ECE 302/303 Lab project #x  
Title

Lab section: D11/etc. Bench #xx Date 2024-10-??

In the title block above, indicate course number, lab project number, lab section, bench number, and date of the report. Please remove the highlighting.

# Abstract

An abstract is a *concise* summary of your report, typically about 150–200 words long. The abstract and the rest of the report need to be independent: Someone who *reads only the abstract* should be able to get the gist of what you were doing and how well your implementation met the design criteria; likewise, someone who *reads only the main body of the report* should not miss anything. Someone who has limited time might read only this part of the report. Only when they need to look up specifics would they then delve into the main body of your report.

The abstract should summarise the objectives and outcomes. The salient, quantitative results should be stated. Did the design meet the objectives? What challenges might lie ahead?

The abstract, as it is a summary of the entire report, will need to be written last.

Student ID numbers should be entered on the lab mark sheet only. The checkpoints mark sheet and the lab report mark sheet are to be included as the last pages in the report. Please submit as one .PDF file through the LAB eClass.

Do not include any of the following: table of contents, table of figures, datasheets for components in the lab kit (you may assume that the reader has access to them, *i.e.*, that they are available in a magical Appendix X).

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| Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| *My/Our signature/s certify that I am/we are submitting my/our own, original work only, and do so in accordance with the University’s Student Academic Integrity Policy and APEGA’s Code of Ethics.* | |

(Note that there is a section break above this paragraph which makes this page numbered as page 1. Your title/abstract page is not to be numbered.)

# General structure of the report

Please see Chapter 3 of the lab manual.

The purpose of this template file is to give students a guide on report writing so that they can apply it to their lab report. Specifically, the motivation for a standardized report format is so that the reports are marked solely for their content and not their formatting or “flashiness”. Furthermore, by being exposed to stringent formatting guidelines, you learn to follow the stringent reporting and documentation guidelines that will be placed on you in your future careers (sorry students – someone had to tell you eventually). Your report, like any detailing scientific or engineering work, should be written in the past tense. The report should have a structure like the following in the order shown below:

* Objectives
* Design
* Simulation results
* Discussion
* Conclusions
* Appendix — May or may not be present.
* Figures and tables — These should not be included in the body of the report, but rather should be on separate pages after all text parts (*i.e.*, everything above). You may have multiple figures/tables on a page.
* Checkpoints mark sheet — this keeps track of your intermediate progress (check-in/check-out marks)
* Lab report marking sheet — a summary of how the marking is done for the reports

The content of some of these sections is discussed in more detail below.

# General formatting guidelines

* Page margins should appear as in this document: 0.75" on all sides.
* Font size at least 12 point, preferred font 12 pt Times New Roman or similar. Line spacing should be set to 1.5 lines.

To make use of this template, obviously you should delete the text we’ve put here and replace it with your report. You can keep the headings below. Formatting is set up through styles:

* “Title” for report title (used on title page above)
* “Subtitle” for report subtitle (used on title page)
* “Body” for body text
* “Body continuation” for a paragraph that continues after an equation
* “Bulleted” as in what you see here, for unordered lists
* “Equation” for equations (see below for guidelines on numbering)
* “Heading 1” for first-level headings
* “Heading 2” for second-level headings
* “Caption” for figure or table captions (see below for guidelines on numbering)

# Objectives

Briefly describe the design goals (specs) and the intent of your design. Usually one short paragraph will suffice. Ensure that all specifications are spelled out. The reader needs to understand the requirements your design was supposed to meet.

In practise, the Objectives section is simply you re-stating, in your own words, the design objectives of the project. You should, in fact, be able to write this part of the lab report before you come to the first lab session!

# Design

Detail the design decisions that are made. What were the *options* available? *Why* was a certain implementation chosen? What are the *advantages* and *disadvantages*? Summarise the calculations, noting that some of the greatly detailed calculations used in the design process can often be relegated to an appendix of the report. The reader should be able to understand your *motivations* and design *choices*. Show the final design of the circuit, component values, *etc*.

