ECE ILLINOIS

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Preparing Your Final Report for ECE 445, Senior Design

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Writing as Leadership

Writing apps have gotten very good

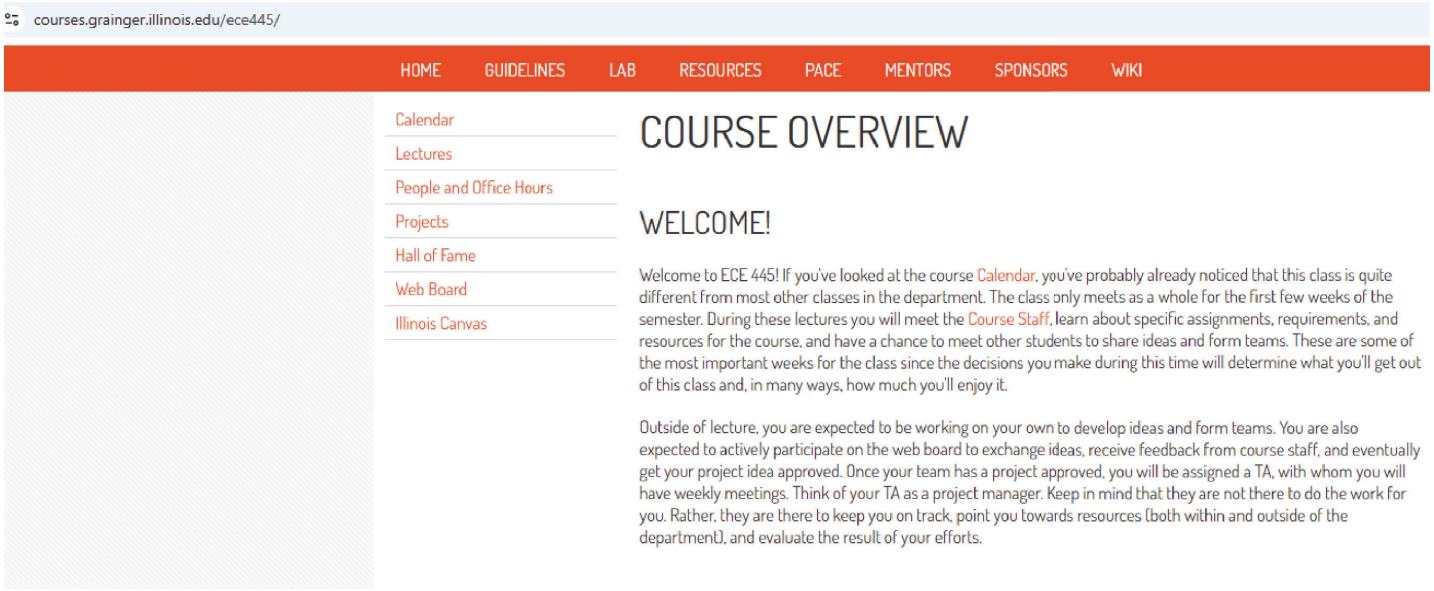
Personal writing performance has plummeted

Average sixth grade student in 1986 in mid-ranked state would be equal to a community college FRESHMAN in 2024.

Employers and institutions are looking for leaders, not doers

It's about the process …

Course Page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HOME
GUIDELINES
LAB
RESOURCES
PACE
MENTORS
SPONSORS
WIKI
Calendar
Lectures
People and Office Hours
Projects
Hall of Fame
Web Board
Illinois Canvas
COURSE OVERVIEW
WELCOME!
Welcome to ECE 445! If you've looked at the course Calendar, you've probably already noticed that this class is quite different from most other classes in the department. The class only meets as a whole for the first few weeks of the semester. During these lectures you will meet the Course Staff, learn about specific assignments, requirements, and resources for the course, and have a chance to meet other students to share ideas and form teams. These are some of the most important weeks for the class since the decisions you make during this time will determine what you'll get out of this class and, in many ways, how much you'll enjoy it.
Outside of lecture, you are expected to be working on your own to develop ideas and form teams. You are also expected to actively participate on the web board to exchange ideas, receive feedback from course staff, and eventually get your project idea approved. Once your team has a project approved, you will be assigned a TA, with whom you will have weekly meetings. Think of your TA as a project manager. Keep in mind that they are not there to do the work for you. Rather, they are there to keep you on track, point you towards resources (both within and outside of the department), and evaluate the result of your efforts.

