Technical Writing Guide

Department of Electrical and Computer Engineering

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Chapter 1

Step by Step

This writing guide begins with a "HOWTO"[1] chapter that describes, step-by-step, how to create a lab notebook and lab report. The following chapters provide more verbose discussions on standards of the Department of Electrical and Computer Engineering (DFEC). The student is expected to read the entire document.

1.1 Lab Notebooks

Step 1: Obtain a lab notebook. For capstone courses, the standard DFEC lab notebook will be provided. For all other courses, it should be purchased. The standard lab notebook for DFEC is the National Brand Computation Notebook, model 43-648, 75 sheets, 4 x 4 Quad., 11 3/4" x 9 1/4". An alternative notebook is the Vela Workings Series - A Grid Notebook.. The lab notebook must be greater than Letter size (to allow pasting of entire pages), must be bound, page numbered, with grid lines on each page.

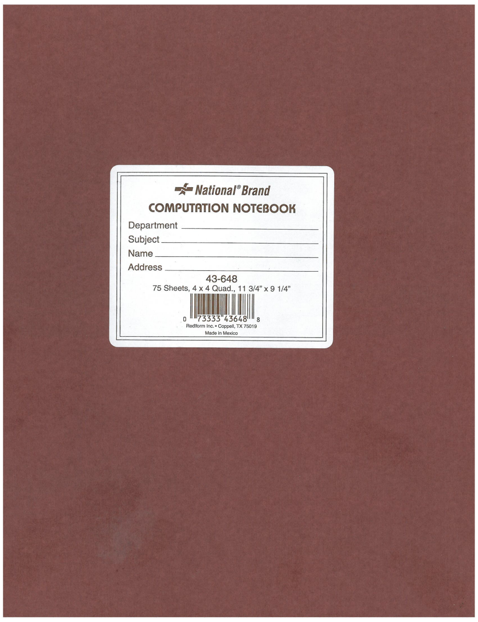


Figure 1.1: This is the cover of the Notebook.

[1] A "HOWTO" is a common word in the Linux community that describes a guide to performing certain tasks within the operating system. It is becoming common place to call a guide a "HOWTO".

Step 2: Label the cover of the notebook with the name, contact information, and subject matter. Place the date or time frame (semester) on the cover as well.

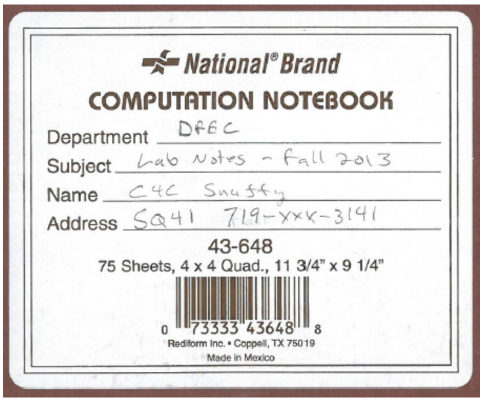
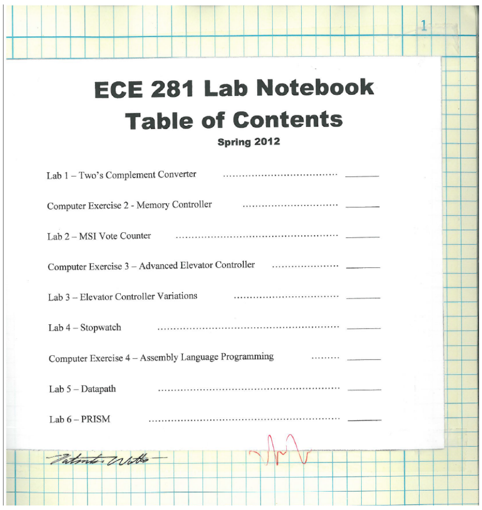


Figure 1.2: This is an example of a properly labeled lab notebook.

Step 3: Insert a Table of Contents. The Table of Contents may be provided by the instructor, if so, glue the page in. For all glued pages, sign the edge to be certain that no other party can remove/replace any inserts without evidence of tampering. If no Table of Contents is provided, reserve the 1st page (front and back) for a Table of Contents to be written in.



1

ECE 281 Lab Notebook

Table of Contents

Spring 2012

Lab 1 – Two's Complement Converter	
Computer Exercise 2 - Memory Controller	
Lab 2 – MSI Vote Counter	
Computer Exercise 3 – Advanced Elevator Controller	
Lab 3 – Elevator Controller Variations	
Lab 4 – Stopwatch	
Computer Exercise 4 – Assembly Language Programming	
Lab 5 – Datapath	
Lab 6 – PRISM	

Figure 1.3: This is an example of a Table of Contents from ECE281.

Step 4: Enter the objective of the lab. Write only in pen. Utilize multiple colors for better clarity. The appropriate objective for a lab notebook include the experimental objectives, not the learning objectives.

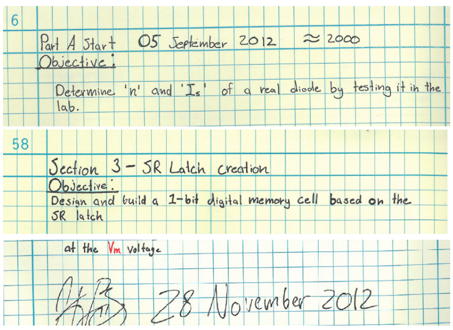


Figure 1.4: Shown here are two examples of objectives. Additionally, each page should be signed and dated as shown.

Step 5: Enter the theory behind the laboratory exercise. The theoretical entries should contain background knowledge to bring a colleage up-to-speed on the basic information needed to understand the lab. A design-based laboratory exercise will not require this section.

