Spring 2019

COURSE SYLLABUS
PHYSICS 452: ADVANCED PHYSICS LABORATORY

Description:
A laboratory course in advanced selected experiments. A written report on each experiment is required. Prerequisites: PHYS252L.
One semester; two credits

Text: Lab Manual for Advanced Physics Laboratory (available from instructor)

Instructor: Dr. John Varriano

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Office Hours:
My schedule is posted on my home page and outside my office. Feel free to come by and see if I am in at times other than my scheduled office hours.

Goals:
This laboratory course supplements the introductory and advanced courses that you have taken, so it is designed to assist you in reaching and reinforcing the goals of those courses. The additional goals of this course are:
1. To investigate in more detail topics discussed in previous physics courses by direct, hands-on observation.
2. To test the models developed to describe different physical phenomena in the real-world environment of the laboratory. To see how well the models work and to find their limitations.
3. To increase the qualitative understanding of physical phenomena by directly seeing how physical quantities affect each other.
4. To see how the process of measurement affects experimental results through measurement uncertainty.
5. To gain independence in setting up and performing advanced experiments. To gain familiarity with experimental equipment.

Topic Prerequisites:
- vector algebra, differential equations, calculus (including vector calculus)
- introductory physics topics including classical mechanics, waves, electromagnetism, optics, quantum physics

Outline:
There are four experiments to perform. The list of experiments is below.

Area	**Experiment**
Mechanics	Normal Modes of Oscillation
Condensed Matter	Bragg Diffraction with Microwaves
Quantum	Planck's Constant via Photoelectric Effect and LED Operation
Magnetism/Quantum	Magnetic Torque and Electron Spin Resonance

You must turn in a report for each experiment. You must write one paper based on one of the first three experiments in the above list.

Grading:
Each report is worth 100 points. The paper is worth 200 points. Thus, there is a maximum of 600 points in the course. Your final grade is determined by using the following scale.

A (>90%) B (80-90%) C (70-80%) D (60-70%) F (<60%)

Reports:
The report should be turned in within approximately two weeks after performing the experiment to ensure timely progress in the course. However, I will accept any report up until the last day of classes. The reports can be hand-written. You will be given a document that describes the experiment with directions on how to perform the experiment and what to include in the report. In general, you need only include the raw data with appropriate uncertainties and the results of the experiment. The results should include any appropriate graphs, calculated values with uncertainties, and comparison of the results to expected values. The calculations of the uncertainties must be shown in detail. (Refer to the "Uncertainty Analysis" document available on the course page.)

Paper:
The paper must be turned in by the last day of classes. The format of the paper should follow the sample paper from the *American Journal of Physics* posted on our course page. Include the same sections (denoted by Roman numerals) and use the same headings as the example paper. The papers must be done using a word processor and plotting software. There must be quantitative error analysis performed on the results and reported in the "Analysis" section. You will be penalized for incorrect spelling and grammar. You can turn in a rough draft of a paper that we can discuss. This will not adversely affect your grade. In fact, it can only help your grade and is strongly encouraged.

☺ *And remember: Physics is fun!*