

Report for

ECE Class Number Lab 1 – LAB TITLE

Lab Section:

TA:

Prepared by:

Member One¹
one@ece.utah.edu

Member Two
two@ece.utah.edu

November 8, 2005



¹Team leader

Abstract

Summarize in approximately 150-200 words the purpose of the lab, methods used, key findings, and significant conclusions. Leave out the “why”.

- Stress content not intent.
- Leave out all extra baggage.
- Assume a knowledgeable reader.
- Write the abstract last
- Avoid passive voice (not “is presented”, “was done”, “is given”)
- Keep it short (200 words or less . . . less is more)
- Make quantitative not qualitative statements
- Don’t use equations or other mathematical notation.
- Remember this is written for the first time reader.

Resources on writing technical abstracts¹:

<http://www.ece.utah.edu/%7Ecufurse/Tutorials/UU%20Thesis/abstract1.pdf>

<http://www.ece.utah.edu/%7Ecufurse/Tutorials/UU%20Thesis/abstract2.pdf>

Additional information for writing each of these lab sections is available at:

<http://www.ece.utah.edu/%7Ecufurse/CLEAR/writing/index.htm> under Lab Reports.

Additional writing resources (for theses, proposals, etc.) are available at:

<http://www.ece.utah.edu/%7Ecufurse/Tutorials/tutorialsUofU.htm>

The LaTeX source of this document is available at:

<http://www.ece.utah.edu/%7Ekstevens/downloads/report-template.tar.gz>

This and other sections of the report should avoid first person (use of I/we/our/you/your, etc.) and should be written in past tense (The lab showed (not shows) this . . .)

Information for this handout was compiled by April Kedrowicz and Cynthia Furse from several sources including the following references.

Keywords:

XXX, XXXX, XXXXX . . .

¹The characters %7E is the URL encoding for ~, and %20 encodes a space character. Using these encodings doesn’t look as nice, but allows your pdf documents to link directly to the referenced web page.

References

- [1] G. Alred, C. Brusaw, and W. Oliu. *Handbook of Technical Writing*. Bedford/St. Martin's, New York. 2003.
- [2] Engineering Communication Center at the University of Toronto, Technical Writing in the School of Engineering at the University of Dayton.
- [3] L. Finkelstein. *Pocket Book of Technical Writing for Engineers and Scientists*. McGraw-Hill, New York. 1999.

ACKNOWLEDGMENTS

You can leave this section out of your lab report unless applicable. Most engineering reports will acknowledge anyone who provided monetary support, technical support, or support in-kind. Particularly helpful individuals are also acknowledged.

EXECUTIVE SUMMARY

Not required in your lab reports, but included here for use in longer reports. Insert a summary of the overall report here. This should be about 1-2 pages in length and should summarize the complete report, including results and conclusions, allowing for a reader to have a grasp of the entire project.

Typically the abstract is very brief and does not include all of the summary details. The executive summary provides a longer description of the summary details. The executive summary is the only part of the report the “average” reader may need. The conclusions and recommendations are generally the most important aspects of what they are looking for here. If more details are desired, THEN the reader will go to the body of the report.

The following (Table of Contents, List of Figures, List of Tables) are optional in ECE lab reports. They will be created automatically if you use the `\tableofcontents`, `\listoftables`, and `\listoffigures` commands.

Contents

ACKNOWLEDGMENTS	iii
EXECUTIVE SUMMARY	iv
1 Introduction	1
1.1 Heading 2	1
1.1.1 Heading 3	2
2 Methods	2
2.1 Heading 2	3
2.1.1 Heading 3	3
3 Results	4
4 Discussion	4
5 Conclusion and Recommendations	5
A Heading 7	6
A.1 Heading 8	7
A.1.1 Heading 9	7
B Notes on using LaTeX	8

List of Tables

1	Insert Table One's caption here	2
2	Insert Table Two's caption here	3

List of Figures

1	fig caption	2
2	fig caption	4
3	Referencing a Figure Example	7

1 Introduction

(A few Paragraphs) The introduction should include the purpose (what was tested), problem (why was the experiment conducted), and scope (what was analyzed) of the report. In addition, introductions can sometimes include justification of the experiment's importance. It can also refer to relevant theory and important previous studies. The goal is to supply sufficient background for readers to understand and evaluate the experiment and its results without having to read previous publications.