Resources on ECE 445 Web Site

- Home➔Guidelines➔ Assignments and Grading➔Final Report
  - "Preparing Your Final Report for ECE 445" (final report guidelines)
  - Word Template (also LaTeX)
  - Other resources

Proposal Rubric

Team # _____

Proposal Evaluation Sheet

Introduction: 5 points	**Max Score**		**Min Score**
Problem	**(1) –** Clearly defined problem statement and justification of problem	**(0) –** Problem statement unclear or justification missing	
Solution, Visual Aid	**(1) –** Concise description of solution and how it will solve the problem. Visual aid shows how solution is used in context	**(0) –** Unclear description of solution or visual aid lacking detail	
High-level Requirements	**(3) –** Three clear, comprehensive, and quantitative (where applicable) reqs.	**(1) –** one requirment unclear or missing	**(0) –** more than one requirement unclear or missing

Design: 13 points	**Max Score**		**Min Score**
Block Diagram (+ mechanical drawings, if applicable)	**(3) –** complete and detailed, labelling supply voltages, data protocols, with logically separated subsystems	**(1) –** lacking important detail, or missing components	**(0) –** lacking multiple important details or missing subsystems
Subsystem Overview	**(4) –** description of purpose of subsystems and their components, including interaction with other subsystems	**(2) –** one subsystem description lacking important details	**(0) –** multiple subsystems unclear or lacking detail
Subsystem Requirements	**(3) –** comprehensive list of reqs that are qualitative and testable. Should not include specifications for off-the-shelf components. See R&V page on site.	**(2) –** missing one req necessary for subsystem function or includes component specs	**(0) –** most subsystem reqs incomplete or inappropriate
Tolerance Analysis	**(3) –** feasibility of a critical subsystem function proven through mathematical analysis or simulation	**(1) –** analysis unsound or fails to demonstrate feasibility of subsystem	**(0) –** missing tolerance analysis

Ethics & Safety: 3 points	**Max Score**		**Min Score**
Considers all ethical issues specific to project Explains how the project and design process address these ethical issues References appropriate ethics code (no plagiarism)	**(3) –** includes all elements	**(2) –** one incomplete or missing element	**(0) –** three or more missing elements

Final Report

FINAL REPORT

VIDEO LECTURE

Video, Slides

DESCRIPTION:

The Final Report Guidelines are the primary reference document for this assignment.

REQUIREMENTS AND GRADING:

The Final Report is held to professional standards of language and format and is evaluated by staff in the ECE Editorial Services, who also check theses and dissertations for the department. The report is also evaluated for technical content and organization by the course staff. The *Grading Rubrics* are available for both English/Formatting and Technical Content , but here are some pointers:

1. If you didn't click the link above, the Final Report Guidelines should be your first stop.
2. Use a template to help get the formatting right (Microsoft Word template or LaTeX template).
3. Since your Final Report is similar in purpose to a thesis, you may find the Thesis Writing Guidelines helpful for style and formatting.
4. For citations, you may also find the IEEE Citation Reference guide useful.
5. Please note the maximum number of pages (20) allowed for the final report. This does not include your references or appendices. **You will be penalized for going over the maximum number of pages and/or not following the prescribed format.**

PREPARING YOUR FINAL REPORT FOR ECE 445, SENIOR DESIGN

By

Professor P. Scott Carney, ECE 445 Course Director

Jamie Hutchinson, ECE Publications Editor

And the ECE 445 Staff

March 2012

Abstract

This guide exemplifies and explains the preparation of final reports for ECE 445 (Senior Design), from formatting and organization to writing style. While this document is generated from the template "ECE 445 Template.dotx" (downloadable from the ECE 445 web site), the format and style requirements outlined are independent of any software or template. LaTeX, OpenOffice, and other packages can produce the required results—provided the user has the necessary skill.

Contents

1. Introduction

The final report presents your project at the demonstration stage. You need to describe the motivation for the project: either a problem to be solved or a goal to be achieved. Relate your solution to that problem in broad terms and then describe in detail the specific design. Write to an imagined audience of company managers who are knowledgeable in your field. They need to see that your design is reliable, economical, and thoroughly tested to meet the specifications in your proposal. If you appear not to understand the engineering principles of your work, have left out important tests, or try to cover with a "sales pitch," your efforts will not impress them. Write as concisely as you can while conveying the necessary information.

Each member of the project team contributes a proportional share of the actual written material. All reports must be submitted electronically as Word or PDF (LaTeX users should not submit .tex files). Reports will be graded for language and format by the ECE Publications Office staff who review ECE MS and PhD theses, and for technical adequacy by your instructor.

The report must receive a passing grade for you to pass the course. Rewrites are allowed until a passing grade is achieved, but once passed, rewritten reports will not be accepted for grade improvement.

This guide describes all the components of a successful final report. Chapter 2 introduces the most reliable outline for your subject matter, along with some possible variations. Chapter 3 specifies the final report format. Chapter 4 addresses the main points of good technical style for writing, and Chapter 5 covers the all-important topic of figures and tables. Chapter 6 offers final words of advice and points to further resources for authors. Appendices A and B contain, respectively, a guide to symbols and abbreviations, and a handy checklist.

2. Outline of Subject Matter

2.1 Introduction

Briefly review and update the material from your proposal, presentation, and individual reports. Describe the function, and show the block diagram (which will most likely be your Figure 1 or Figure 1.1). Describe briefly the blocks into which the project has been divided. Give the performance requirements as they appear in the final version of your proposal. Describe any block-level changes made to the design during the semester. Show that you understand the key factors in the performance of your project. Be quantitative if possible. If in doubt, seek advice.

2.2 Design

2.2.1 Design procedure

Discuss your design decisions for each block at the most general level: What alternative approaches to the design are possible, which was chosen, and why is it desirable?

