Guidelines for Writing Reports for
The Electrical Engineering Program
under The Department of Electrical Engineering and Computer Science
Approved by EE Faculty
Dec. 7, 2008

The Bachelor of Science degree in Electrical Engineering requires numerous core E.E. courses that require written reports. These courses also have concurrent laboratories, which also require reports. The fact is, once you graduate, industry will require you to write well. In some cases, you will be involved in writing proposals or possibly final design reports. It is possible that you will be required to assist in writing user or maintenance manuals. Certainly, you will always be required to write short reports and memos detailing your activities. It is our objective to train you to write well by the time you have graduated.

Writing “good” reports requires much thought, organization and editing but the rewards are great. Those students who can master good technical writing skills will find greater success and opportunity as professionals in industry.

Dr. Lewis Brown, Dean of the College of Engineering

The following guidelines present five typical types of reports you will be required to write throughout your sophomore, junior and senior years. The categories of these reports are:

A. Laboratory Report
B. Research Report
C. Computer Assignment Report
D. Design Report
E. Essay

This document is divided into four parts. The first part provides fundamental guidelines and tips for writing reports, which apply to all three report formats. The second through fourth parts provide detailed formatting and guidelines for each of the report types listed above.

Guidelines/Tips for writing engineering reports

Tools
Know/learn how to use your
1. word processor
2. equation editor
3. drawing editor
4. computer spreadsheet software
5. computer simulation packages (Matlab and PSpice)

1. You should become proficient at using your word processor for such items as page numbers, formatting tables, creating graphs, inserting Greek symbols, and using superscripts and subscripts.
2. You should become proficient at using the equation editor (Word has a built-in equation editor that can be accessed by “inserting object”. You can purchase MathType equation editor – not too expensive, and very useful in Microsoft Word.

3. At times, you will be required to draw a diagram or a circuit. This can be done by using tools such as Microsoft Visio (free to students – visit the Dean of the COE office to obtain a copy), or PSpice.

4. Often you will either record data in a laboratory or generate data using a simulation package. In either case, you should use a spreadsheet program to tabulate and conduct further analysis of the data. Matlab can also be very useful for this type of activity.

5. In a pinch, you may need to draw a diagram or circuit by hand. In these cases, you need (must) use a template/straight edge device. You need to draw everything very neatly.

General Format Guidelines

1. Every report should have a cover page, including title, your name, course number, department, institution, date, , instructor name (with appropriate prefix, such as Dr., Professor, or Instructor …).

2. Use 12 font (Times Roman or Arial).

3. Double space between lines on draft copies (makes it easier to provide feedback from professor) – however, final draft should be 1.5 spacing.

4. Place page numbers on all pages, bottom right (though title page is page 1, don’t display the number 1 on the title page).

5. Equations are centered and the equation numbers are right justified. The equation number is placed in ( ). See example.

\[ F(s) = \int_{-\infty}^{\infty} e^{-st} f(t) dt \]  

(1)

6. When referring to an equation, there are two rules. If referring to the equation at the beginning of the sentence, then do the following: “Equation (1) is the 2-sided Laplace transform and is quite useful in electrical engineering.” If being referred to within the sentence, then do the following: “The 2-sided Laplace transform of (1) is quite useful in electrical engineering.” Not, “The 2-sided Laplace transform of equation (1) is quite useful in electrical engineering.”

7. Use your word processor to make “real tables” (i.e., boxed in, etc.). Center all tables and include a heading and caption with the appropriate table number above each table. For example, “Table 1: Voltage measurements for Part 3”
8. Figures must be centered, and the figure number and caption is centered beneath the figure. For example, “Figure 1: Circuit schematic of Butterworth filter”.

9. All figures and tables must be discussed in the text, including what it is, significant observations, and analysis.

10. Capitalize “Table” and “Fig.” any time they are accompanied by specific table or figure numbers. Examples: “The measured data are plotted in Fig. 2. The figure shows a linear relationship in...”. “The table shows ...” vs. “The data of Table 3...”

11. Always spell out table or Table. Give abbreviation of Figure, i.e., Fig., when used in the middle to end of sentence, but spell it out when used at the very start of the sentence.

12. All graphs must be done with a computer (i.e., spreadsheet software such as Microsoft Excel or even Matlab.). Do not include hand drawn graphs unless specifically instructed to do so.

