FINAL REPORT WRITING GUIDELINES

For ECSE Senior Design Courses

Rensselaer Polytechnic Institute

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TABLE OF CONTENTS

1. THE WRITTEN REPORT

1.1 Purpose

The final report is a professionally prepared document that presents the detailed design of your project. The usual metrics for preparing a design project report in industry are that the intended reader should be able to:

a) Understand technical and socio-economic rationale for your choice of the system design concept versus other possible options, based on the results of engineering analysis and experiments.
b) Reproduce your analysis and testing and build/verify the final design without having to ask you questions.

You should keep these metrics in mind as you write your final report.

1.2 Grading

Each member of the project team contributes a proportional share of the actual written material. You will be graded for language, format and for technical content and adequacy. Both individual and team grades will be assigned. 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.

1.3 General Guidelines

Begin each chapter on a new page.

Use IEEE-recommended abbreviations with no periods (see Appendix 1). Use abbreviations when a unit is preceded by a number (2 cm); spell out if not (e.g., *the scale is calibrated in centimeters).*

References and appendices (if any) should be included in the Table of Contents. Do not number these as chapters but align them in the Table of Contents with the *chapter titles,* not with numbers.

Use lower case Roman numerals for preliminary pages:

i. Title page (*not* numbered on page)
ii. Abstract
iii. Table of Contents

The text of the report begins with Arabic number 1. Number *all* pages.

Margin boundaries:

- 1-inch left margin
- 0.5-inch margin on the other three sides

The maximum number of pages is 25. Use Times New Roman, size 12 font throughout the report, unless otherwise specified.

1.4 Writing Assistance

You can get help with the writing process, including questions of style, grammar, and organization, through the Writing Center at Rensselaer (Sage 4508, writingcenter@rpi.edu). The PowerPoint document RPI_technical_writing_handout.ppt gives a summary of some of the most important information found in most technical writing classes and texts. This is intended to be a reference to help you develop your writing style to a professional level. It is recommended that this handout is used as a starting point in making this transition. For more information on any of the topics discussed, please seek any of the references provided at the end of the document.

2. FORMAT

2.1 Title Page

The title page is the unnumbered first page. The correct style is:

TITLE *(font size 16-20)*
by
Name of Authors and affiliation *(one per line, font size 16)*
ECSE-xxxx Senior Design Project
Project Advisor: Professor xxxx xxxxxxxxxx
Date
Rensselaer Polytechnic Institute

2.2 Abstract

The Abstract is short (200 words or less) and provides enough of a summary of the paper for the reader to decide whether to read the entire document. State very concisely what your project does, and the major points of its design and performance testing. It is important not to confuse an abstract with an introduction. In some contexts, an abstract is called an Executive Summary. The first sentence should give the subject of the report and the last sentence should state the primary conclusion of the report. The abstract should be written in the present tense. The abstract page is numbered *ii*.

2.3 Table of Contents

The table of contents is on a separate page and is numbered *iii*. The table of contents lists the sections of the report along with the page on which they begin. The table of contents serves as both an outline of the report and a means for locating specific sections. The table of contents makes the hierarchical nature of the report evident to the reader, meaning that titles of major section can be differentiated from those of subsections. Some type of numbering or lettering scheme makes this differentiation easier. Use the Table of Contents of these guidelines as your example.

2.4 Body

The body of the report begins on page 1 (Arabic numeral). All subsequent pages are numbered. An outline of the subject matter of the body is given in Section 3.

2.5 References

The references must list all published information sources that are directly quoted or used to support the technical discussion or equations. Reference to these sources must be made at the appropriate points within the report text. Use IEEE style (see Appendix 2) with numbers enclosed in brackets in the text [1]. Each reference is preceded by a bracketed number in the list of references. Example for textual referencing:

> Chen [2] states that the horizontal deflection . . .

The list of references is the last section of the text of the report.

2.6 Appendices

Each appendix starts on a new page and has a title that also appears in the Table of Contents. Computer programs, lengthy derivations, relevant technical data sheets, pertinent background material, patents etc. belong in appendices. The last appendix should contain a one-page resume of each team member. No section numbers are assigned to the appendices, but all pages are numbered.

