Advanced Physics Laboratory

Fall 2017

Instructor	Marvin Johnson
Office	N169
Phone	667-3552
Email	marvin@physics.csustan.edu
Web Page	Physics.csustan.edu Click the Advanced Lab link.
Office Hours	TBA Check the Web Page.

Description

This course is designed to ***introduce*** you to certain laboratory techniques and practices and to introduce you to some of the experiments covered in a modern physics course and in optics, mechanics, electricity and magnetism, and condensed matter physics.

This term you will do the experiments listed below. This means that you have about two weeks per experiment. Note that you should spend about 40 hours in the laboratory for this course. That means that ***you will need to spend about two and 3/4 hours in the lab each week.***

Get a lab book and keep records of your experiments in the lab book! All your notes and data should be put into your lab book. Number the pages as you go along and use the first page as an index! When you turn in your lab write up, you should type them and turn in the typewritten report but be able to turn in your lab book if I ask for it.

Everyone will do the first experiment (measuring g using a pendulum) the "first" week, i.e. August 23-30. The report will be due **the following week on the day lab meets, i.e. Wednesday**. It is your responsibility to get it too me on time. If you can't, you need to see me **before** it is due.

All of you will do the first experiment at the same time. You will rotate through the others. I want a detailed report on experiment 1 only. On the others I want a very brief description of the experiment and a complete presentation of the results and the analysis of the results (see the report guide below). I will want to discuss your results with you after you hand them in. You will need to do an experiment, write it up and hand it in before going on to the next experiment.

Each of you must schedule a time when you will come in and work on your experiments, so that I will be able to work with you and find you. When you come in each day, check the Advanced Lab Page on our web server for notices and discussions of the experiments.

Grading

I will grade your labs on a scale of 0-100. Unexcused late labs will have 10 points deducted. After that they have another 10 points deducted for each week they are late. (**For Experiment one ONLY**, if I have returned the graded labs to the other students, the maximum grade is 70 for a late lab.) I will also give a quiz covering statistics worth 100 points. Your final grade will be based on the total number of points you get divided by the total number of possible points. The table below gives the grades in term of your percent of the possible points. (I use ± grading)

90-100	A	Very Good
80-89	B	Good
65-79	C	Fair
50-64	D	Poor
<50	F	Failing

There are several useful books covering some experiments. Unfortunately there is no single book that covers all the experiments.

Advanced Lab Experiments
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1. Pendulum. Do it the traditional way, i.e. Method I.
2. Spring Constant. Do it statically and dynamically. Compare the results and discuss the correction for the spring's mass. Do this for two different springs
3. Gamma Rays: Gamma ray spectroscopy and the absorption of the cesium gamma rays (662keV) in lead and aluminum. You may also be asked to measure the half-life of Ba-137*.
4. Interferometer: Index of refraction of air and maybe CO_2.
5. Faraday Effect and Lockin Amplification.
6. Blackbody Radiation. You will measure the emitted intensity as a function of temperature and you may also be asked to measure the decrease in intensity with distance.

Below is a brief description of a typical lab report.

The laboratory report should consist of the following sections. (**This is for labs 2-6.**)

1. A title page consisting of the laboratory, your name and your partner's name. (It must be clear who the partner is, and who is the person who wrote the report. The partner's name should be in much smaller print.)
2. A very brief description of the purpose of the experiment.
3. A brief discussion of just what you measured and how you made the measurements. This part may be longer if you depart from the written instructions.
4. The raw data. This is the paper containing the data you actually measured. This must be initialed by me before you leave the lab.
5. A data analysis section. Here you will present the numerical analysis of your data.
6. A discussion of the meaning of your data. You should discuss the results of your measurements in terms of the theories or concepts the laboratory was trying to illustrate. You need to discuss the reliability (accuracy and precision) of your measurements and what part of the measurement process introduced these uncertainties. This is a very important section, especially if you want more than a 70 on the laboratory report. Be as quantitative as you can in this section. If you are asked questions in the laboratory write up, you should answer them here. (Typically you will need to compare the results of your measurements with a generally accepted value or with some theory. Does your experiment produce results that are statistically different from the accepted value or the theory? If so, can you explain what might be causing the difference?)

I **ASSUME** that you have had a basic introduction to the theory of errors and uncertainties in measurements from your General Physics Labs. You should be familiar with

1. Mean Value
2. Standard Deviation
3. Propagation of Errors
4. Significant Figures
5. Units
6. Linear regression
7. Graphing

We will discuss these during the lecture part of the course, but you will need some basic knowledge of them early in the course before we go over them in the lecture.