Physics 305
Optics
Fall, 2009

Meets:
8:00 am – 9:50 am
Tuesday, Thursday
221 Malouf Hall

Instructor:
Dr. Christopher Cline
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Textbook:
Required: *Introduction to Optics*, 3nd Ed., Pedrotti[3].
The *Offical Laboratory Research Notebook*, (found under Chem 303)

Course Description: Physics 305 is a sophomore/junior level course in optics – the study of the behavior light. How we talk about light depends upon the size of the objects in which light interacts. For interactions with big things, things that are large relative to the wavelength of light, we treat light like a ray or a beam. (A ray is a little like your mental picture of a vector). We call this model *Geometrical Optics*. For interactions with little things that are of the same order of magnitude as the wavelength of light, we treat light as a wave. This is the domain of *Physical Optics*. So, its natural that will divide the course equally into two seven week sections. The first section will be mostly about Geometrical Optics; I will teach the first section. The second section we will be more focused on Physical Optics, and Dr. Conwell will teach that section.

In the 1st seven-week stint, we will begin with an overview of oscillations, simple harmonic motion, and fundamental definitions for waves. We will then briefly look at the electromagnetic spectrum. We'll look at color, color space, color perception, and spectroscopy. Then will move to geometric optics. In geometric optics, we treat light as if it were a ray, not unlike your mental picture of a vector. Included here are reflection, refraction, mirrors, prisms, lens, and lens systems. Also in geometric optics, there is a nice application of linear algebra that radically simplifies the study of light propagation through a lens system. We'll look at this too.

Conditions of enrollment: Physics 212 (Physics for Scientists & Engineers II) and Math 202 (Calculus II) are prerequisites for all students enrolled in this course.

How to get help: My office hours are MWF 12:00 pm-1:00 pm and TTh 10:00 am-11:30 am. If you can't come during any of these hours, I will be happy to make an appointment with you for another time. For me, *the* most enjoyable aspect of teaching is working with students one-on-one. *Please, please* come see me often—*especially* if you run into difficulties with concepts.

Class Attendance and Participation: Class meetings are TTh 8:00am-9:50am. Preparation for class, attendance, and participation will be rewarded.

Optics Course Requirements

Lab Books: The basic idea behind keeping any kind of a notebook is this: *If you look back five years from now, can you figure out what you did well enough so that you can explain it to some else*. Your lab book should have graph ruled lines. ***Do not erase.*** Here is why. You may be wrong in thinking you were wrong! Or, more likely, you may have been partly right. Don't scribble out. Just put one line through the material you think is wrong, and correct it. Some students hate this. They are perfectionists; they want their lab books to be flawless. Science does not work that way. A lab book with clean marked out material is a hallmark of a future scientist who has critically analyzed what they have written, found it wanting, and corrected it. You will do your labs in groups, but your write-up should be your own. ***Please put the name of your lab partners on your labs.***

Each Optics Lab should have:

1) an introduction, where you explain the labs purpose and how you are going to accomplish it. In short, an overview of what you are going to do. Your understanding of the relevant physics goes here.

2) a detail section, where you explain the set up of your experiments, (complete with sketches) how you made your measurement, and the numbers you got. Any calculations you make go here. Any graphs or charts must be properly titled and axis labeled. I will specify in each lab how much focus I want on error analysis. However, ***never*** report

numbers with a greater precision than you can justify. You should ***always*** list error values associated with any measurement, like this: 3.14 +/- .05 cm. Sometimes propagating errors through a complex equation can be problematic, and we have one lab explicitly devoted to this problem. Nevertheless, you can always get a rough, but generous, value of your uncertainty by running the highest value, and the lowest value through an equation. And, of course, units are mandatory. Sometimes in this section it is useful to maintain a running monolog of what you did. *"I tried A and B, but that didn't work because I didn't do C. Next I tried A, B, and C and …"*

3) a conclusion. Here you summarize your results, and answer the question: "How well did I accomplish what I set out to do." You should ***never write, "My data fit my model very well."*** Instead, be quantitative, "My model fit my data within the uncertainty of my data. The uncertainty of my data points was +/ <some number>." You should examine and report your sources of uncorrectable errors. Any correctable errors should be corrected, or adjusted.