Introduce the major design equations or other design tools used; show the *general* form of the circuits and describe their functions.

2.2.2 Design details

Present the detailed design, with diagrams and component values. Show how the design equations were applied. Give equations and diagrams with specific design values and data. Place large data tables in an appendix. Circuit diagrams that are too large to be readable on a single page should be broken into pieces for presentation. The full diagram may be included in an appendix. Use photographs only as necessary and treat them, along with all other graphics except tables, as *figures*.

2.3 Verification

Discuss the testing of the completed project and its major blocks. Provide solid technical data, and present it in an easily grasped manner, using graphs where necessary. Include any standard tests for your type of circuit and all specific ones you feel are needed to prove that the design goals were met.

Discuss the Requirement and Verification Table from your design review. Including the table in an appendix will help avoid lengthy and tedious narrative description in the main text, which may not be of immediate interest to your imagined audience of managers. Do not discuss low-level requirements unless they failed to verify, or you found that they were critical in some unexpected way, or you need to makes changes—for instance, to the tolerances or acceptable ranges of quantitative results. It is important to hit the main points and explain any requirement that is not verified, but keep the discussion concise and refer interested readers to the appendix for details.

Note that the design procedure, design details, and design verification can be organized in different ways. The Word template provided by the ECE 445 staff puts the first two in one chapter and the second in another; however, a separate chapter for each is also common, with chapter sections reiterating the main project components. If you do the latter, avoid unnecessary repetition of component descriptions.

Another option, though rarely used, is to organize the report according to components or blocks, with each chapter describing the design procedure, details, and verification for a single component or block.

2.4 Costs

Labor cost estimates should use the following formula for each partner:

$$\text{ideal salary (hourly rate)} \times \text{actual hours spent} \times 2.5$$

Include estimates for electronics and machine shop hours, as applicable. For parts, use real values when you know them; make realistic estimates otherwise. List both the retail cost and what you or the department paid (in this case you may list lab-owned pieces as free). If the project might be commercially viable, estimate the cost of mass-production by listing bulk-purchase costs. Make sure any tables are numbered appropriately, given titles, and cited directly in the text.

2.5 Conclusions

Bring together, concisely, the conclusions to be drawn. It may be appropriate, depending on the nature of the project, to begin or end with a two- or three-sentence executive summary. The reader needs to be convinced that the design will work. Summarize your accomplishments. If uncertainties remain, they should be pointed out, and alternatives, such as modifying performance specifications, should be spelled out to deal with foreseeable outcomes. Use words, not equations or diagrams. Devote a section to ethical considerations with reference to the IEEE Code of Ethics and any other applicable code (e.g., the AMA Code of Medical Ethics for certain bioengineering projects).

2.6 References

Follow the IEEE reference styles provided in this document for various kinds of sources. If you need to cite something for which there is no example, simply use common sense and provide—in a neat and orderly manner emulating the IEEE reference style—the information necessary for another researcher to find that source.

References [1]–[3] are examples of a manual, datasheet, and web page, respectively. References [4]–[7] are more standard, scholarly sources: a book, chapter in an edited book, journal article, and conference proceedings. Reference [8] is a technical report, and reference [9] is class notes. Cite all references consecutively in the text, as is done here. (The ECE Publications Office provides a more detailed description of IEEE reference style on its wiki: https://wiki.engr.illinois.edu/display/ECEThesisReview/.)

3. Format

Specific styles for text, chapter titles, section headings, figure captions, and other format features may vary from those on exhibit in this document (the default styles of the provided Word template). Whatever software you use, and whatever styles you establish, make sure your output meets the following requirements:

- Preliminary pages are numbered with small roman, except title page, which has no page number.
- Table of contents (TOC) is neat, accurate, and consistent in the depth (level of headings) represented for each chapter. Use the automatic TOC feature provided by whatever software you use, and be sure to update the automated content.
- Chapter 1 starts on Arabic page number 1, and the rest of the report, including appendices, follows from that. (Do not use independent page numbering for appendices.)
- Each chapter starts on a new page.
- Preliminary sections (abstract, contents) have chapter status graphically, but are **not** included in the TOC.
- Numbering of chapters and sections is logical, and their style (e.g., capitalization, font size) is consistent.
- References and Appendices have chapter status graphically and are included in the TOC, but they are not numbered as chapters.
- Margins are at least one inch on all sides. Watch margins when you insert figures, tables, and equations!
- Maximum number of pages in main text is 20. (Appendices may exceed this.)

Use the checklist in Appendix B!

4. Technical Style

Write in a formal style and neutral tone without letting your writing become dull and lifeless. Use active voice as much as possible, and employ variety in sentence structure. Avoid wordiness, affectation, awkwardness, and gobbledygook. Intensifiers (adverbs modifying adjectives) and other modifiers should be used very sparingly (though subtle grammatical jokes are welcome). Be quantitative when possible. Use past tense to report transitory results and completed actions ("The resistance was 10 Ω until we replaced R1") and present tense to report final results and discussion ("The trigger fall-time is 15 ms, which is well within the design specifications"). Avoid frequent and arbitrary changes in verb tense.