13. All graphs require labels and units on the axes, and require a legend for more than one set of y-axis data. When graphing discrete measurement data, plot with both lines and symbols (versus lines only) so that one can clearly see what the actual measurements were. If more than one set of data are plotted on the same graph, use different symbols for the data and include a legend which explains the symbols.

14. Orient full page plots/graphs so that they read from the right side of the page (i.e., like your textbooks, journals, etc.) as you read the report, not the left side.

15. One digit numbers should be spelled out in text, except when they include units of measure or refer to page numbers. Use numerals for numbers 10 and greater unless they begin a sentence.

16. Include a leading zero when a number’s magnitude is less than 1 (use 0.83 instead of writing .83).

17. Include a space between any number and an associated unit (i.e., 3.4 mA, not 3.4mA).

18. Use your word processor for Greek symbols for common engineering quantities as $\beta$, $\pi$, $\varphi$, $\omega$, and $\Omega$.

19. Use your word processor to make any necessary superscripts and subscripts. (Use $V = 10R^2$ instead of $V = 10R^2$).

20. Throw away unnecessary (insignificant) digits--they are a tip-off of a novice, not an engineer. Use “the measured phase shift was 34.3°”, instead of “the measured phase shift was 34.26732°”.

21. A Bode plot consists of two semi-logarithmic frequency plots: magnitude (in dB) and phase (in degrees or radians). Make sure you include both if you are reporting on the frequency response of a circuit.
22. Use the correct (i.e., IEEE standard) abbreviations for all units. Table 1 shows a list of approved and incorrect abbreviations:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Correct abbreviation</th>
<th>Incorrect abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volts</td>
<td>V</td>
<td>v</td>
</tr>
<tr>
<td>Amps</td>
<td>A</td>
<td>a</td>
</tr>
<tr>
<td>pico (10^-12)</td>
<td>p</td>
<td>P</td>
</tr>
<tr>
<td>nano (10^-9)</td>
<td>n</td>
<td>N</td>
</tr>
<tr>
<td>milli (10^-3)</td>
<td>m</td>
<td>M</td>
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<tr>
<td>Kilo (10^3)</td>
<td>k</td>
<td>K</td>
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<tr>
<td>Mega (10^6)</td>
<td>M</td>
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<tr>
<td>Time</td>
<td>t</td>
<td>T</td>
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<td>Farad</td>
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<tr>
<td>Henry</td>
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<td>h</td>
</tr>
</tbody>
</table>

23. Place report in a nice plastic binder – see instructor for example. If it is too thick, then place report in a three-ring binder.

24. If your instructor does not require a plastic binder, then staple it in the upper left corner. Use the large stapler in the EE office if the report is too large for the standard stapler.

IEEE Reference/Citation Formatting Guidelines

All sources of information for your report should be cited in the writing. Each discipline has its own preferred format for citing references and electrical engineering is no exception. The Institute of Electrical and Electronics Engineers (IEEE) is the largest professional society in the world and publishes more than 70 magazines and technical journals which adhere to its technical writing standards. It is the standard of the IEEE to include a numbered list of references at the end of the paper (but before an appendix) [1]. The list is to be arranged in the order of citation within the text, not in alphabetical order. The reference numbers should be enclosed in square brackets such as [1]. At the end of the report/paper, include a section called References and list each. The titles of books and articles are to be included, as are the page numbers. This is intended to provide convenient means for the reader to locate the cited material. Some examples for various types of reference material are included below. If you do not see an example for your type of reference source, examine any IEEE Transactions journal in the Library for examples.
References


element of **data book**:


element of **textbook**:


element of **scientific journal paper**:


element of **conference paper proceedings**:


element of **Internet web page**:


Grammar/Writing Style

1. Write the report as if the reader is another person from your peer group—not the instructor. Your language should **not** be conversational, i.e., colloquial. It needs to be direct and professional.

2. Do not be wordy! Choose common language and choose your words sparingly. Use **active** voice, not passive. Sentences in **active voice** are more concise than those in **passive voice**. For some very good instruction and examples, see http://owl.english.purdue.edu/handouts/grammar/g_actpass.html

3. Do not use jargon. Avoid the use of slang or obscure language. Avoid being colloquial.
4. Remember that “data” is plural.

5. Use only **third** person (i.e., absolutely avoid using words like “I” or “we” (use “it was found...”, instead of “I found...”)

