Guidelines for Writing Long Laboratory Reports
MECE 3320

This document will provide you with some guidelines for writing laboratory reports for MECE 3320. Most of the rules discussed here apply to the writing of technical reports in general. Knowing how to write good (technical) reports is a very useful skill that will serve you well in your career.

Various sections of the report and a brief description of their contents are discussed in the following. Note that you do not have to use exactly the same sub-headings as given here, however, each section must appear in the order in which it is discussed.

I. Cover Page

Each report (short or long) **must have a cover page** providing the following information:

Experiment number and title.
Name of author.
Date when experiment was performed and date report was due.

II. Abstract (Executive Summary)

An abstract or executive summary is the essence of the whole report. By reading a well-written abstract the reader should know *what* was done, *why* it was done, *how* it was done and what the *significant results* were. If you were asked to determine specific values of certain parameters or properties in the experiment, e.g. acceleration due to gravity, resistivity, thermal conductivity, etc, you should *include* the *numerical values* of these parameters in the abstract. The abstract should be very brief, between 200-250 words and should not provide details of the experiment. The purpose of the abstract is to provide enough information to the reader that s/he may get the gist of the study and then decide whether to read the report for details. Remember that an abstract is NOT AN INTRODUCTION; this is probably the most common mistakes made by students.

III. Background and Introduction

This section is designed to provide the following:

Background Information: by providing some background you introduce the reader to the problem under study and hence explain the ...
Motivation: ... reasons you are conducting the present experiment. You should also state your ...
Objectives, i.e. what you hope to learn from this work. It is also important to briefly discuss your...
Approach: or how you plan to conduct your study and the reasons for choosing this method. (Note: the details of the experimental approach should be provided in next section)

IV. Experimental Techniques

The goal of this section is to provide the reader with information so that s/he may make an independent judgment on the overall quality of your experiments and the suitability and accuracy of the measurements techniques. Enough detail must be provided so that the reader can repeat your experiments, if they so desire. Information regarding the following should be included:

Hardware: A brief description of the hardware (and software) used to conduct the experiments should be provided. Please use sketches, drawings and pictures of the experimental setup where needed.

Procedure:
A summary of the procedure used to conduct the experiments should be provided

V. Results and Discussion

This constitutes the 'meat' of the report because it presents the results and more importantly your interpretation of the results. It provides a summary of the information learned and the knowledge gained from your experiments. Although in general results and discussion are presented in a narrative form, for the purposes of this class, this section will contain the answers to the questions in the *Questions to be Answered* section of the data sheet. ***The answers to questions should be <u>enumerated</u> in the same order as in the data sheet.***

The questions are structured such that they emphasize the important results and allow you to present data which is *significant,* from the standpoint of your objectives, and *representative* of the overall trends (more detailed results may be included in the appendices). You should include any equations and correlations used and any assumptions made in obtaining your results. Detailed calculations should be included in the appendices. In answering to the *Report Specifications* questions, you must present your results clearly and concisely. Once of the best ways to present your results is in a *graphical form*, i.e. plots; details and do and do's of plots are discussed below.

Graphical representation is the most powerful and useful form of data presentation and interpretation. So, when presenting significant data, PLOT YOUR RESULTS WHENEVER POSSIBLE. Plotting your results appropriately makes the interpretation and subsequent discussion of the results much easier. It also allows you to recognize general trends (and anomalies) or lack of one, distinguish between significant and unimportant parameters and (this is very important), saves you from having to write pages after pages of text necessary to describe aspects of which can be easily displayed in a single plot.

It is important to remember that plots are only useful only if they carefully done. Here are a few pointers on making good plots.

- Each plot must have a self-explanatory *title*.

- *Choose* your *axis carefully*. (This may not be much of an issue for this class since, in most instances, you are explicitly told what to plot.) Plot your dependent variable on the y axis and the independent on the x axis. Sometimes you may have to experiment to find out which parameters should be plotted against each other. Sometimes, several parameters may have to be combined to form a non-dimensional parameter. In fact, whenever possible, try to non-dimensionalize your variables. You may not always be specifically told how to non-dimensionalize your data.
- Clearly *label your axis*, including units.
- Pick your *axis range* carefully to *maximize the space in the plot*. For example, if you are plotting velocity on the x-axis where the axis goes from 0 to 100 m/s while the actual range of velocities measured is 20-45 m/s, then you are only using 25% of the x axis space.
- *Do not randomly connect your data using straight lines*. Use a linear fit or an appropriate smooth curve to illustrate the trend. The equation for the fit should be provided on the graph and the justification for using the particular fit should be provided in the discussion section. If the data is random then just plot the data without any lines.
- If more than one set of data is plotted on the same graph, then represent each set by a different symbol and *provide a legend* on the graph, clearly identifying the symbol for each data set.
- Include *error bars*, representing the uncertainty in your measurements. If error bars are too small to be visible on the plot, mention this in your discussion.

Once the data has been presented its significance is examined and explored in the discussion and analysis section. The trends observed in the results are discussed and any correlation obtained (e.g. via fits of plotted data) is presented. The significance of the results and their trends, or lack of any, should be discussed from a theoretical perspective. The analysis frequently includes additional plots which supplement and shed further light on the data presented in the results section. The results should also be compared to other similar studies or standard reference data if possible. Possible reasons for agreement or discrepancies should be proposed. If any anomalies were observed they should be explained, or at least a logical explanation proposed.

VI. Summary or Conclusions

As the name implies, this provides a summary of the important results obtained in the study and their significance from a theoretical and practical perspective. It discusses the degree of success, or failure, of the study. It emphasizes the contributions of the work to the specific field and frequently includes suggestions for improvements and for future studies that would expand on the present work.

VII. References

List all references used, in alphabetical order using the author's last name.

VIII. Appendix

The appendix includes details, which are too lengthy to be included in the main text but may be of interest to someone who really wants to know all the details of the experiment. ***It must include sample calculations***, especially when you use spreadsheets to do your calculations. The appendix often contains tabulated form of data presented graphically in the main body.

Writing Style

- Remember, your goal in writing a report is to be as clear and concise as possible so be as brief as you can while still conveying the relevant information. Use simple but grammatically correct English, there is no need to use big words.
- It is generally said that one should avoid using first person (I or we) and always use the third person in writing technical reports. For example, instead of writing, "we conducted pitot surveys", *one* should write "pitot surveys were conducted". *I* believe that although this was the practice in the past it is no longer necessary to adhere to this rule. Occasionally, it is appropriate to use the first person especially to avoid monotony. (Reading "the pitot surveys were conducted; the data was collected, the measurements were made ...." can be boring after some time.)
- Avoiding repetition, e.g. starting each sentence with the same phrase, is always a good rule to follow.
- Remember the general rules of good writing also apply to technical report, a fact overlooked by most authors of technical reports. A good report should read like a story (although less exciting perhaps) and flow smoothly with transitions between paragraphs and sections.

General Comments

- Each report (long and short) must be typed using a word processor and stapled. Use tables, graphs, sketches, pictures and whatever is necessary to make your point clearly. Also, don't forget to label and provide titles for your tables and figures, etc.
- Always clearly ***show your units***. Points will be deducted if you don't.
- Be aware of the significant digits in reporting your results. If the accuracy of one of the measured parameters is only 3 significant digits then any variable, which contains that parameter, cannot have more significant digits!
- The reports must be neat and grammatically correct.