General Lab Report Style Guide

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Overview

Lab reports are an important component in the education of undergraduate engineering students. In your future careers, you will be tasked with writing project reports, engineering reports and/or technical papers. As engineers, you will find that the skills acquired from writing lab reports will be very useful.

Some lab assignments have a design aspect, while some are based solely on experimentation and observation. In any case, lab reports should meet a few critical objectives:

1. The lab report should summarize the design and/or experiment (basic theoretical underpinnings, engineering approach, and experimental method) and the results of the experiment (ie. what was learned).
2. The lab report should present results in the form of data (graphical, tabular, etc.), discuss these results, and provide interpretation and conclusions.
3. The lab report should contain enough detail that another student could replicate your work and obtain the same results.
4. The lab report should demonstrate that you understand the principles and theory that the lab was designed to investigate. Occasionally, observations are unexpected or cannot be explained with certainty. The lab report should deal with such uncertainty as frankly as possible. (Note: Generally, undergraduate labs are designed such that all pertinent details of the experiment are well known. Every effort should be made, with assistance from the lab instructor, to understand the key observations).

In your undergraduate studies, you will be exposed to various types of labs (with different instructors, and sometimes different expectations). No single format is appropriate in every case, but most lab reports should contain the following components:

I. Title Page

The title should be descriptive of the work completed, but concise (typically less than 10 words). In some cases, the lab assignment may include an appropriate title for the lab. The title page should also include the date, the names of group members who contributed to the report, the class/lab section, and the name of the person (professor and/or lab instructor) to whom the report is being submitted.

II. Abstract

The abstract should provide a brief synopsis (typically using less than 150 words) of what is contained in the lab report. This should include a description of the experiment conducted (why and how), the data presented, and the main conclusions drawn from the data. When you write a technical report or paper, the abstract is an invaluable tool to those who might subsequently be interested in its contents (ie. instructors, managers, senior vice-presidents, colleagues, etc.). The abstract allows someone to quickly assess

whether or not it is critical to read your entire report (ie. is it important that they read the report, and if so, should they read it immediately?).

The abstract must stand alone, and be intelligible to the target audience. It should not refer to specific figures, sections, or other details in the main body of the lab report.

III. Introduction

The introduction should explain the importance and objectives of the design and/or experiment, and provide a rationale for the method used. For design labs, explain (in introductory terms) the intended application and the engineering principles applied to the design. For experiments, explain (in introductory terms) the physical or other principles that the experiment is designed to illuminate or demonstrate. Follow this by a simple description of the experiment chosen (or assigned, in most cases).

Ideally, the introduction should also place the design and/or experiment in context. You can provide this context by summarizing any related theory or engineering principles. In this summary, include and explain any formulae that are used for the design or to interpret or explain the experimental data. You can provide further context by briefly describing other experimental methods that have been used to illuminate or test the same physical principles.

IV. Design Section

Some labs have a significant design component. For example, a lab might ask you to design and build a circuit to perform analog to digital conversion on an audio signal. For these types of labs, a separate section can be used to outline the design methodology. This includes a description of the design constraints and the goals of the design. What are the inputs you have to work with (input signals, equipment, resources, etc.)? What are the desired outputs (output signals, tasks the design should perform, etc.)? Describe, and where necessary justify, the design chosen.

V. Experimental Procedure and Equipment

The experimental procedure should describe the experiment exactly *as it was carried out*, in chronological order (using proper grammatical structure, as in the rest of the lab report). This description might deviate from the instructions in the lab assignment, for any number of reasons (equipment availability, discovery of damaged equipment, errors in carrying out the lab, etc.). By documenting exactly what you did, you should ensure that a future student could retrace your steps (including mistakes) and make the same observations.

You will undoubtedly refer to various pieces of equipment in the description of experimental procedure. It is generally a good idea to also provide a list of the equipment and/or materials, either before or after the description of experimental procedure. This list should provide make/model of each piece of equipment and, if possible, serial numbers (each piece of equipment in a series will have unique characteristics; this can possibly effect the observations of the experiment).

VI. Results

The results section is a record of key observations. Depending on the experiment, it may be appropriate to present results as pictures, graphical data, tabular data, and/or verbal descriptions. Sometimes a lot of raw data is generated in an experiment, and might be better placed in an appendix. In that case, the raw data should be summarized in some concise manner in the results section. For example, a long list of numbers might be represented by a simple graph, or by its mean and standard deviation. The key requirement is that a reader can assess your observations from reading the results section, without having to resort to the appendices.

Each graph, figure, or table should be described verbally. The results section is also the appropriate place to describe calculations that you need to perform on the raw data. For example, you might perform an experiment designed to measure the speed of sound in water indirectly, by recording some other physical parameter. You would use the raw data, along with the formulae described in the introduction, to estimate the final desired parameter (the speed of sound, for example). You might then also generate more graphical or tabular data, based on these calculations.

VII. Discussion

The discussion is critically important, since it is where you demonstrate your understanding of the design and/or experiment. In a typical experiment (in real life, if not in undergraduate laboratories), some observations are well understood (or at least agree well with known theory) while other observations leave open questions. The discussion section should deal with both cases as frankly as possible. Typically, the discussion section does not contain equations or figures (as those were presented in previous sections). The discussion should address the following points:

1. Conclusions that can be drawn clearly from the results.
2. Uncertainties or ambiguities that arose from the observations. This can and should include speculation regarding the nature of and possible reasons behind these observations.
3. Comparison of the observed results to what might have been expected (from the theory and/or from previous experiments that others have reported). Analyze whether the objectives of the design and/or experiment (described in the introductory section) have been met.
4. Discussion of potential sources of error in the experiment. If possible, suggest improvements to the experiment that would lead to more reliable/accurate results.

A good discussion section enables a reader to envision future directions that remain to be explored, related to the experiment conducted.

VIII. Conclusions

In the conlusion, concisely summarize those things you know with confidence as a result of conducting the lab assignment. This can include both expected and unexpected observations, or conclusions about the experimental method itself (ex. “we conclude that the chosen experimental method cannot provide a reliable estimate of the speed of sound

in water, because …"). You can also use this section to briefly describe suggestions for future work, including ideas for improving the design and/or experiment.

IX. References

List (using IEEE format) any literature sources (books, papers, articles, etc.) that you used to guide the design, understand the experiment, or to interpret the observations.

X. Appendices

Reserve appendices for anything that distracts from the straightforward reading of the main body of the report. Examples of things that belong in appendices include long lists of raw numerical data, long involved theoretical calculations with numerous formulae, and collections of images captured from scientific instruments. Each appendix should be referred to within the main body of the report. Often, the data from the appendix is summarized in some fashion in the results section. This might involve some manipulation of the data, or it might simply be a case of choosing sample data from the large collection of data contained in an appendix.

Miscellaneous Notes

1. Normally, the lab write-up should be a 'first-person' narrative: ex. 'We set the oscilloscope time scale to …". Always be consistent on this throughout a given report.
2. Normally, the report should be written in past tense (ex. "We observed that the signal was not stable …"). Again, be consistent throughout the report.
3. Always keep in mind the target audience for a given technical report or paper, and write at the appropriate level.
4. Always refer to the specific instructions for lab reports given by your instructor. Each lab course has unique characteristics, and requires slightly different elements for written reports. It will not always be necessary (or desired) that you include all of the sub-sections suggested by this General Style Guide.