6. Verb Tense:
   - Use **past** tense when describing a procedure/process that was implemented in order to produce your results (whether in the lab or using a computer program). For example, “After constructing the circuit of Fig. 1, power was applied.”
   - Use **present** tense when analyzing the results and making conclusions. For example, “The data shows that the efficiency of the process is 92%.” Also, when making reference to a figure or data within the report, use present tense. For example, “The test setup is shown in Fig. 1.”
   - Here are some examples of don’t dos: “The block diagram can be seen in Fig. 1”, or “The block diagram can be seen below in Fig. 1”.

7. A short discussion/introduction must precede all figures/tables. It is common practice to make reference to all figures/tables by the figure/table #. For example: “The data provided in Table 3 correspond to the test setup of Fig. 1.”, or “It is shown in Table 3 …”, or “The results of the transient simulation, given in Fig. 5, show a maximum current of ….”

8. Include schematics/block diagrams of all test circuits and designs. An unfamiliar reader should be able to reproduce your work and must therefore have the circuit schematics/block diagrams.

9. **Rarely**, if ever, should you simply place all figures and tables within the appendix. Don’t make the reader search for the figures and tables – they should be following very closely after they have been introduced.

10. When you have gathered data for several comparative procedures, then tabulate the final results. Often you are requested to predict the results based on theoretical analysis. Then compare actual results to predicted results. Your table can include a percent difference analysis between predicted and actual. Sometimes the actual data is that from a hardware test setup, while at other times, it is a result from a simulation. When it is a simulation result, it can still be compared to a predicted result from prior theoretical analysis/prediction.
A. Laboratory Report Format

The following standard format is most frequently used for EE laboratory exercises, which have multiple sections with different procedures and objectives:

- **Title page:** course number, name and section number; lab experiment name and number; author name; date performed, lab partner(s) name(s), and the instructor’s name. Dr. …., or Professor …..or Instructor. See attached example.

- **Introduction:** Provide the necessary background to the lab including the overall lab objectives (not the objectives of instructor for the student, but of the actual exercise itself), design specifications and approach. It should be about ½ to 1 and ½ pages, depending on the exercise. You should include schematic diagram, with explanation. You may have done some prelab derivations – this

- **Procedure:** describe the procedures followed, including sufficient detail on the exercise setup for someone else to reproduce the work. You may have multiple subsections here, depending on the lab exercise.

- **Results/Analysis:** have one formal section for each part of the lab which includes:
  - a formal heading (e.g., Part I: Circuit Design)
  - state the purpose of that section/part
  - state the principal results and discuss them. Compare all measured results with what was theoretically expected/estimated from prelab exercise and explain any differences.
  - conclude each section/part--did you meet the purpose for that section/part? Elaborate, don’t just write “yes” or “no”.
  - tabulate your data and produce necessary plots. Analyze the data and/or plots and make comments. Answer all questions given in the lab manual.

- **Conclusions:** give technical conclusions. Restate the main objectives and how or to what degree they were achieved. What principles, laws and/or theory were validated by the experiment? Describe some applications of your results.

- **Appendix:** include all hand calculations, extra graphs and plots, PSpice results, etc.

**OPTIONAL**

- **Comments:** suggest possible additional tasks that might improve the lab and provide a better/deeper understanding of the technical aspects. If you have other issues/concerns/discrepancies with the lab, ask TA for a “Lab Exercise
Survey” to be completed and submitted directly to the course instructor.

B. **Research Report Format**

The following standard format is most frequently used for reporting on a single problem, procedure and objective. It is quite often used for research-oriented problems done in a lab setting.

- **Title page:** course number, name and section number; lab experiment name and number; author name; date performed, lab partner(s) name(s), and the instructor’s name. Dr. …, or Professor …or Instructor. See attached example.

- **Introduction:** provide the background, motivation and objective(s) and include any design specifications

- **Theory:** describe the relevant theory and equations, preliminary predictions or estimations that were either proved or disproved by the experimental setup

- **Procedure:** describe the procedure followed, including sufficient detail on the experimental setup for someone else to reproduce the work

- **Results & Analysis:** describe the principal results and analyze/discuss them. Compare all results with what was theoretically expected and explain any differences

- **Conclusions:** give technical conclusions. Restate the main objectives and how or to what degree they were achieved. What principles, laws and/or theory were validated by the experiment? Describe some applications of your results

- **References:** properly cite references used for the work (textbooks, data books, web sites, etc.) using IEEE format – look at the guidelines included within this document

- **Appendix:** include all hand calculations, extra full-page graphs and plots, PSpice and/or Matlab results, etc. Also, attach a copy of the assignment itself, assignment rubric and grading key.
C. **Computer Report Format**

The following standard format is most frequently used for reporting on a computer analysis problem like in circuits, electronics, signals, controls courses.

