

Whitman College

Department of Physics

Physics 256: General Physics II Laboratory

Spring 2008

Information

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- Text:** You can find information on these experiments in your modern physics book or an introductory physics text.

The Course Goals

- Conduct a variety of classical and modern physics experiments
- Provide a laboratory experience to help understand classroom material.
- Become more independent researchers
- Further develop a system for keeping a useful laboratory notebook.
- Introduction to technical writing.

Most of the activities require you to design your own experiments. The lab packets contain some helpful information and suggestions, but you will need to determine the experimental procedure you pursue to complete the experiments. **You are expected to have read the labs before coming to class.**

Lab notebook – (Grid paper required)

You should think of your laboratory notebook as a diary of your life in the lab. In addition to being a place to record data, your notebook should also contain your predictions about what you expect to observe, any observations about the experimental procedure that might need modification, and any ideas you have about the analysis of the measurements. **When you are writing in your lab notebook, assume that another person will be attempting to repeat your experiments with just your notebook as a guide.** To that end, your notebook should provide sufficient information and detail about the experiments, and it should be organized (and legible) enough for the other person to follow your experiments. When you go back to analyze or debug experiments, your life will be much easier if you have written everything down clearly. In an active research laboratory, notebooks are read and signed by witnesses regularly, especially when working for a company. The notebook is crucial information when dealing with issues like patents and determining who made a discovery first.

What must be in your notebook: **Use an ink pen.**

1. **Plan.** Start each day with a summary of what you intend to accomplish experimentally. Your plan should lead to predictions since your measurement approach should have the expected result in mind. **Your prediction doesn't need to be correct; however, it will reflect your present understanding of the concepts important for the experiment. This semester, there will be some prelab questions that should be answered in the plan.**
2. **Data – Plot or Record.** Describe each distinct measurement you attempt. Keep data in a table if you are reading values from a meter of some sort. Data should be presented in graphical form whenever possible. In this section, include comments and observations about the experiment and your data.
3. **Analyze.** Compare your data to theoretical models when appropriate. Your data needs to be analyzed so that you can draw some conclusions about your measurement. **Include error propagation.**
4. **Write-up. This semester there will be two types of labs.** All labs should have good notebook records (Plan, Data/Results, Analysis). For “short reports” (see below), the writeup is a one paragraph summary that can be either written into the notebook or typed. For “long reports”, the writeup is 2-3 pages that pulls together the analysis of your data and your assessment of that analysis in light of the relevant theory. Think of this summary like a brief report you might submit to an experiment supervisor who would need to keep up with your progress after a day in the laboratory. Writeups for short reports can either be typed or hand written. Writeups for long reports should be typed and double-spaced.

Grading

Your grade will be determined by averaging the grades you have earned on your laboratory notebooks and reports. Included in that grade will be a component related to your attendance and participation in the group work. In order to pass the class, you must turn in a lab report for each of the eight experiments.

Absences – You are responsible for making up missed work. If you know of an upcoming time conflict with lab make arrangements with your partner(s) to set up a separate time for your group to perform the experiment.

Grading Guidelines for P256 Lab Reports (Notebook and Summary)

A range

- Plan:
- clearly stated and includes:
 - big picture (what the overall question is)
 - sufficient detail to reproduce experiment w/o lab handout
 - predictions
 - Answers to pre-lab questions
- Data/Results:
- easy to follow
 - includes adequate sampling to justify conclusions (i.e. more than one test for each condition)
 - experiment is well-executed with reasonable results
 - graphs are labeled; all quantities have units
- Analysis:
- easy to follow
 - formulas from Excel spreadsheets are explicitly written in symbolic form

- Writeup
- includes error propagation in symbolic form
 - comparison to expected values quantified as % difference
 - thoughtful analysis of the experiment and its physics
 - ties things together into a coherent whole
 - well-written and objective without the use of colloquial language
 - describes potential pitfalls/sources of error and the effect these would have on the overall outcome

B range

- Plan:
- stated clearly but without one of the above elements
- Data/Results:
- well presented
 - limited sampling (1 run per condition) or results differ considerably from expected
- Analysis:
- easy to follow
 - spreadsheets given with out explanations of formulas; some units missing; comparisons to expected values are not quantified with % difference
 - error propagation not given in symbolic form
- Writeup:
- describes the big picture
 - sources of error described but without any detail concerning the effect on the outcome
 - generally well-written but uses imprecise colloquial language

C range

- Plan:
- stated but without multiple of the above elements
- Data/Results:
- presented but difficult to follow
 - sampling and results are not optimal
- Analysis:
- difficult to follow
 - spreadsheets given with out explanations of formulas
 - error propagation not present or not given in symbolic form
- Writeup:
- little reference to big picture
 - sources of error not described or presented but without any detail concerning the effect on the outcome
 - easy to read but imprecise with liberal use of colloquial language

D and below

- Plan:
- Poorly stated without predictions or big picture
 - Insufficient detail to reproduce experiment
- Data/Results:
- sampling poor
 - results quite far from optimal
- Analysis:
- difficult to follow
 - error propagation not presented
- Writeup:
- poorly written without reference to big picture
 - excessive use of colloquial language

Experiments

1. Normal modes* {NM, or Coupled Oscillations - 1 week; short report}
2. RC Circuits {RC/ - 1 week; short report}
3. Diffraction — electron scattering* {Diffraction - 2 weeks; **long report**}
4. Fourier Analysis* {Fourier - 2 weeks; short report}
5. Forced damped harmonic motion* {FDHM - 1 week; **long report** with LRC}
6. LRC Circuits* {LRC - 1 week; **long report** with FDHM}
7. Balmer lines* {Balmer - 1 week; short report}
8. Diode Laser/Spectroscopy* {Diode Laser - 1 week; **long report**}
9. Standing waves on plate* {Two Dimensional Oscillations – 2 weeks; short report}

* These labs include a prelab exercise that should be done before coming to lab.