BME 194: Applied Circuits Lab: Guidelines

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1 How to write up a lab

This document is a combination of advice from Kevin Karplus and Steve Petersen, who have slightly different hot buttons for what they care about. It is based on a handout prepared by Steve Petersen for EE 157, modified by Kevin Karplus.

Reports will emphasize experimental work and concisely summarize that work through an informal reporting style that expresses your individual grasp and understanding. These reports are engineering design reports, as you would write if hired as a consultant on an engineering project. They are **not** high-school chem-lab style proof that you successfully followed a cookbook procedure.

For each lab, the partners have to choose whether to turn in a joint report with both names on it as co-authors, or separate reports with one author each, but explicitly acknowledging in writing the work done by the other partner. Both partners should keep their own lab notebooks, as they may not have access to their partner's lab notebook later in the quarter.

Note: the instructors are **not** the audience for the lab report. The report should be written to a bioengineer who has not read the assignment. It should start with a brief explanation of the problem to be solved, then explain how the problem was solved—what measurements were taken, what calculations were done, what design decisions were made, and what the final result was.

They will normally consist of the following items:

- A cover sheet with the usual information (layout is up to you): the name and number of the lab (for example, "Lab 1: thermistors"); class (BME 194); student's name; and date report was written (due date and instructors' names can also be provided). If you worked with a second student (as most will in this class), both names should appear on the cover. If you turn in separate reports, one name should be as author, the other should be listed as the lab partner.
- The report itself, consisting of
  - A statement of the problem.
  - Any pre-lab analysis and design that was done.
  - A statement of the solution to the problem.
  - Convincing evidence that the solution is a valid, even a good, solution to the original problem. This evidence will usually involve discussion of design constraints, possibly calculations, probably measurements, and almost certainly some citations to data sheets, application notes, web pages, or other sources of inspiration.
  - Schematics for any circuits that are made for the solution or for testing along the way.
  - Plots of any data collected, often with models fit to the data. Since you may be collecting 1000s of data points in one experiment, using the Arduino, it will not be acceptable to hand-plot the data. You must use a computerized graphing tool (such as gnuplot, which is provided in the labs). Excel is not an acceptable graphing tool after elementary-school science fairs—learn to use one that works (there are 100s available).

Reports must be organized, neat and legible; computer-generated typed work is expected. Each report should be complete, thorough, understandable, and literate.

Section headings should be descriptive, not generic. Someone picking up the report and reading just the title and section headings should have a fair idea what the report contains. If you use the same section headings in two different labs, your headings are too generic. This is not the *Journal of Molecular Biology* and we don't accept their belief that all articles must have exactly the same section headings in exactly the same order.

Where appropriate, include well-drawn and labeled engineering schematics for each significant circuit investigated. This is not just the final design, but prototypes you rejected (and why they were rejected), and test circuitry you set up to understand or measure components.

Use good drafting practice when producing figures, graphs, drawings, or schematics and label them for easy reference. No picture, table, schematic, or graph should appear without a name (generally of the form "Figure 1" or "Table 3"), and none should appear without a reference to them **by name** in the main body of the writing. Space must be provided in the flow of your discussion for any tables or figures—do not collect figures and drawings in a single appendix at the end of the report. Ideally figures are on the same page as the discussion of them.

Schematics may be drawn by hand, but you must use a straight-edge if you do so (resistors can be drawn freehand). Unless you are an experienced draughtsman or artist, you'll probably find it faster to use a free tool like the web-based CircuitLab: `http://www.circuitlab.com/editor/`

Transcribe all relevant data from your engineering notes into your report. You do not need to provide tables of the 1000s of data points you collect—but you should graph them.

Cite any external work that you used (data sheets, text books, Wikipedia articles, ...). Provide explicit written acknowledgement of any human help you got. It's fine to get help, but claiming that work as your own (which is what failure to acknowledge is) is the definition of the most serious of academic sins: plagiarism.

2 Notes on length and style

There is no minimum nor maximum length requirement. The scope and depth of what you report on depends on what you were asked to do, learn, or become familiar with.

The four "Cs" of technical writing are Clarity, Correctness, Completeness, and Conciseness. There is an obvious tension between completeness and conciseness, and a similar tension between clarity and correctness. You are not writing a textbook nor a graduate thesis, but a design report for an engineering manager who is not intimately familiar with the problem you are solving. You will have to leave out most textbook material and the details that would go into a thesis, but still have all the information that a manager would need to make a good decision and defend it to higher management.

Remember, you are reporting on something done in the past. Therefore, most of what you write will be expressed in the past tense. To aid you in resolving questions about tenses, the following summary should be helpful:

- Experimental results should always be given in the past tense.
- Things that are continuously true should generally be given in the present tense (like what parameters the data sheet claims).
- Discussions or remarks about the presentation of data should mainly be in the present tense.
- Suggestions for actions to take as a result of the study should generally be in the future tense.

- Discussions of results can be in both the present and past tenses, shifting back and forth from experimental results (past tense) to the conclusions and statements that are continuously true.

Grading will be based on completeness, clarity, understanding, and justification of results.