Include:

- Overview of the lab.
- Describe the problem of interest (“This lab is part three in an eight-part series to design a wireless communication system for a cardiac pacemaker. In this lab, the electrical properties of the human body are evaluated in simulation and measurement, and an artificial material made from water, salt, and sugar to replicate these properties is produced. It is important to know the electrical properties of the human body in order to design an antenna that can be matched in the body, and also to determine how much power will be lost in the body for a given design. This impacts the communication range of the system and the safety of the patient.”)
- Give a survey of what is known in the field about this problem and potential solutions (particularly for longer reports ... this is sometimes called a “literature review”, lots of references here). If this section is really long, it is sometimes given as a separate section on BACKGROUND. At the end of a literature review, be sure to tell what gap in the literature this project will fill. For a short report such as this lab, a few sentences or paragraph describing what is already known (“Hartsgrove, et al. produced tissue stimulant materials for muscle, brain, and ... at ..., ..., and ... MHz [4]. This lab utilizes a similar method to develop $\frac{2}{3}$ muscle stimulant material for 440 MHz.”)
- Be sure to tell how this report/project relates to the larger engineering design problem or project, what you expect to observe, and why.

1.1 Heading 2

Insert text here. Use subheadings only if each section is distinct. There are two ways to format headings / subheadings:

1. Cut and Paste old headings, and type in new text.
2. Format – Styles and Formatting. This will show format bar. Then highlight desired text and click on the format you want it to have.

Here is how to handle equations. The capacitance of two parallel plates is given by [4]:

$$C = \frac{\epsilon A}{d} \tag{1}$$

where ϵ is the permittivity of the material between the plates, A is the area (in m^2), and d is the distance between the plates (in meters). Math mode can start and end with matching ‘\$’ characters.

Here is how to handle tables. Be sure to talk about Table 1 in the text before it appears on the page. To insert the reference to Table 1, label it in the table with the `\label` command and reference it with `\ref`.

Table text	Table text

Table 1: Insert Table One’s caption here

1.1.1 Heading 3

Insert text here...

Make sure your lines/font are big enough to read, add arrows or markers to guide the reader to see what you see in your figures, and be sure all axes are labeled (with units). Whenever possible, try to make the lines in your figures so they will show up not only in color (how you probably plotted them), but also in black and white (how you or others will probably print them). Do this by having colored lines with different line types, markers, etc.

FOR BETTER MATLAB FIGURES:

See <http://www.ece.utah.edu/%7Ecufurse/Tutorials/matlab/Figures/figureformat1.m>

Also download <http://www.ece.utah.edu/%7Ecufurse/Tutorials/matlab/Figures/startup.m>

Put the startup.m file at the beginning of your Matlab codes, and it will make large fonts and heavy lines that are easier to read.

To Store Matlab Figures: Use a *.fig file. This allows easy changes or corrections later. Save as *.jpg or similar to put in your latex document using the `psfig` command.

Figure 1: fig caption

Figure captions and references are done the same way as table captions and references.

2 Methods

The methods section should include a description of the apparatus or equipment used, and a description of the process or procedures followed in *chronological order*. This section should include enough detail so that another researcher could duplicate the experiment (graphs, diagrams, or spreadsheets should be included). Also include any calculations used to conduct the experiment.

Give a full description of the method used to complete the lab. Insert figures, tables, etc. AFTER they are mentioned in the text, and be sure to mention every figure/table/etc. in the text. Number all figures, tables, and equations. Put captions under all figures and tables, and reference everything that comes from a book, website, or other source. Include an equipment and/or materials list and step-by-step instructions so that a peer could do the lab without your help. If detailed derivations, tutorials, etc. are needed, they can be included in appendices. Mention all appendices in the text. Avoid use of “I/we/you”.

When writing the methods section:

1. Describe equipment (part numbers and type/nature/functionality of equipment)

“A xxxx time domain reflectometer was used in this lab to measure the step function response of different types of cables and terminations.”

2. Describe the process (a step by step of the important actions)

“The TDR was connected to one end of a cable with a termination on the far end. The step function response was observed on the TDR screen and manually recorded/sketched.”