3. OUTLINE OF SUBJECT MATTER

3.1 Introduction

Briefly review and update the material from your project proposal. Describe the function, show the block diagram, and give the performance specifications as they appear in your final proposal. Reformulate specifications. Show that you know what variables are important in your project's performance, and what values they should take on. If in doubt, seek advice. Describe briefly the subprojects into which the project has been divided.

3.2 Design Procedure

Discuss your design decisions for each subproject at the most general level: What alternative approaches to the design were 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.

3.3 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.)

3.4 Professional and Societal Consideration

In this section describe how your design choices were impacted by factors such as codes and standards, patents and copyright issues, safety and environmental concerns, ethical dilemmas, or possible diverse economic impact on different segments of society.

3.5 Design Verification

Discuss the testing of the completed project and its major subprojects. Provide solid technical data, and present it in an easily grasped manner, using graphs where possible. 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.

3.6 Costs

Project costs should be included. Labor cost estimates should use the following formula for each partner:

Assumed dream salary ($/hour) * 2.5 * hours spent = $Total

Include estimates for shop and mechanical hours, as applicable. For parts, use real values when you know them, make realistic estimates otherwise.

3.7 Conclusions

Bring together, concisely, the conclusions to be drawn. The reader needs to be convinced that the design will work. If uncertainties remain, they should be pointed out, and alternatives, such as modifying performance specifications, should be spelled out to deal with foreseeable outcomes. This is also the place to discuss extensions to the design or future work. Use words only, no equations or diagrams.

4. FIGURES, TABLES, AND EQUATIONS

Figures and tables should be inserted in the text in one of three places:

- On the page where they are first referenced
- On a separate, nontextual page immediately following the first reference
- Grouped together at the end of each chapter or at the end of the report

If figures appear at the end of a chapter or the report, at the first mention of Figure 1, make the notation: *(All figures appear at the end of the chapter.)* or *(All figures appear at the end of the report.).*

When *figure, table,* and *equation* are followed by a number in the text, capitalize them, e.g., *Figure 1.2, Table 3.1, Equation (2.5)*. Spell out the words *Figure* and *Equation* if they are used at the beginning of a sentence. Otherwise, within the text, you may abbreviate (Fig., Figs., Eq., Eqs.).

4.1 Figures

Each graph, diagram, etc., should have a figure number and a title typed *below* it. The type style should be the same as the text. If figures must be turned 90° on the page, the caption is placed on the nonbinding edge. See the two versions of Fig. 1 for examples.

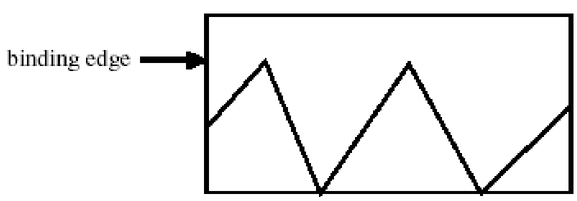


Fig. 1. Photocell characteristics.

OR

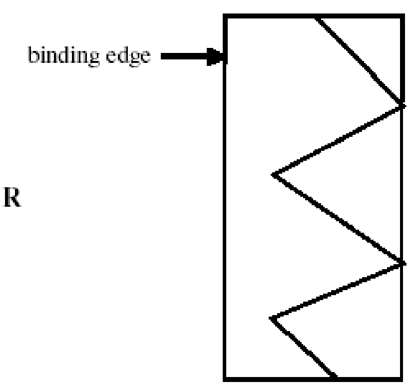


Fig. 1. Photocell characteristics.

Captions must be typed.

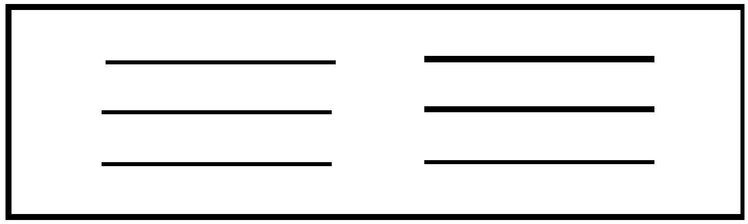
Each figure should be referenced by number in the text: ". . . as shown in Fig. 1."

Number figures consecutively (Fig. 1, Fig. 2) or by chapters (Fig. 1.1, Fig. 1.2, Fig. 2.1, etc.). Whichever numbering system you use, make sure that you follow the same system for tables and equations.

