

GENERAL INFORMATION**Lecturer**

Lecturer and lab coordinator for PHY455/555 is Dr. Kiril A. Streletzky.

Office: SI 124; email address: k.streletzky@csuohio.edu; phone: 687-2433.

Meeting Times

Lecture/Lab: M, W 6:00-10:00 pm, SI 140

Office Hours: M, Tu, W, and Th 10:30am-noon or by appointment, SI 124

Academic Calendar Related to This Class

First day of the class:	Jan 20
Last day to add:	Jan 22
Last day to drop:	Jan 29
President's Day:	Feb 15 (No classes)
Spring Recess:	Mar 14 – Mar 21 (No classes)
Last day to withdraw:	Apr 2
Last day of the class:	May 5
Final Presentation:	May 12 (6:00-9:00pm)

Introduction

The objective of this class is to provide students with various experiences in modern optical and spectroscopic experiment, to give them practice with experimental methods, careful data taking/observation, and critical analysis of the results, to nurture creative skills, and to promote scientific communication skills. These objectives will be achieved by a series of six closed experiments and an open-end experiment.

The closed experiments will be completed first, following the procedures provided. All measurements, calculations, results, error analysis, and any additional observations should be recorded in laboratory notebook. The analysis of the experiments will usually require usage of scientific graphing software such as Origin, Grapher, SigmaPlot, MathCad, IgorPro (Please note: Mathcad is notoriously inconvenient in dealing with huge data arrays, error bars, and publishable quality graphs). You will also find Excel to be very useful for most (but not all!) of the experiments. You are strongly advised to learn Origin as it is considered the standard in the scientific world and would simplify your data analysis considerably. Also, at least one of the labs will have to be done using Origin so it is in your interest to start using it ASAP. Origin is available on all computers in the Optics Lab.

The class will be split into groups of two (three if the class is large) students. Each experiment requires preliminary reading which should be done outside of the laboratory. Be sure to study the apparatus and understand how it works. This is the only way you will be able to obtain meaningful results.

After introductory lecture you will have about two weeks to complete each experiment (see **Syllabus** for detailed schedule). Make sure you record *all* of your measurements and observations into your notebook. At the end of the two weeks you and your partner(s) will have to present your results to the rest of the class (see **Regular Lab Presentations**). After each presentation, you will typically have until next class to finish your lab report (by answering questions, correcting obvious mistakes, incorporating instructor's suggestions). Your lab reports should follow the suggestion of **Regular Lab Reports**.

The open-end experiment in large will be devised by a student. This experiment will also be presented to class at the end of the semester during our scheduled Final. The lab report for this experiment has to be written as a formal report in a style *suitable for publication*. For details see **Open Lab Project**.

Basic Laboratory Rules

The rules listed below should be adhered to at all times while you are in the laboratory.

- 1) Do not smoke, eat, or drink in the laboratory.
- 2) Do not tamper with apparatus if you might destroy careful alignment, break delicate equipment, come into contact with high voltage, be blinded by intense light, or spray intense light around the room.
- 3) Call the instructor when the apparatus is broken.
- 4) Use whatever apparatus you need and manipulate the equipment as necessary within the guidelines of Rule 2.
- 5) Return everything to its original state and, if applicable, return it to its storage location.

Course evaluation

Your grade will be calculated as follows:

Regular Lab Report (5)	(Each 7%)	35%
Regular Lab Presentation (5)	(Each 3%)	15%
Grand Lab Report		10%
Grand Lab Report Presentation		6%
Quizzes (7)	(Each Quiz – 2%)	14%
Open Project Lab Report		13%
Open Project Lab Presentation		7%

You lab reports will be graded on the quantity and quality of the work you perform during the laboratory hours. Not only should your notebook and formal report be legible, but should also demonstrate your power of observation and your ability to reason and analyze (creative abilities are reflected in your ability to extend logic and test new conclusions experimentally). Do not rely on your lab partner to do all the thinking and experimental manipulations – your grade will depend on your participation in all procedures.

Regular Lab Reports

The laboratory reports are to be kept in a hardbound lab notebook with numbered pages for all 6 regular experiments. These reports should be detailed and should contain the following:

- 1) A title and a statement of the objective of the experiment.
- 2) A short description of the underlying theory.
- 3) A step by step description of the method(s), including a schematic optical diagram of the essential apparatus.
- 4) Tables of *all* the data taken, *not just the best data*.
- 5) The results, with examples of calculations, and required derivations.
- 6) A discussion of the accuracy of the experiment with detailed error analysis and justified error propagation.
- 7) Any additional observations made during the experiment.
- 8) A short but to the point conclusion.
- 9) List of references.