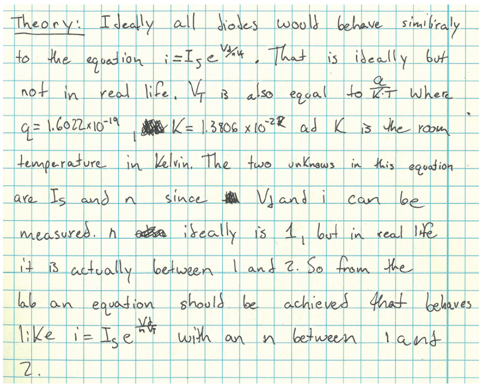
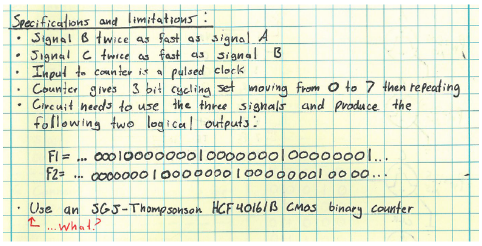

Theory: Ideally all diodes would behave similiraly to the equation $i = I_S e^{V_d/nV_T}$. That is ideally but not in real life. V_T is also equal to $\frac{q}{K \cdot T}$ where $q = 1.6022 \times 10^{-19}$, $K = 1.3806 \times 10^{-23}$ ad K is the room temperature in Kelvin. The two unknows in this equation are I_S and n since V_d and i can be measured. n ideally is 1, but in real life it is actually between 1 and 2. So from the lab an equation should be achieved that behaves like $i = I_S e^{\frac{V_d}{nV_T}}$ with an n between 1 and 2.

Figure 1.5: This is an example of a theory section of a lab notebook.

Step 6: Enter the specifications section[a] of the lab. This section can contain any design requirements as well as physical parameter limitations that may apply to the laboratory exercise.

[a]this section not needed for experimental exercises.


Specifications and limitations:

- Signal B twice as fast as signal A
- Signal C twice as fast as signal B
- Input to counter is a pulsed clock
- Counter gives 3 bit cycling set moving from 0 to 7 then repeating
- Circuit needs to use the three signals and produce the following two logical outputs:

F1 = ... 0001000000001000000001000000001...
F2= ... 0000000100000000100000000100 00...

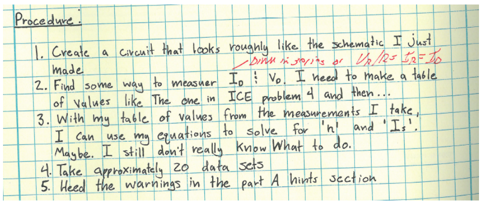
- Use an SGS-Thompsonson HCF40161B CMOS binary counter

...What?

Figure 1.6: Shown here is an example of the specifications for a design-oriented laboratory exercise.

Step 7: Enter the procedure section[a] of the laboratory exercise. The procedure should give an outline of the lab steps needed to achieve the experimental outcomes.

[a]this section not needed for design exercises.


Procedure:

1. Create a circuit that looks roughly like the schematic I just made
2. Find some way to measuer I_D & V_D. I need to make a table of values like The one in ICE problem 4 and then...

Diode in series or $V_R/R = I_R = I_D$

3. With my table of values from the measurements I take, I can use my equations to solve for 'n' and 'I_s'. Maybe. I still don't really know What to do.
4. Take approximately 20 data sets
5. Heed the warnings in the part A hints section

Figure 1.7: This shows the procedures section of a lab notebook.

Step 8: Enter the general approach[a] section of the laboratory exercise. This section describes the abstraction level that the lab is focused on to solve the problem or execute the experiment. Specifically, how was the problem or circuit broken into smaller parts. Simulations are not expected, but may circuit schematics may help.

[a]this section not needed for experimental exercises.

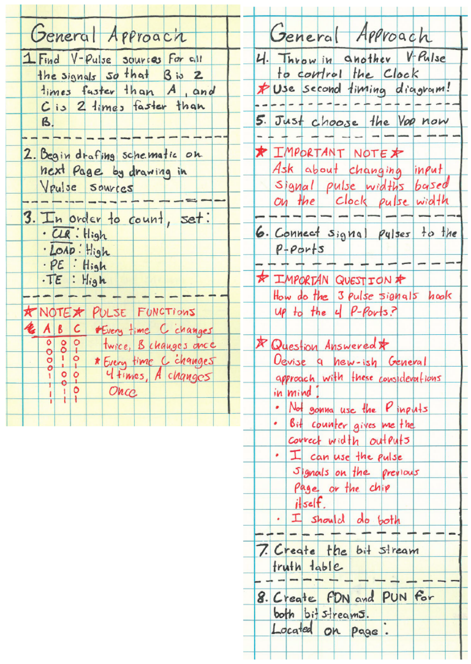


Figure 1.8: This shows the general approach section of a lab notebook.

Step 9: Enter the design section[a] of the lab. This section contains the design(s) that the student came up with to meet the specifications and requirements. It should contain schematics and/or code. The schematics should be of sufficient detail so that the student can construct the circuit in the lab.

[a]this section not needed for experimental exercises.

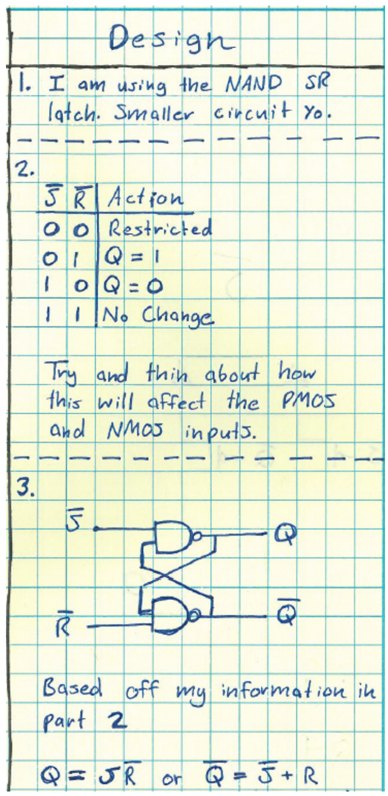


Figure 1.9: Shown here is an example of the design section of a lab notebook.

Step 10: Enter the implementation section[a] of the laboratory exercise. This section allows the student to place evidence, plans, and notes on the actual construction of the circuit in the lab. It should include part numbers and test equipment. Often a student will glue pictures or diagrams of the circuit implementation. In many cases, the instructor must sign off on demonstrations of implementation. Those signoffs can be done here, or on the grade sheet.

[a]this section not needed for design exercises.