4.2 Tables

Each table should have a number and title typed *above* it, preferably in caps. The type should be the same as the text. See Table 1 for an example.

TABLE 1. COMPARISON OF MEASURED AND CALCULATED POWER



Refer to each table in the text by number: “In Table 1, one can clearly see . . . .” The same rules for location of figures apply to tables.

4.3 Equations

Center each equation on a separate line. Number equations consecutively in parentheses at the right margin. Equations may be referenced by number in the text, using parentheses around the number. Example:

The horizontal deflection is

$$x = A \sin \omega t \tag{1}$$

and the vertical deflection is

$$y = B \cos \omega t \tag{2}$$

Squaring and adding Eqs. (1) and (2) yields

$$x^2 / A + y^2 / B = \sin^2 \omega t + \cos^2 \omega t = 1 \tag{3}$$

Only those equations referenced in the text require a number.

APPENDIX 1. RECOMMENDED ABBREVIATIONS

Unit or Term	Symbol or Abbreviation
alternating current	ac
American wire gauge	AWG
ampere	A
ampere-hour	Ah
ampere-turn	At
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
British thermal unit	Btu
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	c/s
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
electronic data processing	EDP
electron volt	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

Unit or Term	Symbol or Abbreviation
footcandle	fc
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
kilocycle per second	kc/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
kilowatthour	kWh
lambert	L
liter	l
liter per second	l/s
logarithm	lcg
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
mgacycle per second	Mc s
megaelectronvolt	MeV
megahertz	MHz
megavolt	MV

Unit or Term	Symbol or Abbreviation
megawatt	MW
megohm	M?
metal-oxide semiconductor	MOS
meter	m
meter-kilogram-second	MKS
mho	mho
microampere	μA
microfarad	μF
microgram	μg
microhenry	μH
micrometer	μm
micromho	μmho
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‡	
millisecond	ms
millisiemens	mS
millivolt	mV
milliwatt	mW
minute (plane angle)	…'
minute (time)	min
nanoampere	nA
nanofarad	mF
nanometer	nm
nanosecond	ns
nanowatt	nW
nautical mile	nmi
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^2
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

Unit or Term	Symbol or Abbreviation
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
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
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

*Deprecated: use gigaelectronvolt (GeV).
**Preferably called *kelvin*
†The name micrometer (μm) is preferred.
‡The name nanometer is preferred.
§Although the use of the abbreviation psi is common, it is not recommended. See pound-force per square inch.

APPENDIX 2. IEEE REFERENCE STYLE

Reference numbering in the text for IEEE publications should look as follows:

[1]
[3], [4]
[5]-[7]

These are all to be on the line and within punctuation marks.

Journal Articles

C. D. Taylor and C. W. Harrison, “On thin wire multiturn loop antennas,” *IEEE Trans. Antennas Propagat.,* vol. AP 22, no. (if you have it), pp. 407-413, May 1974.

Books

R. G. Harrington, *Time Harmonic Electromagnetic Fields.* New York: McGraw-Hill, 1961, pp. 264-316.

M. Abramowitz and I. A. Stegun, Eds., *Handbook of Mathematical Functions* (Applied Mathematics Series 55). Washington, DC: NBS, 1964.

R. L. Byer, “Optical parametric oscillators,” in *Treatise in Quantum Electronics,* H. Rabin and C. L. Tang, Eds. New York: Academic, to be published.

P. K. Cheo, “CO2 lasers,” in *Lasers,* A. K. Levine and A. J. DeMaria, Eds. New York: Dekker, 1971, ch. 2, pp. 111-267.

The Rand Corporation, *A Million Random Digits with 100,000 Normal Deviates.* New York: Free Press, 1955.

Reports

R. C. Hansen, “Tables of Taylor distributions for circular aperture antennas,” Hughes Aircraft Company, Culver City, CA, Hughes Tech. Memorandum 587, Feb. 1959.

C. E. Baum, “On the singularity expansion method for the case of first order poles,” Air Force Weapons Laboratory Interaction Note 129, Oct. 1972.

Papers

P. Bokley and G. A. Thiele, “On efficiency measurements of electrically small antennas,” presented at the Twenty-Third Antenna Symposium USAF Antenna Research and Development Program, Urbana, IL, Oct. 1973.