4.1 Units of Measure

Express quantities with an Arabic number, followed by a space, followed by an IEEE-recommended abbreviation for the unit of measure (see Appendix A). IEEE takes its lead from the International System of Units, which provides a single, coherent measurement system for researchers worldwide. Examples:

0.2 pA, 127 µm, 0.574×10^{-3} mm^2, 10 kΩ, 120 A, $5500.00

Note that units of measure are *not* italicized. (The only exception is µ, which may be italicized; e.g., 127 μm.)

When discussing units without quantities, use words not symbols ("A millimeter-scale device").

4.2 Numbers

In general, use words for numbers up to 10 (e.g., one, two, three), and use numerals for numbers 10 and up. Exceptions:

- Always use a word at the beginning of a sentence: "Forty trials were run." (You may wish to recast as "We ran 40 trials.")
- Unless at the beginning of a sentence, quantities with units of measure are always numerals: 3 mm, 5 V.
- Numbers used as nouns are usually set as numerals: Chapter 3, sample 16, device 2.
- When comparing, within a paragraph, numbers that are above and below 10, make them all numerals: "In trials 1 and 2, we completed 8 and 15 runs, respectively."
- If two numbers that would normally be set as numerals appear next to each other, it may be best to change the lowest number to words: "We completed sixteen 45 min trials."
- In some cases it may be clearer to spell out zero and one than to use numerals 0 and 1.

4.3 Mathematics

Mathematical expressions that are referenced later in the text should be displayed (not in-line) and numbered according to the same system as, but in a sequence independent of, figures and tables. Displayed expressions should be centered (preferred) or indented, with numbers (if used) in parentheses flush right. Insert any punctuation after the equation, not the number. (Such terminal punctuation is not required, but if used it must be applied consistently. The easiest style is simply to

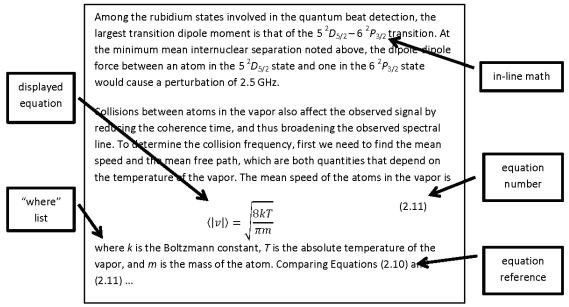


Figure 1. Well formatted passage of running text, in-line math, displayed equation with number, "where" list, and equation references.

have no punctuation after equations.) Text references to numbered equations should be capitalized, with parentheses preceded by a space: "Equation (2.1) shows ...".

A mathematical symbol should be rendered with the same typography (e.g., font, italics, bold, upper/lower case) whether it occurs in display or in-line, and it should always denote the same thing. A sentence should not begin with a mathematical symbol—especially a lower case one, and especially when the previous sentence ends with a mathematical symbol.

Figure 1 depicts correctly formatted math. Pay close attention to italics (for variables) and bold (for vectors and matrices). For easier reading, very long "where" lists can be formatted as ordered lists (indented and aligned).

4.4 Abbreviations

Abbreviations should be defined the first time they appear in both the abstract and the main text. After that, only the abbreviation is necessary, though you may choose to repeat the definition for a new chapter or after an extended period of disuse of the abbreviation. Many standard abbreviations are given in Appendix A. References to figures and equations may be abbreviated using "Fig." and "Eq." as long as the abbreviations are used consistently. The exception is at beginnings of sentences, where words should always be spelled out: "Equation (3.2) gives the formula for ...."

5. Figures and Tables

Figures and tables must be (1) neat and readable, (2) numbered with descriptive, concise captions (for figures) or titles (for tables), (3) cited directly in the text, and (4) well placed in relation to the textual discussion.

5.1 Quality

Figures should be readable within the one-inch required margins. Label axes using standard symbols for units of measure. Employ color and shading strategically to convey important distinctions, not for the sake of variety or show.

Table titles should be short and appear *above* tables. Align decimal points in columns so that quantities are meaningfully conveyed. Use the title and/or column heads to identify units of measure, rather than repeating them in every cell. Simplicity is best.

5.2 Numbering, Citation, and Placement

Number figures, tables, and displayed equations in *independent* sequences according to one of two systems: whole number (1, 2, 3 …) or single-decimal (1.1, 1.2 … 2.1, 2.2, etc., where the number to the left of the decimal corresponds to the chapter number). Use the same system for all three, but do not integrate them in one sequence. Do not create a multiple-decimal numbering system!

In the text, cite every figure and table *directly* (e.g., "Figure 1 shows …" not "the following figure shows …"). Citing (and numbering) equations is optional.

Pick one of three placement schemes for figures and tables and stick with it throughout the report:

1. Place figure or table on the page where it is first cited in text (preferably at top or bottom of page), or on the first possible page after it is cited in text (which may be some pages later if several figures are cited in a short passage).
2. Place figures and tables in a separate section at the end of the chapter.
3. Place figures and tables in a separate chapter (not an appendix) after the conclusion and before the references.

