PH315 Modern Physics Laboratory (2010)

Coordinators:
Aaron Martinez Office 225 Ph. (303) 880 0802 email: aamartin@mines.edu
Frank Kowalski Office 438 Ph. (303) 273-3845 email: fkowalsk@mines.edu

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 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 introduciton should discuss why you want to model the phenomenon and perhaps put it in a historical perspective. For example, if you are doing the detector characterization then you might want a detector to measure microwave radiation from a microwave oven. Google microwave detector and see what applications you can find. You might also discuss the history of the thing your are modeling. 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.

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.

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 write and submit a resume. Please look at the Web site of the CSM Career Center, $http://www.mines.edu/stu_life/career/resume.htm$, for the link for writing resumes. If you already have a resume, make sure it conforms with the specifications given at this site. See also $http://www.mines.edu/Academic/courses/physics/phgn471/resume.htm$.

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

1. Due the second 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 may have collected data in a group.
3. 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, 11, 12, 13, 17. Group completed Noise and Uncertainly handouts
4. Due fourth week of classes at the beginning of class — Baird Chapter 5 problems 3, 19, 23. Chapter 6 problem 3.
5. Due at the beginning of class of the sixth (eighth, tenth, etc.) week of classes — lab reports.
6. Due the fifteenth week of classes — book report.

Grades: Laboratory reports 50%, final lab report 25%, book report 10 %, problem sets 10%, and resume 5%.