- **Title page:** course number, name and section number; project name and number; author name; date performed, and the instructor’s name, with proper salutation, such as Dr. …, or Professor ….or Instructor. See attached example.

- **Introduction:** provide the background, motivation and objective(s) and include any design specifications and constraints. This section should also include figure(s), such as system level diagram, schematic, etc. Explain the basics of this system or schematic diagram. You can use subtitles, such as Objective, Specifications or Constraints, etc.

- **Theory:** describe the relevant theory and summarize the derived equations – you need not show each and every equation that was derived and presented in your appendix – you only need to present key equations and give short explanation of the process to go from one equation to the next. You should use symbols that are found in diagrams and schematics. You will need to provide these intermediate diagrams and schematics with these equations. The diagrams should have variables identical to the ones you have used in your equations!

Before moving past this section, you need to implement derived equations within a software tool such as Matlab. You will program your derived equations and present “predicted results” based on your theory and derivations. These values should be very close to the desired specifications.

- **Procedure:** describe the procedure followed to arrive at the set of “actual” data corresponding to the objectives/specifications of the project. In most cases you will construct your system in a simulation tool such as Simulink or PSpice. These models are considered to be most identical to the “actual” system if you were able to build it in hardware.

In some cases, you will actually build the hardware and run test. This test data will be considered “actual” results, and those of the Simulink and/or PSpice will then fall into the category of “predicted” results.

Hence, this section is to be quite short and is meant to explain to the reader what methods were used, what special tools/features/equipment and how they were used to arrive at “actual” data. This section should contain enough explanation so that a year from now a person could essentially recreate the “actual” results.
- **Results & Analysis:** after you are done with the description of the procedure/process followed to arrive at the “actual” data, such as transient and steady-state results, you will present these “actual” data. You can show a representative transient plot. This figure should be well annotated, showing key data points. If you run multiple simulations, you don’t necessarily have to show each and every plot. This is a good time to put the key results for each simulation into a table. The table should always have a column of “predicted” results. The next columns should show “actual” results, the last column should show a %-difference between “actual” and “predicted”. The equation for comparison is shown in (2)

\[
\frac{\text{actual} - \text{predicted}}{\text{predicted}} \times 100\%.
\] (2)

If the % difference is positive, then the “actual” is higher than “predicted”, by that % value, and if negative, the “actual” is lower than “predicted” by that % value. Most often you will also perform a percent difference analysis between predicted and actual. Sometimes, it will be appropriate to talk about the mean and/or standard deviation of your results.

- **Conclusions:** give technical conclusions. Restate the main objectives and how or to what degree they were achieved. What principles, laws and/or theory were validated by the analysis or design? Describe some applications of your results.

- **References:** properly cite references used for the work (textbooks, data books, web sites, etc.) using IEEE format – look at the guidelines included within this document.

- **Appendix:** include all hand calculations, full-page graphs and plots, additional PSpice and/or Matlab results if necessary, etc. Also, attach a copy of the assignment itself, assignment rubric and grading key.
D. **Design Report Format**

The following standard format is most frequently used for reporting on a paper and/or hardware design problem like in circuits, electronics, signals, controls courses.

- **Title page:** course number, name and section number; project name and number; author name; date performed, and the instructor’s name, with proper salutation, such as Dr. …, or Professor …..or Instructor. **See attached example.**

- **Introduction:** provide the background, motivation and objective(s) and include any design specifications and constraints. This section should also include figure(s), such as system level diagram, schematic, etc. Explain the basics of this system or schematic diagram. You can use subtitles, such as **Objective, Specifications or Constraints, etc.**

- **Theory:** describe the relevant theory and/or summarize derived equations – you need not show each and every equation that was derived and presented in your appendix – you only need to present key equations and give short explanation of the process to go from one equation to the next. You should use symbols that correspond to those found in the diagrams and schematics. You will need to provide these intermediate diagrams and schematics with these equations. The diagrams should have variables identical to the ones you have used in your equations!

