PHYS276 LAB REPORT GUIDE

In this laboratory course we will be mainly concerned with elementary experiments in electricity and magnetism. A major focus of this laboratory is to develop experience in scientific writing. Good scientific writing is a critical skill that you will need in the future whether you choose to pursue a technical career in industry or to pursue scientific research. In general, the purpose of the following guidelines is to help you write concise, easily read, and self-contained reports. The report should be such that you or some other student could, after several months, go back to the report and know what you did and what the basic results of the experiment were. It is not necessary to follow this outline exactly, but it should be clear to the reader what was measured, what the primary results are, and what analysis was done to determine whatever quantities you are reporting.

A typical lab report will be about 10 pages long, including tables and figures. The actual length will, of course, vary from experiment to experiment. Printed reports must be stapled and have minimum 0.5" margins and 12 point font. Reports will typically have the following clearly marked sections: ABSTRACT, INTRODUCTION, EQUIPMENT, PROCEDURES, RESULTS, ANALYSIS/DISCUSSION, and CONCLUSIONS, as well as any necessary APPENDICES. Explanations of what is to go in each section are given below, while detailed expectations and grading scheme are given in the Lab Report Rubric available from the ELMS web site. Note that the actual Rubric may need to be altered for each individual experiment. (For example, labs that do not need much error analysis will have few points assigned to that section, etc.) Remember:

Be sure to include all measured results.
Be fanatical about units, uncertainties and errors.
Be sure to make all the measurements asked for in the manual.
Be a perfectionist when it comes to figures!

A. TITLE PAGE and ABSTRACT

This is the first thing someone is to see when they review your report – make it look professional! It also serves to clearly state pertinent information. Be sure to include your name and your partner's name, the experiment number, title, date and ABSTRACT. (This should all be on a separate cover page.) The abstract should contain a brief summary of the purpose of the experiment and your main results and conclusions – THIS SHOULD BE NO MORE THAN 3-4 SENTENCES!! Specific measured quantities should be included in the abstract in stating your results, along with respective error values, but no more than what is necessary for someone to know the end result. For examples of real life abstracts see http://arxiv.org/list/cond-mat/new .

B. INTRODUCTION

This should include the background and theory necessary for someone unfamiliar with the material to follow what you have tested in the experiment. It should not be a word for word copy of the lab manual material, but should summarize the concepts in a straightforward way, highlighting the concepts, theory, equations, etc that are being tested.

1. What equations were tested?
2. What is to be determined experimentally?
3. What is the meaning of the equations given (be brief), and are there any important assumptions used in their derivations?

C. EQUIPMENT AND PROCEDURES

Describe the apparatus, including diagrams as appropriate. Figures in the lab manual are available on the course web site for download – it is acceptable to use these in your report. Include your own figures if it is necessary to clarify your work. Identify all the pieces of apparatus that you used in a list format, including make/model #'s and any necessary calibration constants – this list should be sufficient enough for someone to repeat your experiment, and thus test your results (this is how science works!!) Briefly discuss the procedure for carrying out the measurements in a few paragraphs, including any special circumstances or deviations from the procedure outlined in the manual that pertain to your experiment and results. Again, you must include enough info for someone to repeat the experiment.

D. DATA/RESULTS

Show your data, in tabular or graphical form. Be sure to make clear the meaning of all numerical values listed. BE SURE TO INCLUDE UNITS AND THE APPROPRIATE NUMBER OF SIGNIFICANT DIGITS. Do not just import your raw Excel tables into your lab report: include only the columns of numbers that are relevant for explaining clearly what it is that you measured and how they relate to your result. It is acceptable to put large tables of data into an Appendix, but they must be properly labeled, cited and easy to find! It is ok to put extra figures into an Appendix as well, but the main figures – those including end-result data and analysis – should be in the main body of the report.

Remember, **FIGURES** are arguably the most important part of your presentation – make them pretty!! Each figure should have a title, properly labeled x- and y- axis titles WITH UNITS, a legend identifying data and fits, and an appropriate caption identifying the figure (i.e. "Figure 3") and describing what it contains --- see rubric for further details. When choosing figure and table titles, use descriptive language like "Inverse Relation of Voltage and Load Resistance of a Battery" instead of "1/V vs. 1/R_Load" – in other words, do not simply repeat axis labels!

E. ANALYSIS AND DISCUSSION

This section contains the manipulation of data so that it may be compared with the equations/theory to be tested. Make clear exactly what is being done with the data, *i.e.* what equations are being used. Refer to equations (*i.e.* "Eq. 3") presented in your Introduction

section – DO NOT INTRODUCE THEM IN THIS SECTION! If you are fitting data, provide and explain the expression you are using to do the fitting. It is not necessary to include all intermediate steps: clear prose is much more valuable than a string of equations. Be sure to include all graphs that have been asked for in the lab manual.

Compute the uncertainties in the quantities you are determining experimentally. Again, it is not necessary to write out all intermediate steps in the error analysis, but instead give an example and/or explain clearly how the uncertainties in the measurements were determined. Be sure to identify the principal sources of uncertainty, both random and systematic, and explain the calculations you used to determine the final uncertainties in your results.

Discussion of your results should be centered on how your results compare to the expected outcome according to the theory presented in the Introduction section (Again, do not introduce new concepts here – they should be in the Intro!) Because all of your results will have computed error values and numeric tests (i.e. Chi^2 and probability values), you have everything necessary to discuss your results in quantitative comparison to theory. If everything agrees, then you can state that you have verified the theoretical expectation. If not, you must discuss possible reasons for the discrepancy and suggestions for improving the procedure and/or analysis approach. In this course, you are testing well-accepted theories so you should consider possible sources of error not accounted for in your analysis – not the possibility of the theory being incorrect. In real life, when fully supported by the experiment and analysis, such discrepancies between experimental results and theoretical models are often the grounds for an important scientific find!

F. CONCLUSIONS

This final section should, in a paragraph or two, summarize your main results, analysis and discussion points, focusing on the main findings of your experiment and the possible reasons for discrepancies or deviations from expected results. This is not simply a repeat of your abstract, but should be an emphasis of the main points of your report and can include any concluding remarks you would like to make.

G. APPENDICES

In general, Appendices are the place to put supporting data, figures and analyses that are useful to include in support of your main report, but not necessary to achieving your conclusions. If you need to include pieces of raw data from lab spreadsheets, put them in an Appendix. Note, however, that if you have included all the appropriate figures and tables in the body of the report, it should not be necessary to include further data from your raw spreadsheets.