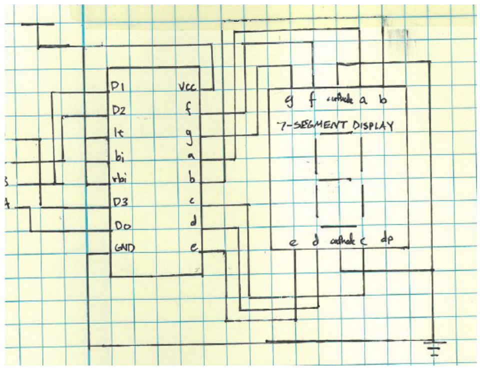


Figure 1.10: This shows the implementation section of a lab notebook.

Step 11: Enter the analysis section of the laboratory exercise. This section should discuss the data collected during the laboratory exercise. Specifically discuss how the data was the same or different than the predicted values. Discussion of the results of the test plan should be placed here.

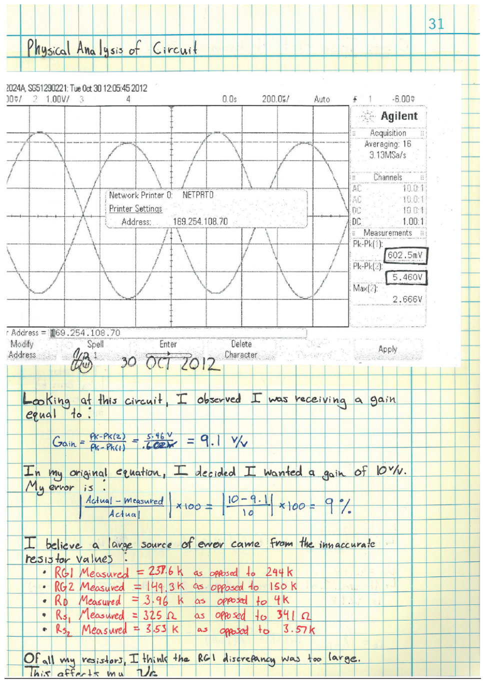


Figure 1.11: This shows an analysis section of a lab notebook.

Step 12: Enter the conclusion section of the lab notebook. This section is to record any conclusive observations or thoughts that will be further discussed in the lab report. Some classes use the lab notebook *as* a lab report, in this case, place a well-thought out paragraph that describes how the objectives were met. See Section 3.2.10 on page 14 for more.

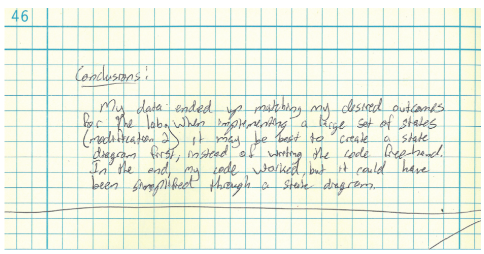


Figure 1.12: Shown here is an example of the conclusions in a lab notebook.

Chapter 2

Lab Notebooks

Lab notebooks are a legal record of the laboratory work performed during a design or experiment. Lab notebooks have numbered, bound pages, and for engineers, grid-lines. There are margins for annotations, but more importantly for signatures and dates. The lab notebook is not a scratchpad, nor should there many scratch-outs. In some classes, the use of the lab notebook is graded, and in others it is not. It is a highly recommended way to keep track of occurrences and in some cases "prove" the engineer did perform some design or experiment.

2.1 Purpose

The purpose of a lab notebook is to record activity. The activity to record may be data, or design ideas. The lab notebook should be the guiding document used by a third party to recreate your experiment or design. It can also be used in some courts of law to prove that an idea "belongs" to one engineer over another. In some classes, the lab notebook *is* the lab report.

2.2 Structure

The lab notebook structure is a subset of the structure of the lab report (see Chapter 3). The brand of lab notebook should be DFEC-approved, with bound pages that are numbered. Each page should have grid-lines. The book should be properly labeled in ink, with the name of the owner and the subject matter enclosed. In general, the lab notebook shall:

- Have a Table of Contents. Reserve two pages for a big design. Some of the notebooks have a Table of Contents already.
- Have notes only in pen. Use colored pens for clarity. This notebook is a permanent record of the work performed, as such, it should look professional.

- Have unused portions of the page "Z"-ed out. This is done to prevent anything from being added later on - perhaps without your permission.
- Have each page signed and dated. Sign and date each page as it is used. Do not sign/date after the fact. If you need to add something, annotate a later page as "Additional Notes for XXX."
- Have extra materials glued onto the page. Label anything you add (on the notebook paper) and sign the edges to ensure no additional material is removed or added without the permission of the author. When adding plots, label what is being plotted, and the source of the plot (SPICE, Oscilloscope, MATLAB.)
- Have errors lined through, with an explanation.

Reserve two pages for the Table of Contents of big design projects, one page for a class. Place individual lab assignments afte the the Table of Contents. Some laboratory efforts are experimental in nature, while others are design based. Each lab assignment should be structured as follows, with differences between the two types of laboratory activities noted:

- "Objective" see Section 3.2.2
- Experimental lab: "Theory" , Design lab: "Specifications and Limitations" see Section 3.2.4 and section 3.2.3
- Experimental lab: "Procedure", Design lab: "General Approach" see Section 3.2.5
- Design lab: "Design" see Section 3.2.7
- "Implementation" see Section 3.2.8
- "Analysis" [Optional] see Section 3.2.9
- "Conclusions" [Optional] see Section 3.2.10

The analysis and conclusions sections in the lab notebook can be used by the writer to make notes and observations that will lead to a proper understanding for the lab report. Some courses may use the lab notebook as a lab report, as such, these sections will not be optional.

2.3 Instructor's Intent

The instructor should use the lab notebook to asses the student's ability to perform experiments. While the lab report can assess the ability to communicate what happened in the lab, the lab notebook is a good reflection of the student's ability on laboratory techniques, specifically, recording data and procedures. The lab notebook also gives insight into debugging techniques and certain design skills, if annotated in the lab notebook.

Certain classes advocate that "thinking in the lab notebook" is important, and even graded. It has been interpreted, in the past, that it means to use the lab notebook as a scratchpad. That evidence of cognitive effort can be seen by the scratch-outs, ramblings, cartoons, and gibberish found in some student's lab notebooks. This is not true. Instructors look for serendipitous discovery in the lab notebook. "Thinking in the lab notebook" implies certain design paths were abandoned and new ones embarked upon. Evidence of those path changes should be evident in the lab notebook, but not documented as scratched out designs.