Schemes 2 and 3 require a numbered section or chapter entitled "Figures and Tables" with a table of contents entry. When you cite the first figure or table in the text, notify the reader with a comment such as "All figures and tables are in Section X.X" or "All figures and tables are in Chapter X." Figure 2 and Table 1 provide examples of scheme 1.

Do not (as has been popular recently in ECE 445 final reports) create independent series of schematics, photographs, block diagrams, etc. *These are all figures*, part of one sequence of figures. If helpful, you may specify the kind of figure in the caption or textual discussion, but it is usually obvious. Large

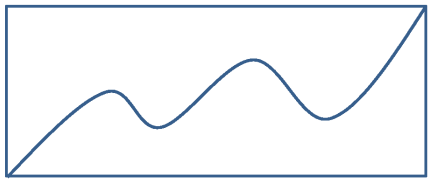


Figure 2. Figure placed according to scheme 1.

schematics (such as circuit diagrams) that are presented in pieces in the main text may be included intact in an appendix, but they are still cited, captioned, and numbered (e.g., A.1, A.2 …, if using the decimal system) as figures.

You may place figures and tables according to scheme 2 or 3 in the main text while using scheme 1 in an appendix; otherwise, however, *do not mix* the three placement schemes o utlined above.

Do not scatter figures among short passages of text as if narrating a slide show. Rather, write in unified, coherent, complete paragraphs, and try to hold blocks of text together on the page. This is why top or bottom of the page is best for figure and table location.

Large figures and tables may be rotated 90 degrees counterclockwise along with the caption, but keep the page number at the bottom in "portrait" orientation. Multipage figures and tables should have a caption or title such as "Figure 1 (continued)" on every page after the first. However, never split a figure or table across a page break when it will fit in one page; for example, do not start a short table at the bottom of one page and continue it on the next.

Table 1 Table placed according to scheme 1

Part	Manufacturer	Cost ($)
Part A	Cisco	119.99
Part B	AMD	57.99

6. Conclusion and Further Resources

Even if it provides the necessary structure and formatting styles for a report, a template cannot guarantee a well-organized and formatted final document, much less a well-written one. The best way to ensure success is to start early, collaborate carefully, seek help when you get stuck, and revise, revise, revise! Use the checklist provided in Appendix B.

In addition to the ECE 445 staff and ECE Publications Office (jhutchin@illinois.edu), you can get help with the writing process, including questions of style, grammar, and organization, through the Writer's Workshop with locations across campus including Grainger Library. See the web site at www.cws.illinois.edu/workshop/ . (The link "Writer Resources" is extremely helpful, with a grammar handbook, ESL resources, and writing tips.)

Strunk and White [10] bears reading about once per year for anyone who must write effectively in his or her career. Williams [11] is more lengthy but very worthwhile. For technical writing in particular, Alley [12] remains a fresh, highly readable introduction, while Alred et al. [13] provide an exhaustive overview that is useful as a reference tool.

Finally, do not simply write mechanically. Keep in mind that the purpose of writing is to convey ideas. Focus on your ideas, make certain that they are clear to you, and work to make them clear to your reader.

References

[1] *Motorola Semiconductor Data Manual,* Motorola Semiconductor Products, Inc., Phoenix, AZ, 2007.

[2] *Double Data Rate (DDR) SDRAM,* datasheet, Micron Technology, Inc., 2000. Available at: http://download.micron.com/pdf/datasheets/dram/ddr/512MBDDRx4x8x16.pdf

[3] Linx Technologies LT Series, web page. Available at: http://www.linxtechnologies.com/products/rf-modules/lt-series-transceiver-modules/. Accessed January 2012.

[4] J. A. Prufrock, *Lasers and Their Applications in Surface Science and Technology,* 2nd ed. New York, NY: McGraw-Hill, 2009.

[5] W. P. Mondragon, "Principles of coherent light sources: Coherent lasers and pulsed lasers," in *Lasers and Their Applications in Surface Science and Technology,* 2nd ed., J. A. Prufrock, Ed. New York, NY: McGraw-Hill, 2009, pp. 117-132.

[6] G. Liu, "TDM and TWDM de Bruijn nets and shufflenets for optical communications," *IEEE Transactions on Computers*, vol. 59, no. 1, pp. 695-701, June 2011.

[7] S. Al Kuran, "The prospects for GaAs MESFET technology in dc–ac voltage conversion," in *Proceedings of the Fourteenth Annual Portable Design Conference*, 2010, pp. 137-142.

[8] K. E. Elliott and C. M. Greene, "A local adaptive protocol," Argonne National Laboratory, Argonne, IL, Tech. Rep. 916-1010-BB, 2006.

[9] J. Groeppelhaus, "Java 5.7 tutorial: Design of a full adder," class notes for ECE 290, Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, 2011.

[10] W. Strunk Jr. and E. B. White, *The Elements of Style,* 4th ed. Needham Heights, MA: Allyn & Bacon, 2000.

[11] J. M. Williams, *Style: Lessons in Clarity and Grace*, 9th ed. New York, NY: Pearson Education, 2007.

[12] M. Alley, *The Craft of Scientific Writing*, 3rd ed. New York, NY: Springer, 1996.