3. Describe/explain what parameters were measured

“A TDR measures the voltage step function response of a cable by sending a step function down the wire and reading the total (incident plus reflected) response at the input.”

4. Discuss potential sources of error (possibly yielding unexpected results, but also possible that it didn’t cause any problems in this lab).

“The TDR has a limited rise time step, which clearly shows up in all of our measurements. The ideal response has an infinite rise time, but the TDR does not. This will reduce the precision to which we can measure lengths and may also result in difficulty in observing faults or other problems very near the TDR test point.”

2.1 Heading 2

Insert text for this subsection.

Table text	Table text

Table 2: Insert Table Two’s caption here

2.1.1 Heading 3

Insert text here ...



Figure 2: fig caption

3 Results

The results are the data that the experiment yielded. Give a full set of observations and results using clear language and past tense. Include graphs and/or tables as appropriate. Your observations should ‘prove’ that the lab did what you said it would in the introduction. Be specific and quantitative whenever you can. For instance, it is better to say, “The power decreased by 3 dB” instead of “The power went down.” Although results should be stated in verbal form, also include tables, charts, graphs, or calculations. Remember to label them! A clear statement drawing attention to the results will help readers interpret any figures. Do not include all of your raw data in this section. Extract that which is important to prove what you said the experiment would do, and put the rest (if applicable) in an appendix. Remember to reference any appendices as necessary.

Describe the results of the simulations in detail

- Include plots, tables, etc. as needed for clarity and precision
“Plot the magnetic field along the y-axis for a rod extending from $z = -\frac{\pi}{2}$ to $\frac{\pi}{2}$ meters having a current distribution of $I(z) = \cos(z)$ in the z -direction.”
- Include (always!) detailed information on how close this is to what is expected. “The data were close to what was expected” is NOT good enough. “The data were within x% of expected values.” is good. Include measured and expected responses on the same graph, for instance.
“We expect the field distribution away from the antenna to fall off first as $\frac{1}{r^3}$, then $\frac{1}{r^2}$, and then as $\frac{1}{r}$.” Plot these curves on the curve that you obtained from simulation, and show which regions fit the $\frac{1}{r^3}$, $\frac{1}{r^2}$, and $\frac{1}{r}$ expectations.
- Comment on your results.
Comment on the size of your antenna relative to the size of the $\frac{1}{r^3}$, $\frac{1}{r^2}$, and $\frac{1}{r}$ regions. How far away from the antenna do you need to be (relative to its height) before you are in the far field ($\frac{1}{r}$) region?

4 Discussion

The discussion presents an interpretation of the data. This is the most important part, because it is here that the experimenter(s) demonstrate understanding of the experiment and related concepts. The purpose of the discussion section is to explain, analyze, and interpret. The significance or

meaning of the results should be communicated. Focus this section as appropriate by: comparing expected results with actual results, analyzing experimental error, explaining results in terms of theoretical issues, relating results to the experimental objectives, comparing results to similar investigations, and analyzing the strengths and limitation of the experimental design. Tip: Summarize the degree to which the experiment achieved its goals.

The introduction described the expected observations. Now, tell if they were actually observed, and if not, why. Also discuss any other observations that might have been unexpected. If something is not what you expected, explain why this might have happened. Be specific and give the SIGNIFICANCE of your observations. For instance, “In this lab, a single stage 10 dB amplifier for a wireless communication system at 400 MHz was designed, prototyped, and tested. The amplifier achieved a gain of 9 dB, which is 1dB less than the design specification. This means that an additional gain of 1 dB in excess of the design specification will be required in the filter design. If this gain cannot be replaced in other areas of the circuit, the system is expected to transmit 10 feet less than the design specification.”

5 Conclusion and Recommendations

This section should present overall conclusions relating to the original purpose of the study (which was stated in the introduction and should be restated here). List conclusions in order of importance and link them to information in previous sections of the report. The conclusion should include a statement of what is known “for sure” as well as any recommendations, including how to improve performance, how this will impact other portions of the design, etc. State what actions should be taken based on the results of the study.