Each design iteration should be annotated as such. Along with every iteration, there should be a documented reason the student has chosen another path. This is beneficial to follow-on readers of the lab notebook, as it helps identify student pitfalls.

2.3.1 Expectations

The lab notebook can be used as a legal record. As such, DFEC expects white spaces to be "Z-ed" out with an initial and date. Any data in the lab notebook should be written in pen. Nothing should be scotch-taped. Glue is the only acceptable method as it ensures no alteration of the document to some degree. DFEC prefers the lab notebook be used to record data, not merely to hold taped/glued lab handouts for the lab exercise being undertaken.

There is some data that may be necessary in the lab notebook. Data that is not readily in the public doman. Because data sheets are readily available, the data sheet should be referenced, not pasted in. Procedures for the laboratory exercise *can* be pasted in. If a grade sheet is required by the course instructor, it can be included at the front of the laboratory exercise in that section of the laboratory notebook. Simulation results and schematics can be pasted in.

Chapter 3

Lab Reports

*Lab reports are the primary method to describe laboratory activity for DFEC.*Lab reports are formal documents that rely on data collected during the lab (and hopefully collected in a lab notebook), as well as pre-lab designs and calculations, to demonstrate extraction of information from the experiment (analysis) to arrive at a learning/lab objective. Lab reports are the standard way that activity, results, and learning objectives are evaluated in DFEC.

3.1 Purpose

The purpose of the lab report is to present, in a consolidated form, the purpose of the laboratory activity, the procedures planned and executed, the data collected, the analysis of the data, and the conclusions drawn. There are a number of lab activities that different courses in DFEC use.. In lower-level classes, a step-by-step laboratory exercise guides the student through elementary laboratory techniques and circuit construction. In higher level classes, the laboratories contain experimental elements as well as design elements. Because the higher level classes will not provide as much guidance to the student as the lower level classes, more description on the approach and procedures is necessary.

3.2 Structure

Table 3.1 describes the sections of the a lab report that are expected for experimental and design focused laboratory exercises. For a design project, a technical report is expected (see Chapter 4) for additional guidance. Each section of a laboratory report is meant to provide the reader the supportive structure to make the case for the learning objectives in the conclusions.

Experiment	Design Exercise	Design Project
Title Page	Title / Abstract	See Tech
Objective	Objective	Report
Theory	Specifications	
Procedure	General Approach	
Implementation	Design	
Analysis	Implementation	
Conclusions	Analysis	
Grade / Demo Page	Conclusions	
	Grade / Demo Page	

Table 3.1: Three different laboratory styles that may be used in DFEC. The associated required sections are listed.

3.2.1 Title Page

The title page provides a cover sheet for the formal document. It is critical the student's [1]name, assignment, class, section, academic year, course, and instructor's name are on the front. Do not place anything else on the cover sheet.

3.2.2 Objective

Every exercise in class has a learning objective and a experimental objective. The learning objective for an ECE281 Lab is shown in Fig. 3.1. Conversly, the experimental objective is listed as:

> You are to design, simulate, and build a two's complement converter. The input will be a 3-bit number in two'scomplement format and the output of your circuit will be the associated number after undergoing 2's complement negation.

The appropriate objective for the lab report are the experimental goals, in this case to design, simulate, build, and demonstrate a 2's complement converter.

3.2.3 Theory

This section contains background knowledge that brings a colleague up-to-speed on the equations, variables, general schematics, block diagrams that will be used in the laboratory exercise. Precise descriptions of *specific* behavior or goals of the design are specified here. Any predictions or expected behavior of some circuit or device is also included. This section contains theoretical analysis, answering the "how" question as it pertains to system operation. Graphical analysis from SPICE simulations, Electronic

[1]Avoid using possessives in papers - not sure that is written anywhere, but it seems to improve the prose.

Objectives

This lab will introduce you to the basic hardware and software used in digital design. You will practice combinational circuit minimization and design. You continue to learn how to model circuits in Xilinx ISE and how to wire and test integrated circuit (IC) chips. You will also practice basic debugging techniques.

Figure 3.1: The objectives for the Spring 2013 ECE281 Lab 1. Note these are learning objectives.

Design Automation software, MATLAB programs, equations, and proofs are placed in this section to support the student's predictions.

This section should also include background on how to verify the theory. Sufficient depth should be given to testing the assumptions that are contained in this section experimentally, as well as any real-world effects that may change the predicted results from measured results.

3.2.4 Specifications

Specifications provide scope to the laboratory exercise. Specific limits are listed, with emphasis on characterisitcs that make the design exercise particularly interesting. This section may be a table of design parameters, or could contain design topology specifics. For example, "Design a latch using only NAND gates," or "utilize only a +12V supply" would be instances of design parameters that need to be included. Much of this data should come from instructor direction. There may be cases, for a design exercise, where specifications may be self-generated.

3.2.5 Procedure

The procedure section contains an ordered list of the steps that will be followed to complete the laboratory exercise. In lower level classes, these may be descriptive step-by-step instructions that walk you through every aspect of the lab. In upper level classes, these may be partially generated by the student to guide data collection and problem solving iteration. This section may also contain circuits, simulations, and calculations that show the reader measuring points, expected values, and possibly data collection tables.

3.2.6 General Approach

The general approach will only be used for design exercises. This section defines the abstraction structure you have chosen to use to solve the design problem. How was the problem broken into smaller parts. What design methodology was used for each of the smaller problems that arose. Simulations are not expected in this section. The writer may need to specify how to test/measure if the problem that is being solved is actually solved.

3.2.7 Design

This section contains both the details of your design and design methodology. While this section may contain mostly circuit schematics, it should also contain any supporting design calculations that were required to complete the design. It should also contain simulations that show the design works. The end of this section should contain ready-to-build schematics of the circuit or program that a colleague could use to build the design.

3.2.8 Implementation

Include evidence and a record of the circuit implementation. This could include pictures, protoboard diagrams, part numbers, any issues that caused unpredicted problems, and any design changes that were made. A reference to power supplies, power consumption, test equipment, and lab space can be made here. The purpose of this section is to show you did the implementation, but also to show you have sufficient documentation that would allow some third party to build your circuit to the same performance specifications.