J. Shapira, L. B. Felsen, and A. Hessel, “Rays and modes for fields excited and observed near a concave surface,” in *Dig. URSI Symp. on Electromagnetic Wave Theory,* Imperial College of Science and Technology, London, SW 7, England, July 9-12, 1974.

Miscellaneous

Manuals

Bell Telephone Laboratories Technical Staff, *Transmission Systems for Communications,* Bell Telephone Laboratories, 1970.

ASTAP (Advanced Statistical Analysis Program), General Manual, GH 20-1271-0, IBM-East Fishkill, Jan. 1973.

Application Notes

Hewlett-Packard, Appl. Note 935, pp. 25-29.

Hughes Aircraft Co., "Tunable millimeter wave detectors and mixers," pp. C-18 - C-19, Aug. 1973.

Catalogs

Catalog No. MWM-1, *Microwave Components,* M. W. Microwave Corp., Brooklyn, NY.

Theses

U. Mingelgrin, "The pressure broadening of the O2 microwave spectrum," Ph.D. dissertation, Harvard Univ., Cambridge, MA, 1972.

S. Black, "The finite difference method," M.S. thesis, Univ. of Illinois, Urbana, IL, 1986.

Patents

U. Hochuli and P. Haldemann, "Gas laser," U.S. Patent 3 614642, July 8, 1973.

Internet

Computational, Optical, and Discharge Physics Group, University of Illinois at Urbana-Champaign, "Hybrid plasma equipment model: Inductively coupled plasma reactive ion etching reactors," December 1995, http://uigelz.ece.uiuc.edu/Projects/HPEM-ICP/index.html.

D. Poelman (dirk_poelman@rug.ac.be), "Re: Question on transformerless power supply," usenet post to sci.electronics.design, July 4, 1997.

Class Notes

J. Greenlaw, "Mentor graphics tutorial: Design of a full-adder," class notes for ECE 290, Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Spring 1997.

APPENDIX 3. CHECKLIST FOR ECSE SENIOR DESIGN FINAL REPORTS

Pagination/Margins

___ Title page unnumbered (counts as i)
___ Front matter in Roman numerals (ii, etc.); text begins with page 1
___ Minimum of 1-inch left margin on *all* pages (watch those large figures); minimum of 1/2-inch margin on other three sides
___ Page number in same location on all pages

Abstract

___ On page ii
___ Title "ABSTRACT" has same format at chapter titles

Table of Contents

Format

___ Preliminary material *not* included (i.e., do not list abstract)
___ Chapter titles and subheading format is consistent
___ Use leader dots
___ Page numbers aligned on right (use right tab function)

Agreement with text

___ Wording of chapter titles and subheadings must match table of contents exactly
___ Page numbers correct

Figures

Location

___ Figures located on same page as first mention in text/next page after first mention
or
___ All figures located at end of report

Referenced in text

___ All figures cited by number in text (e.g., "Figure 1.3 shows . . .")
___ Figures numbered in order of mention in text

Quality

___ All wording in figures is readable
___ Graphics are clear

Captions

___ All figures have descriptive caption (more than just "Figure 4.1")
___ Caption located *below* figure

Tables

Location

___ Tables located on same page as first mention in text/next page after first mention

or

___ All tables located at end of report (use same location scheme as for figures)

Referenced in text

___ All tables cited by number in text (e.g., "Table 2.1 indicates . . .")
___ Tables numbered in order of mention in text

Quality

___ All wording in tables is readable

Headings

___ All tables have descriptive heading (more than just "Table 3.2")
___ Headings located *above* table

Equations

Numbering sequence

___ Equations numbered in order of appearance in text
___ Numbering scheme matches that of figures/tables

Use of ( )

___ All equation numbers are within parentheses, whether in display equation or in text
___ Equation numbers in display equations are flush with right margin

References

Referenced in Text

___ All references listed are cited in text; all references cited in text are listed

IEEE Style

___ References numbered in order of mention in text
___ Reference numbers in brackets, e.g., [3]
___ Follow guidelines described in Appendix 2

Appendices

___ Appear *after* References
___ Any figures/tables have some introductory/explanatory paragraph citing figure/table
___ Last appendix has team members' one-page resumes