Finally, the design section should point the reader to the final circuit schematic. The circuit diagram is for the complete circuit, showing component types, values, part numbers, and SPICE simulation node numbers. Someone who was given only this schematic and nothing else should be able to duplicate your circuit. A neatly hand-drawn schematic done on engg. paper and scanned with your phone is perfectly acceptable; you do not need to waste time using computer-based schematic capture. You will not be penalised for a hand-drawn diagram, nor you will not gain any additional points for a computer-drawn schematic.

This section will likely contain many equations, like for example the equation that determines the power, *P*, dissipated by a resistor:

(1)

where *V* is the rms voltage dropped across the resistor, and *R* is the value of the resistance. Note how Eqn. (1) has been labeled and formatted on the page and that all of the variables (which should be italicized in the body to indicate that they are a variable) have been described in the text immediately after the equation. This example was rather trivial; in your report, you won’t need to describe what *V* and *R* are! Equations should be numbered consecutively as they appear. You can refer to equations as “Eqn. 1”, “Eqn. 2”, *etc*.

You will also likely be using several figures and tables in this section. Figure labeling of course will follow similar rules that equations did. Refer to figures as “Fig. 1”, “Fig. 2”, *etc* and tables as “Table 1”, “Table 2”, *etc*. Figures and tables are to be placed at the end of the document after all text sections.

## Part 1

For sub-headings, use “Heading 2” style.

## Part 2

blah blah …

# Simulation

This part should include relevant SPICE circuit simulation data, graphs and waveforms. SPICE is very powerful! Demonstrate to us that you use circuit simulation as a tool *integrated into the design and testing process*. If no simulation work is done until after the circuit is built, then it’s almost pointless, no?

There is always debate as to whether this section should be part of a combined “test and simulation results” section or as a section separate from the tests done on the prototype circuit. Really, both are acceptable; just keep in mind the flow of your paper. Remember that the purpose of your report is to discuss the design, implementation, simulation, and theory of your circuit.

Should the simulation be done with the component values initially calculated in the design of the circuit, the final values used, or some combination? Here, it will become clear how complete a job you did as an engineer. Did you not take the results from your design calculations and plug them into the simulator as a test on the design? Or was your simulation merely done *ex post facto*? There is no doubt that those who are most successful in the ECE 302/303 labs make extensive use of theory (calculations), simulation, and test results in an *integrated* fashion.

# Test results

Detail the tests and measurements done on the prototype circuit. For clear, comparative results, tables may work best. In other situations, a graph is the best way to present the results. The test procedures and results should show how well the implementation meets the design specs detailed in the Objectives section. Again, things like raw data (*e.g.*, numerical data used to plot a graph) can be relegated to an appendix.

In practise, the boundaries between the three sections above may be blurred somewhat, especially given the our typical approach to electronics design where we work on things one stage at a time. We design, simulate, build, and test one part of the circuit before proceeding with the successive stage. So, it is acceptable to think of the above portions of the report as a chronicle of the problem-solving process. There are multiple approaches that can work, as long as the lab report evaluation criteria (see marking guide for a summary) are met.

# Discussion

In many ways, this is arguably the *most important* section of your report, and will quite possibly be the longest section of the report. Here, you compare results between theory, prototype circuit, and simulation.

Discuss and evaluate the overall performance of your design. Did the experimental results agree with your design? Did they agree with the SPICE simulation? (Note the three-way comparison amongst design, simulation, and prototype circuit.) Explain, as best you can, any differences. Are the discrepancies actually significant? *e.g.*, how do component tolerances affect your results? What are the limitations of this design? Suggest any improvements.

It is important to make an honest evaluation. If a design decision that you made was unwise, there is nothing wrong with the discussion and evaluation saying that the design performed poorly because of something you chose to do in your design. We are interested in what you learned. On the other hand, “blaming” component tolerance as “the reason it didn’t work” only shows that you don’t understand tolerances and design margins. Likewise, explanations of “the equipment didn’t work” is more likely that you didn’t use it properly.

