PH315 Modern Physics Laboratory (2015) sec. A Tuesday 9:30-10:45 Alderson 134 then 10:45-12:30 MH275 and sec. B Thursday 1:00-2:15 Alderson 140 then 2:16-4:00 MH275

Coordinators:
Lam Mach [lmach@mymail.mines.edu]; Logan Hillberry [lhillber@mymail.mines.edu]; Kevin Rozmiarek [krozmiar@mymail.mines.edu] and
Frank Kowalski Office 438 Ph. (303) 273-3845 email: fkowalsk@mines.edu
(office hours: Tuesday: 1-3, and Thursday 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 critical thinking, experimental physics, and technical writing. By the end of the course you will be able construct a quantitative argument which addresses the issue of the data supporting or not supporting a model. A subsidiary goal is to practice modeling a physical system, which is the foundation of the scientific process. Most experiments will either verify a model or measure a physical quantity (which is part of some model) 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 evaluation of your understanding of that process. After this course you should have improved in your abililty to "think critically, reason analytically, and use language accurately and effectively."[1]

Laboratory Reports: The class will be divided into lab groups, each of which will turn in 7 laboratory reports (individually for the last one), not including the circuit decay report. The report must at least include: Abstract, Author Contributions, Model Section (theory), Procedure, Data Analysis, Discusion/Conclusions, References (**no wikipedia citations allowed**). The deliverables are:

1. A text file with the report title (including author names) of **only** the Procedure section must be emailed to me (the Friday before the report is due for section A and the Monday before the report is due for section B.

2. A LaTeX
   $http://www.math.jmu.edu/\ arnoldea/latex\_setup\_and\_tutorial.htm$
   generated hardcopy of the **full report** must be turned in when due. The objective of the lab report is to convince the reader that the data does or does not support the model. One writing resource is the campus writing center ($http://inside.mines.edu/LAIS-Writing-Center-$).

3. Discuss the assumptions and possible validity of the model. For example, v/c is small compared with the error in the measurement and therefore can be neglected. Finish the model section with a **working equation** from which your error analysis begins in the next section. The conclusion section addresses if the data support the model.

4. Each section must have the name of the group member who wrote it with the title of that section.

5. In the Author Contributions section of the full report, indicate the work each student did on the report (this must alternate for each report).

6. Use googlebooks to find book references rather than web citations.

Laboratory Activities:

1. Schedule: In the first lab period you will collect data and evaluate it to determine if it supports your model using a quick calculation. You then assign report duties and begin writing the report. In the second lab period the data is carefully collected, evaluated, and the rough draft of the complete report is evaluated for errors by all members of the group.

[1] Passing Oxbridge Admissions Tests by R. Hutton and G. Hutton

2. You will turn in the procedure section a few days (see above) before the final report is due. You will use these to understand what to do at the beginning of each new lab.

3. You will then evaluate these Procedure sections by giving both positive and negative comments online. You then start this new lab.

4. Near the end of every lab period your group will meet with either Lam, Kevin, Logan, or me. Be prepared to answer questions individually about the lab, show that you understand how to collect data for that lab, and/or get feedback on your lab report.

5. Lab timeline: (a) Mini-lecture. (b) formulate model (analytic thinking). (c) read procedure written by previous students. (d) evaluate this procedure online by given both positive and negative feedback. (e) collect data. (f) check your data against the model predictions. (g) recollect data if necessary. (h) construct a rough draft of the report. (i) meet with a TA before leaving for oral group report.

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. Use the link for writing resumes at the Web site of the CSM Career Center, if you have questions.

Grades: Laboratory reports 30%, final lab report individually written 30%, book report 5 %, problem sets 5%, and class and lab participation 30%.

Problem sets:

1. Second class: Answer online questions in lab.

2. Third class: Group completed work due at the beginning of third week of classes at the end of lab — Baird Chapter 3 problems 3, 4, 5, 7, 8, 13.

3. Fourth class: (1) At the beginning of class hand in your resume. (2) At the end of class hand in chapter 2 problems 11, 12 and chapter 3 problem 17 and chapter 5 problems 3, 19, 23 from Baird.

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