Physics 133, Summer 2017

Credits: 5
Prerequisite: Physics 5C and 5D. Prerequisites waived for non-UCSC students.
Time: TTh 1 PM - 5 PM
Course meeting dates: 06/26/17 - 09/01/17
Place: Natural Sciences 2 Rm. 110
Instructor: Alice Durand
Instructor email: adurand@ucsc.edu
Office hours: On appointment (or stop by ISB 290)
Teaching Assistant: Joey Schindler
Teaching Assistant email: jcschind@ucsc.edu
Laboratory Manager: Prof. George Brown, Nat Sci 2 Rm. 176

At least one staff member will be present in the lab at all times.

Course description

Demonstration of phenomena of classical and modern physics. Development of a familiarity with experimental methods.

Course homepage

This syllabus and other resources are available on the eCommons course page at http://ecommons.ucsc.edu. You will need a UCSC ID and CruzGold password to access the course page.

Summary

This course will introduce you to intermediate level experiments on electronic circuits and complex impedance, the absorption of gamma rays by lead, and atomic spectra. It will familiarize you with equipment commonly used in physics laboratories (e.g. oscilloscopes, function generators, Geiger-Muller tubes, electronic counters, and spectrometers). You will learn how to effectively take data and assess your results using error analysis.

Course requirements

- Students are asked to work in pairs to complete the experiments. You cannot take data alone, you and your partner must work together to obtain the data needed.
- Be present in the laboratory two days per week during the class section. Even if you are not taking data that day, you will need time to prepare the next experiment, analyze your data, and discuss with your partner and instructors. It is very important to analyze your data as you go, as you may find you need to re-take data!

- Complete three experiments and submit a written report for each. The format of the written report is described in the lab manual. The lab reports should range from 5 to 10 pages and MUST contain:
  1. Title and Abstract
  2. Introduction
  3. Apparatus and Procedure
  4. Data and Results
  5. Discussion and Analysis
  6. Summary/Conclusion
  7. References
- Complete one in-depth Exploration for a lab of your choice. This should be at least 2-3 pages in length, and will be turned in along with your lab report.
- Maintain a laboratory notebook of your work, detailing what you did, the data collected, and any exercises given in the lab manual. It will be very valuable to you when writing up your lab report. All notebooks will be collected at the end of the course and will make up a portion of your grade.
- Attend the introductory sessions on course expectations, statistics, and programming. A lecture on radiation safety will be held on Tuesday, 6/26, and is MANDATORY for all students.
- Complete two homework assignments on error analysis and programming.

Course materials

You will need a Physics 133 lab manual, which is available at the bookstore. Also required is a bound laboratory notebook, which you should bring to the first lab session on Tuesday, June 26.

All of the quantitative work can be done on a personal computer using a spreadsheet program and Python. We will be showing you how to program simple plots in Python using Jupyter Notebook, and you will be expected to use Python plots in your reports (though if you are already familiar with another type of software, such as gnuplot, Grace, Mathematica, or MatLab, you may use that). You can use your preferred word processing program to write up the report, but Latex is strongly recommended. An example Latex document will be provided on ecommons.

The first homework assignment will be based on the lecture notes and the textbook Statistics for Physics Students by Professor David Smith, all of which will be available to you on ecommons. You are welcome to use any other books on error analysis; you will find some in the lab room available for check out or in-class use. A couple that

I recommend are A Practical Guide to Data Analysis for Physical Science Students, by Louis Lyons, and An Introduction to Error Analysis, by John Taylor.

The second homework assignment will be based on programming in Python. You will be able to use Jupyter Notebook online, which is a convenient way to program in a browser. All students are able to access their Jupyter account on the UCSC hyperion server - simply go to https://hyperion.ucsc.edu/hub/login and input your Cruzid and Blue password.

Grading policy

Lab reports (60%)

Evaluations will be based on the three written reports describing the experiments performed. The report should be written in the style of an article submitted to a physics journal. You should include all of the sections mentioned above, along with data tables, graphs, and error analysis of your data. We will be grading roughly based on the Report Format Guide given in section 1.2.3 of your lab manual. For more info on writing reports, see the Resources section of ecommons.

For the Impedance lab, the worksheet handed out on the battery and the diodes will be due along with your lab report. It will be counted as part of the lab report grade for that lab.

The focus of the lab write-up is to convey clearly the goal and result of the experiment. Grading will be based in roughly equal parts on the experimental work, the data analysis, and the written presentation. Each partner must submit their OWN lab report in their OWN words with their OWN data tables and figures.

Each lab report will be worth 20% of your grade, and you will get an option to rewrite the first lab report. The rewrite will be due one week after I return your graded Lab 1.

In-depth Exploration (10%)

As part of one of your lab reports (you may choose which one), you will also submit an extra Exploration section that goes in depth on a particular aspect of that lab. The Exploration is worth 10% of your total grade. You have two possible types of Explorations:

- **Option 1: Further Research** - choose one topic below:
  1. Give an extensive **historical background** of the experiment. You can focus on the scientists involved, the development of the experiment, or the development of the apparatus.
  2. Perform **theoretical calculations** which delve deeper into the physics of the experiment. For example, show the calculations for more complicated

circuits in the Low-Frequency Impedance lab, or describe in detail the atomic transitions involved in the Spectroscopy lab.

These are to be done INDEPENDENTLY from your lab partner. The total length should be at least 2-3 pages.

- **Option 2: Further Experiment** - Design and carry out an extra experiment by using and/or modifying the given apparatus. You must address the points below:
  1. What will your extra experiment test or show? Provide some background on the physics.
  2. Draw a labeled schematic of your new experiment.
  3. Briefly describe the procedure for your new experiment.
  4. Show the data/results you obtain with your new experiment.
  5. Discuss the results. Are they what you expected?

  The experiment may be done WITH your lab partner, but you must each still submit a separate Exploration writeup in your own words. The total length should be at least 2-3 pages.

  The entire upper division/lower division lab/physics demonstration room resources are at your disposal - if you'd like some equipment or material to modify your apparatus, just come talk to me and we'll find it!

If you have your own idea for an Exploration that does not fall within the above categories, let me know! The Exploration is to be submitted along with your lab report, but as a separate document. **An Exploration plan describing your intended project ($\approx$ 1 - 2 paragraphs) will be due about halfway into each experiment time block.**

Note: The Impedance lab takes longer than the other two labs, so be sure to plan accordingly if you want to do an Exploration for it!

Lab notebook (10%)

The lab notebook will be graded based on procedure (keeping notes of what you did), data (all of your data should be kept in the notebook), and the exercises from the lab manual.

Homework (20%)

The homework assignments will be on error analysis and programming.

LATE POLICY

For every day (24 hours) late that an assignment is turned in, you will be docked 10% of the total points on the assignment. For example, if the assignment is out of 100, you will lose 10 points for each day late. If it is out of 20, you will lose 2 points for each day late. *This does not apply to the final report/lab notebook, which must be turned in on time or will receive a 0*

PLAGIARISM POLICY

See document on website for the full plagiarism policy.

Schedule

The course breaks into three 3-week blocs, and a new experimental cycle begins with each bloc. Please bring your finished lab reports to the second class session after the bloc ends. Note that your final lab reports are due on Friday, September 1 (not a class day). These may be turned into my mailbox in ISB 232 by 5 pm. This is a HARD DEADLINE, absolutely NO LATE REPORTS will be accepted! Your lab notebooks are due along with the last lab report.

A class schedule can be found on ecommons with all of the deadlines and experiment blocs.