Homework: I will make regular Homework Assignments due at intervals of very approximately a week and a half at the beginning of a specified class meeting.

As you surely know by now, the primary purpose of assigned problems in physics is ***absolutely not*** to see if you can get the right answer. Rather, it is for you to practice and then demonstrate that you have learned 1) how to determine the fundamental physical principles that are involved in a described situation and 2) how to apply those principles in a disciplined and orderly fashion. Of course, if you have learned how to do these things, you should expect to get the right answer too, but that is - really - of secondary importance. You will find - indeed, you probably have found - that, given time, an open book, lots of worked examples, and knowledge of the correct answer, it is very often possible to "get the answer" without the slightest understanding of what you are doing. Please guard against this; it is a complete waste of your time because it does not prepare you for, and it obviously will not work on, exams.

Accordingly, we are not - and you should not be - satisfied with problem "solutions" that simply consist of a series of mathematical manipulations leading to a result. Instead, the problem solutions you submit are to be "presented." By this we mean that they should be readable by someone who does not have access to the problem statement; should include written explanations and thoughtful comments about what you are doing and, especially, why; should use well-defined and consistent notation (employing unique and meaningful subscripts and superscripts as necessary); should be accompanied by neatly drawn and carefully labeled diagrams; and should flow in a logical and orderly progression down the page. They should use more space for the written explanatory information than for the mathematics! They should ***not*** include lengthy, multiple-step, purely mathematical manipulations because it only serves to obscure the physics. Do this kind of work on scratch paper and simply say something like "Solving equations 1, 2, and 3 for x, y, and z, we obtain ..." and give the result.

I *strongly* encourage you to form study groups and to discuss with others your readings, questions that come up in and out of class, and how to go about solving problems. The work ***you*** turn in, however, must be ***yours***, based on the understanding ***you*** have acquired. When faced with two write-ups that show any signs of copying, I conclude that at least one person hasn't done the work. In such cases both papers will receive no credit.

I do not accept late Homework Assignments, but, in order to allow for extraordinary circumstances (*including* absence for *any* reason), I will throw out your two lowest scores.

Midterms and Final: We will have two take-home exams, and one in-class, open-book/open-note final, cumulative final. Of course, I trust you will do all your own work on the exams. If you are caught cheating on an exam you will receive an F for the exam for the first offense; for a second offense, an F for the entire course.

Grading: Your overall "Course Score" will be calculated using the following relative weights:

Homework	20%
Take Home Exams	34% (17% each)
Final Exam	16%
All Labs	30%

Academic Integrity: Please make sure that you have read and fully understood Westminster's Policy on Academic Honesty (and Dishonesty) that appears in the Academic Catalog. My sincere desire is to act as facilitator—not an enforcer—for your studies in physics. Accordingly, I operate on the assumption that all of our interactions are based on openness, honesty, and good faith. I expect all of us to be honest and to treat each other fairly and with respect. Because our trust in each other is absolutely *crucial* to the effectiveness of our relationship, I take an uncompromising stance, as should you, on the necessity for sanctions when it is violated.

Services for Students with Disabilities: Westminster College provides equal access in higher education to academically qualified students with physical, learning, and psychiatric disabilities. The START Center works with departments throughout the college to help ensure that programs and facilities are accessible to all members of the college community.

To access services, students must meet with counselors in the START Center and provide documentation of their disabilities. Appropriate documentation is necessary to verify eligibility and support requests for accommodations, academic modifications, and/or other aids. Once eligibility is established, students meet with their disability advisors to determine individualized services. The START Center can also provide referrals for testing and assessment of disabilities.

The Services for Students with Disabilities program is located in the START Center in Carleson Hall. The office of the 504/ADA coordinator Susan Heath also is located in the START Center. A copy of the ADA Grievance Policy is found in the Policies and Procedures section of the Student Handbook. Additional information about disabilites service guidelines is on the START Center web page. If you have questions regarding services for students with disabilities or require alternate format of this information, please call 832-2280, TTY 832-2286, or email startcenter@westminstercollege.edu.