References

- [1] D. Baumann and C. Bruns. *Microsoft Word Theory and Design*. IFH, ETH Zurich, 2004.
- [2] IEEE Reference Format. http://www.ieee.org/portals/cms_docs/pubs/transactions/auinfo03.pdf.
- [3] J. Knapp, January 2012. Personal Communication (to be used if someone told you something, and you need to use it as a reference).
- [4] J. Matula and R. Franck. A Case for Two. In *Proc. 15th Int. Zurich Symp. and Technical Exhibition on Electromagnetic Compatibility*, volume 1, pages 347–350, Zurich, Switzerland, Feb. 2003.
- [5] Author Name. Article Name. *Journal Name*, vnum(jnum):pnum–pnum, jmonth Year.
- [6] Hoyle Schimanski and Cane R. Thanner. Raiders of the Lost Ark. *IEEE Transactions on Electromagnetic Compatibility*, 51(5):543–547, May 2003.
- [7] F. T. Ulaby. *Fundamentals of Applied Electromagnetics*, chapter 2.1. Prentice Hall, ETH Zurich, 2004.

All references should be cited. However, in this text they all are not (bad form). Including unrefereced citations is done using the `\nocite` command.

How to use references:

References should appear immediately after the information you reference [5]. If you have a reference for the entire paper, state this in the start of your paper or a footnote. If you want to copy a paragraph or large section of verbiage from a paper, indent it and make it smaller font [4]:

Bla blablablablabla
Bla blablablablabla
Bla blablablablabla

What should you reference:

Anything that someone else thought/designed/wrote/drew/talked about. Better to over-reference than under-reference. Give credit where credit is due, or even where it just might be due.

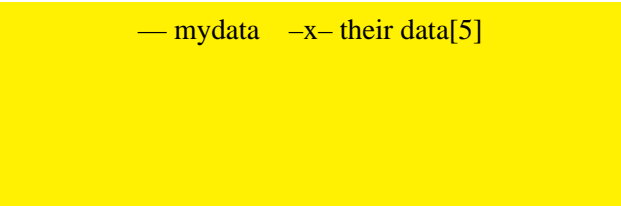
Referencing Figures:

A figure copied or adapted from a source should have a note of this in the caption.

A Heading 7

Introduction to appendix. . .

Appendices are commonly used for technical data and details that are beyond what the average reader needs in order to understand your report. Derivations of formulas, full sets of data (when only part is included in figures in the main body), full circuit schematics (when block diagrams are included in the text), data sheets (especially for internal “engineering” reports), instructions for use, etc.



— mydata -x- their data[5]

Figure 3: Reflection coefficient of microstrip antenna from [2]. OR adapted from [2] OR Reprinted with permission from [2]. Formal permission to include someone else's figure is required if this is a thesis, published paper, or book. DATA is not copyrighted. You can replot someone's data, and include it without permission, which should then have a reference from [2]. Often, you might add their data (such as measured data) into your own figure. In that case it is best to include this in the legend.

A.1 Heading 8

Text on subheading 1...

A.1.1 Heading 9

B Notes on using LaTeX

- This document contains the following files:

1. report-template.tex
2. report-template.bib
3. ece-logo.png
4. yellow200x100.png

You can download these files from the following web site:

<http://www.ece.utah.edu/%7Ekstevens/downloads/report-template.tar.gz>. You will need to uncompress and extract the files using the following commands:

```
gunzip -v report-template.tar.gz
tar xvf report-template.tar
```

You can then edit these files to produce your report.

- Bibliography entries should be put into the file `report-template.bib`. The reference key is the first entry of every bibliography type. There is an example of most of the reference types (journal articles, Ph.D. Thesis, etc.) in this bibliography. You may want to collect your own bibliographical references over time and reference this file in your documents. To do this, replace the `\bibliography{ }` command with your personal bibliography.
- To compile this document into a pdf file, run the following commands:

```
pdflatex report-template
bibtex report-template
pdflatex report-template
pdflatex report-template
acroread report-template.pdf
```
- The command `bibtex` compiles your bibliography. You must run `pdflatex` to generate the reference table before running `bibtex`.
- You usually need to run `pdflatex` at least twice, as one pass creates indexes, citation information, page numbers, etc. The second run uses this information.
- You should use `latex-mode` and `font-lock-mode` when editing latex files in emacs. These modes are toggled using the commands inside of emacs in the form:
`M-x font-lock-mode`