3.2.9 Analysis

This section details the measured results of the test plan. The test plan verifies (or does not verify) the circuit achieved the stated goals or behaved as predicted. This section should have data tables or plots of data that support the argument for the design or experiment. This section may be iterative. If a problem was found in design, it is in this section the debug procedure is detailed, and the fix implemented and retested. There may be several iterations of this section.

3.2.10 Conclusions

The conclusion section can be confusing for the writer (and reader). In this section, do not confuse learning objective conclusions with experimental (or design) conclusions. The conclusion should include a restatement of the original problem. A summary of the approach/procedures should then be included. A summary of the implementation, analysis, and testing should lead the reader, to the final conclusions. The final conclusions should address the predicted behavior versus measured behavior, as well differences seen in simulations and circuit operation. There should be a sufficient link from the theory section that allows the basis for the conclusion.

3.2.11 Comments / Prologue

This section may be added for the writer to address learning objectives. The student may comment on the learning objectives, and any particular difficulty the student had with equipment, software, parts, or procedures. The student may also add the documentation statement here. This section is normally not graded, but provides the instructor clues on better laboratory exercise experiential design.

3.2.12 Backmatter

Because these are formal laboratory reports, there may be additional sections. We call these sections “backmatter.” These include additional tables, ~~perhaps in~~ an appendix, a glossary, a bibiliography, or any additional supporting material. A technical report should have an index for fast reference by the gaining capstone/499 group. If the lab report has gone through a number of iterations/reviews, include hard copies of the reviews in this section (if directed).

3.2.13 Grade Sheet / Demonstration Page

Place the instructor-directed demonstration page with grader sheet as the last page of the report. If the grade sheet is not provided, create one with your name, class, section, academic year, course, along with spaces to record any demonstrated items. The instructor should provide the grading criteria. If so, provide a space for the instructor to annotate grades/feedback. If the report is being composed electronically, a scanned copy of the demonstration sheet should be provided if time constraints do not allow physical turn-in.

3.3 Iteration

Iteration on the lab report is essential to producing a good account of laboratory exercises. The instructor may mandate this iterative approach is used. The instructor should provide iterative grade sheets for each version which contain feedback scores. In some cases, feedback may be provided by mentoring faculty. In others it may come from colleagues.

3.4 Instructor’s Intent

The primary purpose of the laboratory report is to account for the activities of the student in the lab and to demonstrate the learning objectives. While the pedagogical goals of the laboratory do not always specify effective written communication, it should evaluated and assessed with each laboratory assignment. Attention should be paid to the mechanics of writing. For classes without iteration built-in, the instructor should refuse laboratory reports that do not adhere to the standard specified here (or supplemented by the assignment) and contain minor errors that would have be captured by proper iteration. Alternatively, writing mechanics grade could be used to capture and assess the level of writing that is present in the report.

3.4.1 Expectations

Lab reports will adhere to the sections outlined above. While it is possible for some students to provide handwritten reports, it is discouraged. A laboratory report is a formal document that should be typeset. Figures should be drawn using Visio, Inkscape, Powerpoint, or any appropriate electronic drawing package that can draw vector graphics. The Comic Sans font will not be used. Pages will be numbered, and an appropriate header and footer will be utilized for page numbers and section.

Chapter 4

Technical Reports

4.1 Purpose

Technical reports convey information obtained over the course of an in-depth investigation. These types of reports can be a culminating document for DFEC capstone courses, or for 499-level courses that are independent study. Technical reports communicate designs, operating procedures, tests, test results, and directions for further work. Because technical reports will be referenced not only by the faculty but other students, the scope and audience for technical reports must be carefully considered.

4.2 Structure

4.2.1 Title / Abstract / Documentation Page

This gives the reader an overview of your entire report. It should be single-spaced and relatively short. The writer's intent is to give the user a quick synopsis of the work, including conclusions reached. Whether you include the abstract or not depends upon the course and instructor. The abstract should be fewer than 200 words, depending on the limitations specified by the journal, conference, or instructor.

4.2.2 Table of Contents

Use the automated Table of Contents generation tools in Microsoft Word or LaTeX(see Figure 4.1.) This will ensure changes made throughout editing are updated automatically. This will also standardize the Table of Contents that will be used throughout your time in the department.

Contents

Figure 4.1: An example of a Table of Contents.

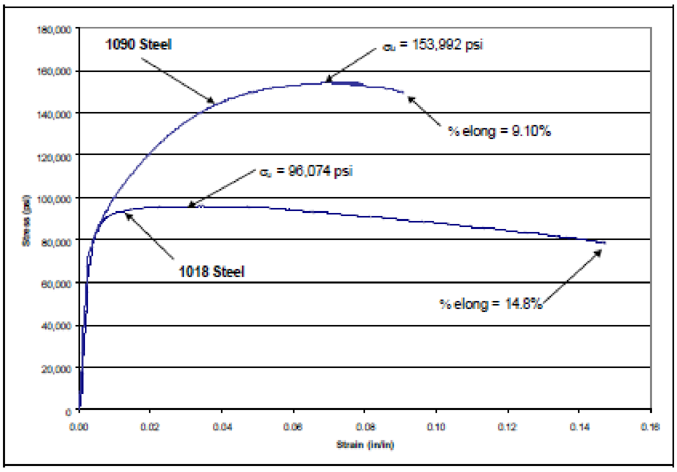


Figure 4.2: An example of a Figure. The caption should be concise, but explanatory.

4.2.3 List of Figures

Each Figure should have a title and a reference number. The titles in the List of Figures should match the ones on the actual figure. Titles should appear below the figure, center justified. The figure should be referenced contextually. For example: "Fig. 4.2 is an example of a figure in a document." The reference could also be performed parenthetically: "(see Fig 4.2)" as an example of this technique.