The first two pages of the lab notebook should be left blank for the Table of Contents. After the Table of Contents all pages should be consecutively numbered. Any pre-lab notes for the lab should also be kept in the notebook before the corresponding lab. *All experimental observations/measurements* should be recorded in the notebook in the laboratory. The goal here is to learn how to record your data directly into the notebook and to write up an experiment neatly and adequately while it is being done. Some (if not most) of the data analysis and sample calculations are expected to be done in the lab as well. The final summary of data analysis, error analysis, and conclusion can be done at home but are to be entered into your lab notebook right after your in-class recorded data. *Clearly separate in your notebook the measurements/observations done during the experiment and the analysis done later.* Also, please leave a couple of pages after each lab for my comments.

The ideal notebook is a clear, legible, working notebook, containing all pertinent and little superfluous information. The report should be understood by anyone reasonably informed on the subject without any additional explanation. Approach the experiment and the writing of the report as if you were doing publishable research.

In discussing the accuracy of the results, list the factors that might limit the accuracy. For as many of those factors as possible, make a numerical estimate of the uncertainty and its effect on the result. Single out those factors, which are most important and base an estimate of the accuracy of the final result on them. While doing an experiment, it is important to *take repeated readings of each measured quantity* in order to estimate the uncertainty in the measurement.

Regular Lab Presentations

The important component of the course curriculum is lab presentations. After completing each lab you will have to present your findings to the class and myself and be able to answer questions that arise during your presentation. In addition to your experimental findings, you should present the theoretical basis of the experiment *at least* in the scope given to you in the Lab Manual/Textbook. Make sure you can explain the formulas that you have been using as well answer simple questions on the subject. Since

you are going to work on the experiments in pairs I expect from *both partners to actively participate in presentation*. Each student should present some theory and some of the results which are not presented by his partner. PowerPoint presentations are encouraged. However, you can also present your results on overhead transparencies. An electronic and a paper copy of each presentation is to be submitted to me at the presentation for my comments. More detailed guidelines on the length and content of each presentation will be given to at later point in time.

Quizzes

As means of encouraging you to think about physics of the experiments you do in the lab you will be given 7 quizzes on the subject of regular lab experiments and error analysis. Most (if not all) of the quizzes will be take-home. I will be announcing the quiz dates/deadlines and details on quiz taking as we proceed.

Grand Lab Project/Presentation

After finishing five Regular Labs, presenting your findings, and submitting lab reports you will be given an opportunity to show off your acquired experimentalist mastery in the Grand Lab Project (which is simply your sixth Regular Lab). Each of the permanent groups will do a different type of experiment (from the list: B,C,D,E,F). This lab will be new for your group but already done and presented by all other groups. Since all of the types of labs will be presented by that point of the semester and publically critiqued – you will be given only 2.5-3 class periods to start and finish your corresponding Grand Lab Project and prepare the presentation. Your goal is to use all of the earlier acquired knowledge and experience (which includes carefully listening to presentations by your peers and their critique) in this project. This sixth Regular Lab (called Grand Lab Project) will be presented (both orally and in a notebook) in same manner as previous labs but it is worth more percentage points.

Open Lab Project/Presentation

The Open End Lab project will involve your independent work on setting up a chosen new experiment basically from scratch. We have specific optical equipment (Dynamic and Static Light Scattering (SLS) Set Up, Light Photometer, Triple Spectrometer, X-ray machine, and One Photon at a Time setup, Holography Setup, etc) which has barely been tested. The equipment comes with short manuals and in some cases with a general suggestion for a possible student lab experiment. Your goal will be to design and test an experiment that would highlight the power of specific optical method/concept (following the guidelines of the manufacturer). Apart from designing and doing an experiment yourself you will have to design a meaningful format for the lab report for this lab. If you desire so you can use textbooks, scientific literature, and internet sources in addition to manufacturer-provided suggestions in order to make your Open End Lab more interesting and thought-stimulating. You are encouraged to seek advice from me when you working on the project. At the end of the semester, you will have to officially present your idea and results to me and your peers. Also, the lab report (in the notebook) for this lab has to be submitted to me after you get my comments a day BEFORE your presentation. I will return it to you with my comments on the day of the final. Then on the last day of the semester you are to submit the lab report of the Open Lab

Project written in the format of a physics journal publication. More detailed instructions will be given to you as our semester progresses.

As you may guess, the Open End Lab experiments are not as well defined as regular experiments. For this reason a formal report is required. It should contain the same aspects as the lab notebook and be written in the style of a research article published in a physics journal. I will provide you with more detailed information on the Open Lab Project later this semester.

Another advice with regard to the Open End Lab Project: *start working on it as soon as possible*. We have a semi-rigid lab schedule this semester with specific experiments assigned to specific weeks. If you are done with one regular lab ahead of time you, most likely, will have to wait until other groups finish the same experiment before proceeding to the next lab. This might be a good time for you to start thinking about details and learning the physics behind the open lab experiment. At that time, you can also bring your ideas about the open lab to me for discussion.