[13] G. J. Alred, C. T. Brusaw, and W. E. Oliu, *Handbook of Technical Writing*, 8th ed. New York, NY: St. Martin's Press, 2006.

Appendix A Recommended Abbreviations

Unit or Term	Symbol or Abbreviation
alternating current	ac
American wire gauge	AWG
ampere	A
ampere-hour	Ah
amplitude modulation	AM
angstrom	Å
antilogarithm	antilog
atomic mass unit (unified)	u
audio frequency	AF
automatic frequency control	AFC
automatic gain control	AGC
automatic volume control	AVC
average	avg
backward-wave oscillator	BWO
bar	bar
barn	b
beat-frequency oscillator	BFO
bel	B
billion electronvolts*	BeV
binary coded decimal	BCD
bit	b
British thermal unit	Btu
byte	B
calorie	cal
candela	cd
candela per square foot	cd/ft^2
candela per square meter	cd/m^2
cathode-ray oscilloscope	CRO
cathode-ray tube	CRT
centimeter	cm
centimeter-gram-second	CGS
circular mil	cmil
continuous wave	CW
coulomb	C
cubic centimeter	cm^3
cubic foot per minute	ft^3/min
cubic meter	m^3
cubic meter per second	m^3/s
curie	Ci
cycle per second	Hz
decibel	dB
decibel referred to one milliwatt	dBm
degree Celsius	°C
degree Fahrenheit	°F
degree Kelvin**	K
degree (plane angle)	...°
degree Rankine	°R
degree (temperature interval or difference)	deg
diameter	diam
direct current	dc
double sideband	DSB
dyne	dyn
electrocardiograph	EKG
electroencephalograph	EEG
electromagnetic compatibility	EMC
electromagnetic unit	EMU
electromotive force	EMF
electronvolt	eV
electrostatic unit	ESU
erg	erg
extra-high voltage	EHV
extremely high frequency	EHF
extremely low frequency	ELF
farad	F
field-effect transistor	FET
foot	ft
footlambert	FL
foot per minute	ft/min
foot per second	ft/s
foot-poundal	ft-pdl
foot pound-force	ft•lbf
frequency modulation	FM
frequency-shift keying	FSK
gallon	gal
gallon per minute	gal/min
gauss	G
gigacycle per second	Gc/s
gigaelectronvolt	GeV
gigahertz	GHz
gilbert	Gb
gram	g
henry	H
hertz	Hz
high frequency	HF
high voltage	HV
horsepower	hp
hour	h
inch	in
inch per second	in/s
inductance-capacitance	LC
infrared	IR
inside diameter	ID
intermediate frequency	IF
joule	J
joule per degree	J/deg
joule per kelvin	J/K
kilobit per second	kb/s
kilobyte	kB
kilocycle per second	kHz/s
kiloelectronvolt	keV
kilogauss	kG
kilogram	kg
kilogram-force	kgf
kilohertz	kHz
kilohm	kΩ
kilojoule	kJ
kilometer	km
kilometer per hour	km/h
kilovar	kvar
kilovolt	kV
kilovoltampere	kVA
kilowatt	kW

*Deprecated: use gigaelectronvolt (GeV).
**Preferably called simply *kelvin*.

Unit or Term	Symbol or Abbreviation
kilowatthour	kWh
lambert	L
liter	l
liter per second	l/s
logarithm	log
logarithm, natural	ln
low frequency	LF
lumen	lm
lumen per square foot	lm/ft^2
lumen per square meter	lm/m^2
lumen per watt	lm/W
lumen-second	lm•s
lux	lx
magnetohydrodynamics	MHD
magnetomotive force	MMF
maxwell	Mx
medium frequency	MF
megacycle per second	MHz/s
megaelectronvolt	MeV
megahertz	MHz
megavolt	MV
megohm	MΩ
metal-oxide semiconductor	MOS
meter	m
microampere	μA
microfarad	μF
microgram	μg
microhenry	μH
micrometer	μm
micron*	μ
microsecond	μs
microsiemens	μS
microwatt	μW
mil	mil
mile per hour	mi/h
mile (statute)	mi
milliampere	mA
milligram	mg
millihenry	mH
milliliter	ml
millimeter	mm
millimeter of mercury, conventional	mmHg
millimicron‡	nm
millisecond	ms
millisiemens	mS
millivolt	mV
milliwatt	mW
minute (plane angle)	′
minute (time)	min
nanoampere	nA
nanofarad	nF
nanometer	nm
nanosecond	ns
nanowatt	nW
nautical mile	nmi

*The name *micrometer* (μm) is preferred.
‡The name *nanometer* is preferred.