4.2.4 List of Tables

Each table should have a succinct title and reference number. Again, the titles should match. Titles should appear below the table, center justified.[1]Utilize the cross-referencing features of Microsoft Word or LaTeXto insure that page, reference, and titles do not get

[1]Some publications prefer table captions to be above table.

k	x_1^k	x_2^k	x_3^k	remarks
0	-0.3	0.6	0.7	
1	0.47102965	0.04883157	-0.53345964	*
2	0.49988691	0.00228830	-0.52246185	s_3
3	0.49999976	0.00005380	-0.52365600	
4	0.5	0.00000307	-0.52359743	$\epsilon < 10^{-5}$
7	0.5	0	-0.52359878	$\epsilon < \xi$

Table 4.1: This is an example of a table [3].

confused during editing. See Table 4.1 as an example.

4.2.5 List of Symbols and Abbreviations

Every report should address acronyms, symbols, and any reference symbols the reader may not readily know.

4.2.6 The Report

This section will have an introduction, conclusion, and the supporting paragraphs that provide the reader a clear path between the two. The introduction should be structured around getting the intended audience to understand the writer's perspective, the problem being addressed, the purpose of the report, thereby motivating the reader to proceed. The conclusion should bring the reader around to the point of view of the writer, based upon the evidence presented. Clear and concise, the conclusion is the best place to make final arguments to the reader. In between, the writer should craft the supporting paragraphs that provide the reader with the evidence, measurements, and techniques that led the writer to the conclusion presented.

4.2.7 Bibliography

Use a bibliography tool to reference your material. Bibtex, used with LaTeX, is superior. Microsoft Word can also do references. Be sure to use the automated tools to prevent edits from citing the incorrect sources.

4.2.8 Appendices

The appendices should contain supporting documentation the reader can use to justify or duplicate the work in the paper. This may include actual reference material - if that material is difficult to obtain. Additionally, the appendices may contain specifics or details that would have cluttered the main body of the report.

4.3 Iteration

The technical report will have multiple iterations. In each course that requires a technical report, drafts and or versions of the document will be submitted during the composition process. Care must be taken to annotate the document with the version number and date this document represents. Annotations of corrections and changes can be made using MS Word (Track Changes) or Adobe. Alternatively, hand corrections can be scanned in and retained for future reference. Typically, hand corrections will use proofreading symbols (see Fig. 4.3) and abbreviations (see Fig. 4.4).

4.4 Instructor's Intent

The pedagogical goals go beyond the content of the technical report. The instructor is looking beyond a record of work done, assessment of data collected and conclusions gained from said work. The instructor is looking to confirm 1) adherence to writing standards, 2) ability to thematically organize a technical document, and 3) ascert and argue for any conclusions or learning objectives gained through the exercise.

Adherence to writing standards can be measured by the use of templates, guides, and standards as provided by the instructor. Lack of evidence of iteration (drafts, corrections, etc.) is just as egregious as failing to turn in the document. Thematic composition is a subject not normally graded in Engineering courses. Graduates are required to be able to communicate effectively [6], and as such, *written communication will be graded with as much weight as the content.* The instructor will look for the ability of the student to create support paragraphs that provide a logical course of arguments that lead to the conclusion.

The tertiary goal will be the student's opportunity to demonstrate the learning objectives of the exercise. Clearly, if the learning objectives are not met by the student, it will be most evident in evaluation of this goal. This particular pedagogical goal should be an important part of the feedback/revision step for the student. It is at this step any foundational errors or omissions can be noticed and rectified before the final submission. Often, feedback during this step results in a collection of additional data as well as changes in other supporting parts of the document.

Symbol	Meaning	Example
or or	delete	take ~~it~~ out
	close up	print as o ne word
	delete and close up	clo~~s~~se up
∧ or > or	caret	insert here (something
#	insert a space	put onehere
eq#	space evenly	space evenly where indicated
stet	let stand	let marked ~~text~~ stand as set
tr	transpose	change order the
/	used to separate two or more marks and often as a concluding stroke at the end of an insertion	
[	set farther to the left	too far to the right
]	set farther to the right	too far to the left
	set as ligature (such as)	encyclopaedia
	align horizontally	alignment
‖	align vertically	align with surrounding text
x	broken character	imperfect
□	indent or insert em quad space	
¶	begin a new paragraph	
(sp)	spell out	set 5 lbs as five pounds
cap	set in CAPITALS	set nato as NATO
sm cap or s.c.	set in SMALL CAPITALS	set signal as SIGNAL
lc	set in lowercase	set South as south
ital	set in *italic*	set oeuvre as *oeuvre*
rom	set in roman	set *mensch* as mensch
bf	set in **boldface**	set important as **important**
= or -/ or or /H/	hyphen	multi-colored
or en or /N/	en dash	1965–72
or em or /M/	em (or long) dash	Now—at last!—we know.
∨	superscript or superior	as in πr^2
∧	subscript or inferior	as in $H_2 0$
or	centered	for a centered dot in $p \cdot q$
	comma	
	apostrophe	
⊙	period	
; or ;/	semicolon	
: or	colon	
or	quotation marks	
(/)	parentheses	
[/]	brackets	
OK/?	query to author: has this been set as intended?	
or [1]	push down a work-up	an unintended mark
[1]	turn over an inverted letter	inverted
wf [1]	wrong font	wrong size or style

Figure 4.3: Proofreading symbols to be used by faculty and students for feedback [4].

Abbreviation	Meaning	Example
Ab	a faulty abbreviation	She had earned a Phd along with her M.D.
Agr See also P/A and S/V	agreement problem: subject/verb *or* pronoun/antecedent	The piano as well as the guitar need tuning. The student lost their book.
Awk	awkward expression or construction	The storm had the effect of causing millions of dollars in damage.
Cap	faulty capitalization	We spent the Fall in Southern spain.
CS	comma splice	Raoul tried his best, this time that wasn't good enough
DICT	faulty diction	Due to the fact that we were wondering as to whether it would rain, we stayed home.
Dgl	dangling construction	Working harder than ever, this job proved to be too much for him to handle.
- ed	problem with final -*ed*	Last summer he walk all the way to Birmingham.
Frag	fragment	Depending on the amount of snow we get this winter and whether the towns buy new trucks.
||	problem in parallel form	My income is bigger than my wife.
P/A	pronoun/antecedent agreement	A student in accounting would be wise to see their advisor this month.
Pron	problem with pronoun	My aunt and my mother have wrecked her car The committee has lost their chance to change things. You'll have to do this on one's own time.
Rep	unnecessary repetition	The car was blue in color.
R-O	run-on sentence	Raoul tried his best this time that wasn't good enough.
Sp	spelling error	This sentence is flaude with two mispellings.
- s	problem with final -*s*	He wonder what these teacher think of him.
STET	Let it stand	The proofreader uses this Latin term to indicate that proofreading marks calling for a change should be ignored and the text as originally written should be "let stand."
S/V	subject/verb agreement	The problem with these cities are leadership.
T	verb tense problem	He comes into the room, and he pulled his gun.
Wdy	wordy	Seldom have we perused a document so verbose, so ostentatious in phrasing, so burdened with too many words.
WW	wrong word	What affect did the movie have on Sheila? She tried to hard to analyze its conclusion.