Here, you also evaluate (*i.e.*, use your engineering judgement to assess) the performance of your circuit. Compare and contrast the measured, theoretical, and simulated data; use quantifiable parameters such as the % *error* and the % *difference*, as given by the following equations:

(2a)

(2b)

where *x* is the uncertainty (error bar) for a given quantity *x*, and where *xtheory* is the theoretically known value for the measured quantity, *xmeasured*. There is a very good likelihood that you will have a quantity of importance within your lab that *does not* agree very well with the measured value; it is a mistake to dismiss the discrepancy and simply say “it worked, so who cares”, or to blame “human error” (the latter comes up surprisingly often but is a poor excuse to use, as it is not a quantifiable source of error). Rather, accept that not all measurements or theories are perfect. Can you come up with a plausible explanation to describe the discrepancy? Furthermore, you can even suggest some improvements that would remedy the discrepancy; *i.e.*, how could the design be improved? Relate this discussion back to the design choices you made.

To stress the issue: you will not necessarily lose marks if a quantity does not agree with theory, or even if your circuit didn’t quite meet all the design specifications. We are *far more interested in your discussion* and what lessons you learned. The point of the discussion is for you to demonstrate that you understood what you were doing. Show us your engineering judgement.

# Conclusions

A brief section which summarises the report to end it. The conclusion should address the following: Overall, how well did the design and prototype circuit meet the objectives? What might need to be done differently?

The text of the report (from objectives to conclusions; does not include figures/tables) is to be no longer than **10 pages**, formatted per the requirements. The pages are numbered, so you can tell easily. Any pages in excess of of the allowance will not be read. So if, for example, your discussion spills past page 12, it will be truncated (you could lose marks) and you’ll also get a zero for the conclusion because it will be considered not to be there. The title/abstract page, appendix pages, and figure/table pages do not count as part of the 10/12-page limit.

The best reports we have seen are those that are concise. It is clear that there is a lot of content, thought, and discussion to cover. There is evidence that there was careful consideration given as to what was most important (and therefore should be included in the report) *vs*. less important stuff (which was left out or put in the appendix). The best reports don’t always need the full quota of pages.

The worst reports are those that struggle with content. The design shows little thought or awareness of design choices; the measurements were incomplete; simulations were not rigorous — therefore there seems to be little to talk about so things are stretched out to fill 10/12 pages in the futile thought that somehow it will look “less bad” than a shorter report or that it will somehow compare favourably to a good report of longer length. If you take a small, finite amount of content that could be discussed in (for example) four pages and stretch it out to eight pages, then you’ve only added four pages of filler.

# Tables and Figures

(page break before) Place all figures mentioned in the body in sequential order. You should not have figures that are not mentioned in the body of the report. Either edit your manuscript so that it is mentioned, or remove the figure. If it is not important enough to mention in your report somewhere, then it does not belong here.

Again, it is to be emphasised that neatly hand-drawn and scanned figures are perfectly acceptable (and receive no fewer marks than computer-drawn figures).

While in the lab manual, it is stated that the page limit on tables and figures is 6 pages, due to formatting differences, this limit may be overlooked. However, do not take this as license to include absolutely every figure and table that you can imagine; you must still show judgement as to what is important enough to present and what is not as important. (Note that you can put multiple figures on the same page, so long as they are of a reasonable size.) Think about using tables and graphs showing multiple plots, especially for results that are to be compared.

# Appendix

(Insert a page break before this section.) The appendix contains supporting information such as detailed calculations, tables of raw data, *etc*.

The appendix is probably the most misunderstood and misused (and sometimes underused) section of student reports. The important thing to note about this section can be summed up with analogy: the human appendix is not necessary for survival and it can be removed if necessary. You should think of the report appendix in the same way. The reader could completely ignore the appendix and it should not take away from the report. The person marking your report will be instructed to not assign any marks for the content in this section, rather they will peruse the appendix to make sure that it has been properly used.

The appendix (if present) is not included in the page count for the main text of the report

Marking Guide

The marking guide should be included as the last page of the report. Your student ID numbers should appear on the marking guide only.