Unit or Term	Symbol or Abbreviation
neper	Np
newton	N
newton meter	N•m
newton per square meter	N/m^2
oersted	Oe
ohm	Ω
ounce (avoirdupois)	oz
outside diameter	OD
phase modulation	PM
picoampere	pA
picofarad	pF
picosecond	ps
picowatt	pW
pound	lb
poundal	pdl
pound-force	lbf
pound-force foot	lbf-ft
pound-force per square inch	lbf/in
pound per square inch§	psi
power factor	PF
private branch exchange	PBX
pulse-amplitude modulation	PAM
pulse code modulation	PCM
pulse count modulation	PCM
pulse duration modulation	PDM
pulse position modulation	PPM
pulse repetition frequency	PRF
pulse-repetition rate	PRR
pulse-time modulation	PTM
pulse-width modulation	PWM
radian	rad
radio frequency	RF
radio-frequency interference	RFI
resistance-capacitance	RC
resistance-inductance-capacitance	RLC
revolution per minute	r/min
revolution per second	r/s
roentgen	R
root-mean-square	rms
second (plane angle)	″
second (time)	s
short wave	SW
siemens	S
signal-to-noise ratio	SNR
silicon controlled rectifier	SCR
single sideband	SSB
square foot	ft^2
square inch	in^2
square meter	m^2
square yard	yd^2
standing-wave ratio	SWR
steradian	sr
superhigh frequency	SHF
television	TV
television interference	TVI

§Although the use of the abbreviation psi is common, it is not recommended. See pound-force per square inch.

Unit or Term	Symbol or Abbreviation
tesla	T
thin-film transistor	TFT
transverse electric	TE
transverse electromagnetic	TEM
transverse magnetic	TM
traveling-wave tube	TWT
ultrahigh frequency	UHF
ultraviolet	UV
vacuum-tube voltmeter	VTVM
var	var
variable-frequency oscillator	VFO
very-high frequency	VHF
very-low frequency	VLF

Unit or Term	Symbol or Abbreviation
vestigial sideband	VSB
volt	V
voltage controlled oscillator	VCO
voltage standing-wave ratio	VSWR
voltampere	VA
volume unit	vu
watt	W
watthour	Wh
watt per steradian	W/sr
watt per steradian square meter	$W/(sr \cdot m^2)$
weber	Wb
yard	yd

Appendix B Checklist for ECE 445 Final Report Authors

Note: "Automatic" features should still be checked!

Pagination and margins

_____ Title page unnumbered (counts as i)

_____ Preliminary pages in lower case roman numerals

_____ Chapter 1 starts on Arabic page 1; all pages numbered consecutively after that; each chapter begins on new page

_____ Minimum one-inch margin on all sides of every page (page number falls slightly outside, which is OK)

Abstract

_____ On page ii

_____ Title same style as chapter titles, but unnumbered

_____ Presents main findings concisely and that is all

Table of contents

Format

_____ Preliminary material (abstract) *not* included

_____ Consistent capitalization

_____ Leader dots appear and page numbers aligned (automatic)

Agreement with text

_____ Wording of chapter titles and subheadings matches text exactly (automatic)

_____ Page numbers correct (automatic)

_____ Update your automatically generated content!

Figures

Placement

_____ Same page as first citation in text or first possible page after that

or

_____ Separate section (with tables) at end of each chapter

or

_____ Separate chapter (with tables) after Conclusion

_____ **Not** scattered among short passages of text

Figures (continued)

Numbering and citations

_____ Every figure cited directly in text (e.g., "Figure 1 shows …")

_____ Figures numbered in order of their citation in text

Quality

_____ Information conveyed economically

_____ Neat, legible, and within margins

_____ Axes labeled

Captions

_____ Every figure has descriptive caption (not just "Figure 1")

_____ Caption below figure, use "Figure X (continued)" for multipage figures

Tables

Placement

_____ Same page as first cited in text or first possible page after that

or

_____ Separate section (with figures) at end of each chapter

or

_____ Separate chapter (with figures) after Conclusion

Numbering and citations

_____ Every table cited directly in text (e.g., "Table 1 shows …")

_____ Tables numbered in order of their citation in text

Quality

_____ Neat and legible

_____ Decimals aligned

_____ Column and row headers labeled, with unit symbols, if necessary

Titles

_____ All tables have descriptive title (not just "Table 1")

_____ Title *above* table, use "Table X (continued) for multipage figures

Equations

_____ Neat and legible, with proper use of italics and bold

_____ Centered or indented consistently

_____ Numbered in sequence and according to same scheme (whole number or single-decimal) as figures and tables, but in a sequence independent of figures and tables

_____ Use of parentheses both in display and in text citation

_____ Numbers are flush right

Appendices

_____ Appear before References *if* they contain reference citations

_____ Figures and tables numbered, with captions/titles, and cited in the text

References

_____ All references cited in the text, and every citation corresponds to an entry in References

_____ Numbered in order of citation in text

_____ Use of brackets and other IEEE style

_____ Use the template, and proofread!

Writing and style

_____ Quantities expressed with number, space, and correct unit symbol

_____ Abbreviations defined at first use and used consistently afterward

_____ Writing is neutral in tone, formal in style, and consistent from writer to writer

_____ Active voice used as much as possible

_____ Needless words omitted

_____ Every sentence clear and readable

_____ Read the paper aloud

_____ Ask a friend unfamiliar with the subject matter to read and comment

Abstract

- Provide 150 words, or less, briefly describing the function and overall design of your project along with main results.
- Avoid introductory material such as background, competitors, and motivation—save that for Introduction.
- Don’t give a sales pitch.
- Do not include in Table of Contents.

