PH315 Modern Physics Laboratory (2012)

Coordinators:
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(office hours: Tuesday: 11-1 and Wednesday: 9-12)

Texts: QED:The strange theory of light and matter by R.P. Feynmann and **Experimentation: An introduction to measurement theory and experiment design**, by D.C. Baird.

Goals: The primary goal of this course is to develop skills in experimental physics and technical writing. A subsidiary goal is to learn how to model a physical system, which is the foundation of the scientific process. Most experiments will either verify a model or measure a physical quantity as accurately as possible, given experimental constraints. For both types of experiments it is important to identify and understand the sources of experimental uncertainties, how to quantify the uncertainty, how uncertainty propagates in models, and how to design a procedure to mitigate uncertainty. In addition, communicating your results in a written report leads to a self-critical evaluation of your understanding of that process, which is important in improving your problem solving skills.

Laboratory Reports: The class will be divided into lab groups, each of which will turn in about 5 laboratory reports (individually for the last one), not including the circuit decay report. The report must at least include: Abstract, Author Contributions, Introduction, Model Section (theory), Procedure, Data Analysis, Discusion/Conclusions, References (no wikipedia citations allowed). A LaTeX
http : *//www.math.jmu.edu/ arnoldea/latex_setup_and_tutorial.htm*
generated file of the full **report** must be turned in along with an emailed pdf file of only the Model and Procedure (**MP**) sections. In the Author Contributions section of the full report, indicate the work each student did on the report (this must alternate for each report). For the next lab your Model and Procedure (**MP**) sections will be used by the next group to complete that lab. Grading(tentative): 0 or 1 (depending on if you make requested modifications) times (75% for the report and 25% for the **MP** student graded part). The objective of the lab report is to convince the reader that the model does or does not match the data. One writing resource is the campus writing center (*http* : *//www.mines.edu/academic/lais/wc/*).

The introduction and model (or theory) sections are two separate sections, rather than one big one. The introduction should discuss the objectives (what you are trying to accomplish) and importance (why you want to model the phenomenon) of the lab. The model section presents the model to which you are seeing if the data match within error. Discuss the assumptions and possible validity of the model. Is v/c small compared with the error in your measurement and therefore effects of order v/c can be neglected? Finish with a working equation from which your error analysis later in the report begins. The conclusion section addresses whether you accomplished the objectives

Finally, make sure each section has the name of the group member who wrote it along side the title of the section. Please email the pdf of the model and procedure section, without these names, to me on Monday for the Tuesday section and Wednesday for the Thursday section.

Use googlebooks to find book references rather than web citations.

Report: A report on the book **QED:The strange theory of light and matter** by R.P. Feynmann is required. In writing this report please relate the discussion in the book to the experiments performed in this course. Start reading well before the deadline so that you can understand how the book relates to the experiments as you do them.

Resume: Please submit a resume at the beginning of the third class period in writing. Please look at the Web site of the CSM Career Center, for the link for writing resumes.

Grades: Laboratory reports 30%, exams 30%, final lab report 10%, book report 5 %, problem sets 5%, and class participation 20%.

Problem sets and schedule: All labs subsequent to the circuit decay lab except for the final lab are team reports.

1. Due the third week of classes at the beginning of class: Hand in resume.

2. Due second week of classes at the beginning of class: Submit the circuit decay lab which is to be turned in individually although you collected data in a class.

3. Group completed work due third week of classes at the beginning of class — Baird Chapter 2 problems 11, 12 and Baird Chapter 3 problems 3, 4, 5, 7, 8, 9. Problem on thermal noise in a resistor: (a) Make normalized histograms of the thermal noise voltages for a resistor using sample sizes of 10, 100, and 1000. Calculate the standard deviation 10 times for different groups of size 10, 100, and 1000 samples. Discuss how your data supports or falsifies the proposition that the standard deviation depends on sample size. (b) Discuss how your data supports or falisfies the rms value of the thermal voltage squared, V_{RMS}^2, depending linearly on the resistance.

4. Due fourth week of classes at the beginning of class — Baird Chapter 3 problems 11, 12, 13, 17 and Baird Chapter 5 problems 3, 19, 23. Chapter 6 problem 3.

5. Due at the beginning of class of the fifth (seventh, ninth, etc.) week of classes — lab reports.

6. Due at the beginning of class the eight, tenth, etc. week of class; email the score for each group along with the written comments as outlined in the rubric on the wiki, in a text, Word, or LaTeX format. I would like this to be a group effort in evaluating the model and procedure sections. Talk it over. However, only turn in one document per model-procedure section for your group. If you were given 3 model-procedure sections (from 3 different groups) then turn in one document for each model-procedure section for a total of 3 documents to be turned in by your group.

7. Due the fifteenth week of classes — book report.