Figure 4.4: Abbreviations that may be useful to the faculty or student. [5]

Chapter 5

Research Papers

Research papers can be assigned by any course. In particular, ECE 485, Computer Architecture, has a culminating research paper that involves mulitple iteration steps. This chapter will discuss the standards for research papers in DFEC.

5.1 Purpose

The purpose of a research paper could be to:

- Submit a paper for publication.
- Fulfill the requirements for a class assignment..
- Report on student or faculty led research efforts.

The primary difference between a research paper and a technical report is the audience. For a research paper, the student is tasked with learning, in depth, a specific subject. The *inform* part of the writing goal is the highest one here. The research paper brings together disparate sources of information that culminates with an assessment of the state of the art, or determines from the combination of sources, new (or new to the reader) information on a subject matter.

The writer may need to *persuade* the reader to a certain view on the subject matter. In fact, if there is no persuasion involved, the research paper can be cognitively "empty." The writer is encouraged to find juxtaposition-ed view points in the literature that allow for comparison and in-depth investigation.

5.2 Structure

Whether for publication or for pedagogical goals, research papers in DFEC will use the IEEE transactions and journal template and style guide. The style guide can be found at the IEEE transaction website[8].

5.3 Instructor's Intent

The intent of the research paper is to prepare the student to produce publication quality documents. Every attempt should be made to persuade the students to use a typesetting program (like LaTeX) instead of Microsoft Word. Multiple iterations are expected for a research paper, and it is the goal of DFEC to simulate the advisor review process for research papers. For ECE 485, the instructor assigns a mentor. The paper goes through several iterations with the guidance and feedback of the mentor. It is during this iterative process the student truly captures the important aspects of research writing.

5.3.1 Expectations

Students tend to place filler in research papers. The instructor / evaluator should keep a keen eye out for sentences that do not add to the logical structure of the paper. Each sentence should be thoughtfully connected to the paragraph in which it resides. Research papers tend to be limited by page count, with the writer struggling to fit all the information in. Research papers are an exercise in conciseness. An excellent book for learning about conciseness is [7].

Chapter 6

Essays

Essays are more free form expositions on a single, limited topic. They can be found in a number of courses in DFEC for example, the student may be tasked to write an essay on ethics. The writing standards espoused in this document still apply.

6.1 Purpose

A typical essay involves persuasion. Either the writer intends to persuade an argument to the reader, or to persuade, effectively, that the opinion of the writer has been well thought out. The writer must make a significant effort to craft an organized document in limited space that conveys that message.

6.2 Structure

An essay should have an introduction, supporting paragraphs, and conclusion. Because essays can vary in length, the conclusion and introduction could be multiple paragraphs. The writer must take into account the audience (for DFEC we assume a colleague) to craft the introduction, such that the reader can follow the remaining part of the essay to the conclusion. The conclusion should not need to summarize much, but actually stitch together the supporting ideas to make the case the writer has in mind.

The mechanics and composition of writing come into play with essays greater than the other vehicles discussed so far. The essay is free form, but must be managed logically. The composition process must be adhered to, as well as proper mechanics, to ensure that a coherent conclusion is reached. Purdue has an excellent online writing guide that can be found at owl.english.purdue.edu.

6.3 Instructor's Intent

The DFEC instructor can use the essay for a short-assignment assessment of the writing skills of a student. The essay could be an ethics assignment, or simply a portion of a quiz that evaluates the knowledge level of a particular subject. The astute instructor will look for short essay answers that are fragments and are unorganized. The wise student should be wary to write without even a bit of forethought to the logical order of prose.

6.3.1 Expectations

The expectations for an essay are simple: an introduction, supporting paragraphs, and a concluding paragraph that ties the others together.

Chapter 7

Writing Guidance

7.1 Introduction

Technical writing is one of the most challenging tasks for an engineer. Even though an engineer may design a great microprocessor, solve a tough problem, or even create original research, his/her inability to properly communicate those events may make the achievements moot. This technical writing guide is representative of the style, format, composition, and structure that the Department of Electrical and Computer Engineering (DFEC) prefers. It is by no means the final word on style. Variations to this guide are acceptable and expected.

This document should provide to both the student, and the faculty a baseline example of the type of formatting, composition, and structure to convey technical ideas and experimental results. In particular, the student and faculty member will be provided with rudimentary guides to several formats of written communication used in the Department of Electrical and Computer Engineering (DFEC). These media include lab reports, lab notebooks, essays, and research papers. These guides convey standards either party can use to create and give feedback on effective written communication.

7.2 Mechanics of Writing

There are two ways to look at the writing process: mechanics and composition. The mechanics of writing includes the following: margins, fonts, paper size, and to some extent, the structural format of a document. Sentence structure and grammar play a critical role in the standardization process. Care should be taken to adhere to (by both faculty and student) existing academic standards of excellence. While these standards can be evasive outside of DFEC, this guide provides a set of standards that a member of DFEC (student or faculty) can assume, in lieu of any additional course or assignment specifications. *Assignments will be graded against the standards in this guide.*

7.3 Composition

Composition involves the use of language to present a basic idea to the reader. It is written communication. Composition implies that the ideas communicated come from various sources that, when brought together, bring forth a new perspective, born of the foundations from which it originated. Haphazard writing is quite evident to even the most immature reader.

