination	TBA, Last class or in the week of Dec 12 th , 2011