Table of Contents

- Neat and complete
- Reader-friendly: uses leader dots
- Accurately reflects headings
- Accurately reflects page numbers
- Consistent depth (chapter titles, sections, subsections)

Figures and Tables

- Three placement options:
  - Same page as first citation in text, or first possible page after
  - Separate section at end of each chapter
  - Separate chapter (*not* an appendix) at end of main text

—*Pick **one style** for the entire report.*

Figures and Tables

- Cite every figure and table *directly* in the text (e.g.: "Figure 1 shows …" **not** "The following schematic shows …").
- Number figures in order of their citation in text.
- Use whole number (1,2,3 …) or single-decimal (1.1, 1.2, … 2.1, 2.2 …) system.

Figures and Tables

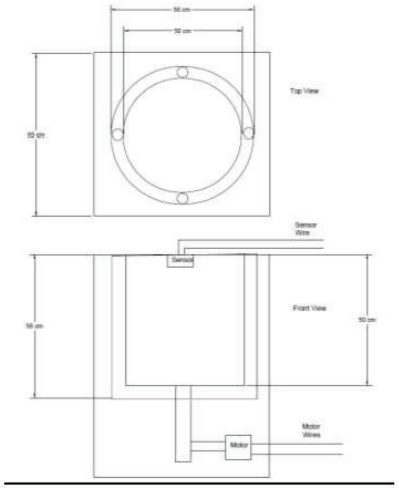
- Convey the information economically.
- Make them neat and legible, and stay within 1-inch margins.
- Label axes, rows, columns.
- Write neat, concise captions.

Figures and Tables

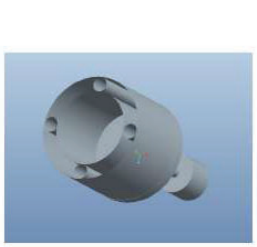
- As much as possible, anchor them at tops and bottoms of pages with text wrapping.
- Do not pin them to text citations, resulting in scattered figures interspersed with short passages of text—as if narrating a slide show.

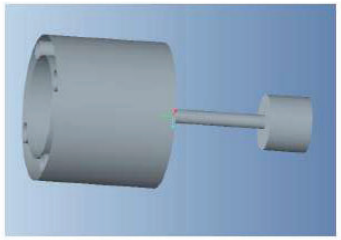
3.2 Drum design details

The basic drum design layout is as follows:



A 3D view of the design is as follows:





The design has been made based on the requirements and optimized so as to reduce the power consumption of the dryer. It is a single axis rotational design used for rotating the dryer at high rotation per minute. The heating coil is placed so as to utilize the law of physics which states that hot air rises up. It is also kept along a horizontal axis of rotation so as to allow the tumbling of clothes inside the drum.

3.2 Drum design details

The design has been made based on the requirements and optimized so as to reduce the power consumption of the dryer. It is a single axis rotational design used for rotating the dryer at high rotation per minute. The heating coil is placed so as to utilize the law of physics which states that hot air rises up. It is also kept along a horizontal axis of rotation so as to allow the tumbling of clothes inside the drum. Figure 3.1 shows a schematic of the drum, and Figure 3.2 shows a 3D view.

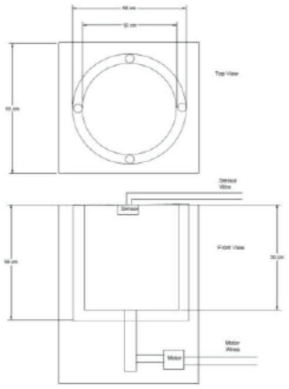


Figure 3.1 Drum schematic

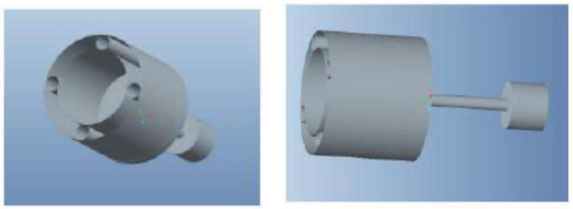


Figure 3.2 3D views of the drum

Appendices

- Reserve for detailed technical material that, while it may be important, is secondary or would disrupt the project description of the main text.
- Examples: Requirement & verification table (required), large data tables, lengthy code, sets of schematics, etc.

References

- Numbered
- Neat, complete, consistent
- Cited in the text
  - "According to Smith [1], a major design consideration is …"
  - "The PIC16F87A data sheet [1] specifies …"

Miscellaneous

- Consistent voice for multiple authors
  - Use "we," not "I," "Mary," etc.
- Pagination
  - Title page, preliminary pages, main text
- Page flow
  - Start each chapter on new page
  - Otherwise, avoid big white spaces
- Distinguish tables and figures
- Avoid "brain dump" with too much detail

Optional Consultation with Editorial Staff

Email ece-thesis@illinois.edu to schedule an optional consultation from Feb-April with Dr. McElroy or Taryn Smith. We will provide feedback on your design document, offer tips for the final report, and answer any questions.

Please email me to arrange a meeting: ageiger2@illinois.edu.