> Successful writing ... is not the product of inspiration, nor is it merely the spoken word converted to print; it is the result of knowing how to structure information using both words and design to achieve an intended purpose.[1]

Each sentence is a logical collection of language constructs. Subject, verb, and object are the basics supporting clauses provide clarification without hindering conciseness. A paragraph is theme-based, providing a single cogent idea (or argument) that is supported by a collection of sentences. Rather, each document is a collection of paragraphs. These themes are not abrupt nor robotic. These themes are supported by an introduction, a summary, and a conclusion. All of the constructs of composition are designed to communicate to the the reader new ideas, experimental results, and illumination of the writer's perspective. Composition flows in steps:

1. Preparation
2. Research
3. Organization
4. Writing a draft
5. Revision

7.3.1 Preparation

The most important part of the composition process is the *preparation*. The goals to achieve in the preparation stage are: 1) define the purpose, 2) define the audience, 3) determine the scope, and 4) select the appropriate medium. A methodical approach to writing is essential for maintaining a sense of coherence and to bind the author's prose to the purpose of reader understanding.

For DFEC, the student can assume the purpose of a technical composition is to describe experimental results, knowledge gained, and actions taken during the course of an assignment or laboratory exercise. In general, there may be an "assigned purpose" that supersedes the pedagogical goals. For instance, the assignment may be to "describe the contemporary issues that have arisen due to the increased use of unmanned aerial vehicles," whereas the pedagogical goals may be to "demonstrate the ability to effectively research, communicate, and advocate in written form." Clearly, a certain level of pluralism is required on the composer's part to achieve both requirements. The student (and faculty) should keep both objectives in mind when composing and evaluating technical writing.

The intended audience for a technical report may vary by instructor and course. For the purposes of a typical assignment, the writer can assume a colleague. In this case, another student with a similar background is the intended audience. This will be different for presentations or papers intended for conferences and other external venues. The careful composer will also note the audience may vary in the time domain. That is, while one should write based on the current audience, one should also anticipate what a reader at least 10 years from now may need to know to understand the context. Therefore, it may be necessary to develop, for the reader, the current state of the art of the subject matter under discussion.

Scope merely implies the variation in what will be included and not included in the document. Scope is closely tied to the audience and purpose. Identify the scope of the composition in order to avoid losing the reader with useless information or overwhelming the reader with too many assumptions.

The media of choice for technical writing may seem limited, but this would be a misconception. The media possibilities include (and are not limited to): 1) email, 2) web site, 3) blog, 4), lab notebook, 5) journal article, 6) technical report, or 7) operating manual. Each of these venues requires a different amount of preparation and scope. Based on the medium chosen, the assumptions about scope and audience will change. The reader should think of media and scope as forming a nexus of *expectation*. The prospective writer should ask,"What does the reader expect from this composition?" This juxtaposition of the writer as reader is critical to creating useful written communication.

7.3.2 Research

It is critical to do background investigation into the subject matter of the composition. For a typical laboratory report, the textbook, lecture notes, and course handouts may be sufficient to provide the background. The more formal document will require investigation into the subject matter to more directly plan the composition of the paper.

Because of the nature of the academic environment at the United States Air Force Academy, documentation of sources is critical. Carefully think about using figures, pictures, charts, or other imagery in reports. If done, they must be explicitly referenced and given proper attribution. It is not only appropriate academically, but a key part of the Honor system.

Using words from other sources without quoting is forbidden. The author should use their own writing to get the message across. It will be obvious to the reader when a certain style has changed (active voice/1st person) . It is much better to introduce the idea, provide a quote and a citation, than to try to paraphrase the idea and pass it off as originating from the author.

7.3.3 Organization

The objective of written communication must be supported by organized themes. The general form of written communication includes introductory material, supporting arguments in the form of data and/or research, and summarizing and/or concluding remarks. In subsequent chapters, specifics will be provided that guide the writer (and faculty) towards the expected organization of several examples of classroom assignments. In the absence of an agreed upon format (in some cases a template is provided), the writer should focus on effective communication, instead of merely fulfilling a page count requirement. It is poor practice to assign word count and page count requirements. The writer and faculty should have depth and breadth requirements that detail the number of ideas, themes, comparisons, and even sources that are expected to be used during fulfillment of an assignment. In-depth requirements like these tend to enforce deep learning goals that are more significant than a page count.

This document is in the format of a technical report. It contains introductory material that introduces the purpose of the document. It contains supporting ideas and instruction. It also has summarizing components that bring emphasis to the key ideas of the material. See Chapter 4 on page 17 for a formal definition of the sections and organization of this document.

7.3.4 Draft

Writing a technical document requires a number of iterations. Before the document is final, it should be clearly labeled/marked as a draft. In the case of lab notebooks, they are considered less formal, and as such, correction and modifications to the contents should be performed, initialed, and dated. At least three iterations of a document are usually needed to produce a quality submission. An instructor may make the drafts a required turn-in item. If so, be sure to annotate the version of the draft on the document. It would be a best practice to require classmates to formally review reports of colleague, with their comments receiving grades as well. This ensures robust feedback and provides additional avenues for feedback concerning writing composition, organization, and style.

7.3.5 Revision

Track the versions of a technical report. This can be done with"Track Changes" in Microsoft Word, or with the available DFEC Team Foundation Server, as well as more stable methods such as a Git repository or a subversion repository. If using version control software proves to be too daunting, save the work periodically. That is, save a copy with the date and time annexed to the file name. This can be a great help with large deletions and additions of text and/or graphs. You should use the same diligence with the creation of graphics and charts.

7.4 Syntax

Writing requires adherence to rules. In particular, if the chosen document language is English, adhere to the syntax and structure of that language. There are an innumerable number of references for the language. See the reference on page 37 for a recommended book that can assist the author during writing. Perhaps the best reference is faculty guidance and feedback. However, faculty feedback comes with the cost of a lower grade. This book [2] is an excellent guide to the syntax of the English language and can greatly assist the student in mastering syntax in a composition. See the library, or a suitable writing tutorial center[1] for additional references.

7.5 Conclusions

Ultimately, the document created reflects the amount of work the author has put into the project or lab. The writer's job is to communicate to the reader an idea. The writer must support the idea and must justify that position through evidence, research, and logic. At the end of the document, the author should pose the argument made, using the evidence presented, and defend the position that was presented. The conclusion is just that, not a summary!

[1] The United States Air Force Academy has a "Writing Center" that is the subject matter expert for all questions related to composition, structure and style.

Appendix A

Examples

A.1 Lab Reports

Index

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