- **Design:** With all equations described that were used to arrive at final design values, and with reference to equations used as presented in the theory sections, explain values arrived at for each key component (like resistor and capacitor values, inductors, selected digital-to-analog converter with key part specifications. If a software simulation tool such as Matlab or PSpice was used to help in arriving to particular values, explain how they were used, with reference to the code or simulation schematics and setting provided in your appendix.

In some cases a worst case analysis or Monte-Carlo analysis was used in the design process. This is the section that those procedures and results are to be described.

This section will often contain submodule or subcircuit descriptions as well as a description of the complete, or top-level, system.

- **Analysis & Specifications:** Once a final design is selected, a final analysis may need to be completed. From this analysis, a set of actual specifications for the design can be stated. In the design process nominal component values were selected. Hence, it is the responsibility of the designer to complete a final analysis (which is often already a byproduct of the design process) showing what the actual nominal performance values are for the design, along with statistical values, like worst case, etc. These performance values should
be placed into a table along with the target values as described in the original assignment. The table should always have a minimum of three columns “target” and “design” values, with third column comparing “design” to “target” values, often simply a percent difference analysis. Sometimes the design is implemented in hardware/software from which “actual” results can be recorded. In this case, the table should be expanded to include “actual” results, and an additional column comparing “actual” to “target”. The percent difference equation for comparison is shown in (3)

$$\frac{\text{design} - \text{target}}{\text{target}} \times 100\% \text{ or } \frac{\text{actual} - \text{target}}{\text{target}} \times 100\%.$$  \hspace{1cm} (3)

Sometimes, it will be appropriate to talk about the mean and/or standard deviation of your results.

This analysis and table establish the final specifications of the design, from which a set of data sheets are established and published along with the component and/or system when it is placed on the market.

- **Conclusions:** give technical conclusions. Restate the main objectives and/or target specifications, and how or to what degree they were achieved. Where/when appropriate, also describe some additional applications of your design.

- **References:** properly cite references used for the work (textbooks, data books, web sites, etc.) using IEEE format – look at the guidelines included within this document

- **Appendix:** include all hand calculations, full-page graphs and plots, additional PSpice and/or Matlab results, if necessary, etc. Also, attach a copy of the assignment itself, assignment rubric and grading key.
E. Essay Format

The following standard format is most frequently used for writing a short essay. It is quite often used for stating an opinion but one in which the opinion is substantiated by existing literature (evidence to substantiate your opinion or claim, i.e. thesis statement). The paper does not need to have subtitles for each section since it is a short paper, however, the general structure of the paper is given by:

- **Title page:** course number, name and section number; lab experiment name and number; author name; date performed, and the instructor’s name. Dr. …, or Professor … or Instructor

- **Thesis/Claim:** make a strong claim about the system or device for which you will then discuss details and give proof later in the paper. Claim should be direct/clear, not vague and ambiguous. This paragraph should have components that give the reader a clear understanding of the main subject within the paper, along with the claim/thesis statement.

- **System or device:** describe the system or device in sufficient technical detail – this part draws upon your knowledge of technical material that is the current subject of the course for which the essay is being written.

- **Proof:** explain the details of the claim and provide sufficient evidence from external sources that give support to your claim. Here is where IEEE style referencing is extremely important. Proof does not come from you but from current literature (unless of course you, the writer of the essay, generated actual data to support your claim).

- **Conclusions:** give technical conclusions about the system/device described as well as key claim-related conclusions (not an exact restatement of the Thesis paragraph, but one that is a bit more detailed perhaps but with essentially the same content.

- **References:** properly cite references used for the work (textbooks, data books, web sites, etc.) using IEEE format – look at the guidelines included within this document.

- **Appendix:** include portions of all reference material that were used to produce your essay. For example, you will need to make copies of pages from a book from which you drew your information. You must highlight sections of the material with a yellow highlighter. It is not a good idea to inundate your instructor with numerous pages of un-highlighted or overly-highlighted material in hopes to distract/deceive your instructor (make your instructor happy here).
Laboratory Experiment No. 3
Bipolar Junction Transistor Characteristics

Written by: Mary Student         Date Performed: 10/15/08
Lab Partner: John Doe            Lab Section 2, Tue. 9:00-11:50
Instructor: Dr. Smith, or Mr. Smith, or Professor Smith (use appropriate title)