

## **Thesis Guidelines**

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Sitting down to write a thesis is challenging, as it is difficult to know where to start. The purpose of this document is to provide a basic structure for a M.S. or Ph.D. thesis<sup>1</sup>. Guidelines for chapter content are proved first, followed by grammatical expectations and reference formatting. If you would like a concrete example of a thesis that follows these guidelines, you may borrow one from me.

### **Generic Thesis Architecture:**

1) Abstract

The abstract must be written last. An abstract is not an introduction. It summarizes the main highlights of your thesis, including the results. Your abstract should be between 200-350 words and not include any citations or figures. The abstract should include one or two sentences on each of the following sections:

- A) Background: A description of the problem and why it is being investigated.
- B) Methods: Briefly summarize the primary methods used in your thesis.
- C) Results: Briefly describe the major results of the thesis.
- D) Conclusions: Summarize the conclusion of the results and discuss the meanings of the interpretation. In other words, describe the implications of your thesis

Considering your audience may help you to write a strong abstract. Your abstract will be the description of your thesis that the user of an online search engine would find. What should you tell the reader to let them know whether they should go to the trouble of ordering your thesis through inter-library loan?

2) Table of Contents

List the title and page numbers of the sections that follow. If your thesis includes appendices, each should be given a short, descriptive name. If your thesis includes more than one appendix, each should be assigned a consecutive letter identifier (A, B, C, ...) in addition to the name. For example:

Appendix B: Custom Fixture Part Drawings

3) Introduction (Chapter 1)

The introduction includes three sub-sections as described below. The main section itself is typically a very brief paragraph previewing the layout of the three subsections.

A) Background

The background is your “sales pitch.” Describe the importance of your work using as few specialized terms as possible. Explain the basic motivation for writing your thesis. Discuss the value of its contributions to the field. Convince the reader that continuing with reading the rest of your thesis is worthwhile.

An effective background begins with a two paragraph “funnel”: start out describing the overall subject area of your work, and then sequentially focus in on exactly what constitutes your contribution. The background is typically about three double-spaced pages in length.

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<sup>1</sup> A portion of the content of this document originated with Dr. Thomas R. Chase at the Univeristy of Minnesota.

B) Literature Review

A thorough literature review is one of the hallmarks of an excellent research document. Two classes of references are discussed: primary and secondary.

Primary references have direct relation to your work. They may provide essential background, or they may constitute “competition.” The critical contributions of “background” references must be acknowledged. You must clarify how “competing” references differ from your work; i.e., clarify the additional contributions provided by your thesis. Primary references should be discussed at a level of approximately one paragraph per reference. You are expected to find and discuss ALL primary references.

Secondary references put your work in context with the literature on the topic of your thesis in general. For example, if your thesis concerns precision position synthesis of mechanisms, you might include a sample secondary reference on the optimization approach to solving synthesis problems, and compare your work on synthesis with a sample secondary work addressing mechanism analysis. You are not expected to locate and describe all secondary references, rather only a few “typical” examples. They are discussed at a level of about one sentence per reference.

Beware of a common flaw afflicting literature reviews. Do not merely summarize the contributions of each article you find, but synthesize and interpret the results from all of your reading to find commonalities and differences. Discuss gaps in the research and how this leads into your work. Literature reviews sometimes degenerate to a simple listing of others’ work, without describing how your work relates to their work. Remember the reader has not yet reached the body of your thesis, so you must explain this relationship.

Writing a good literature review requires multiple days of hard work searching for references in the library. Often succinctly summarizing a work in a single sentence can be quite challenging and requires significant editing. However, you can take great pride in a well-don literature review. For additional information on writing a literature review, see “Literature Review Guide” by J. Van de Ven.

C) Overview

The overview previews the layout of the remainder of your thesis. This provides a “roadmap” so that the reader knows what to expect in the chapters to follow. “Tell the reader what you are about to tell them.” Describe the contents of each chapter of approximately one to two sentences per chapter.

2) Body (Chapters 2 through N-1)

Considerable flexibility exists in the contents of the body. Whatever the contents, divide your overall work into logical portions<sup>2</sup>, then develop each portion as a chapter

**YOU MUST THOROUGHLY OUTLINE THE CONTENTS OF ALL CHAPTERS BEFORE WRITING ANY INDIVIDUAL CHAPTER. SORT OUT THE LOGICAL CONTENTS OF EACH CHAPTER IN THE OUTLINE FIRST! FAILURE TO DO SO GUARANTEES A “MUDDLED” BODY!**

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<sup>2</sup> The logical order to present the contents of your thesis is likely different than the chronological order you completed the work.

Investing a few intense hours or days on developing a good outline will save you many hours and days of revisions later on.

A typical chapter might be organized as follows:

A) Introduction:

The introduction needs to capture the reader and provide the context and background information needed to understand the rest of the chapter. The introduction typically includes: a description of the problem addressed in the chapter and why it is important, a discussion of any previous research that specifically relates to the work in this chapter, and a roadmap of what is to come in the chapter.

B) Methods:

Describe the methods of your work to the extent that a competent peer could reproduce your work. Give details about equipment used, sample preparation, data collection methods, computational methods, etc.

C) Results:

Present the key results of this portion of your work without interpreting the meaning. Present the data through tables and figures as appropriate.

D) Discussion:

Interpret the results based on the framework you laid in the introduction. Do the results agree with your hypotheses or with what others have found? Why or why not? Discuss the theoretical and practical implications of your results.

E) Conclusion:

Use the conclusion to summarize the significance of your results and provide a framework for future chapters

3) Conclusion (Chapter N)

The conclusion chapter in some sense comprises the “introduction written backwards.” The conclusion should include the following three subsections:

A) Review:

“Tell the reader what you just told them.” Refresh the reader’s memory about the contents of each preceding chapter at a level of approximately one to two sentences per chapter. The review can be very effective at enabling the reader to understand the overall scope of your work.

B) Conclusions:

Summarize the salient contributions of your work. Justify that your work constitutes a contribution to the literature worthy of awarding a degree.

C) Recommendations for Future Work:

Suggest how it would make sense to extend your work in the future. This may include opportunities for confirming or relaxing assumptions required within the scope of your work or applying your work to related research.

The last paragraph of your conclusion should close your thesis with a short, “upbeat” statement about your work.

4) References

List ALL references cited in your thesis. While current journals use a variety of citation styles, I recommend using ASME’s style as a baseline (see attached). Do not include “bibliographic” references that are not actually cited in your thesis.

I dislike references described as “personal conversation,” “unpublished class notes,” or Wikipedia type webpages, usually equivalent formal reference citations can be found. If you feel that you

should recognize the unpublished contribution of an individual, this can be done with a footnote or an acknowledgement.

5) Appendices

Your thesis may or may not include one or more appendices. Appendices include information that does not flow well if include in the main body. Common examples of information included in appendices are listing of computer programs used to obtain your results, documentation of experimental setups, standards required for your work, tables of raw data, and part drawings.

Remember, each appendix must be given a descriptive title. Most appendices require at least an introductory paragraph explaining what the appendix contains and why.

**Grammatical and Stylistic Preferences:**

You are expected to adhere to the standard guidelines for technical writing described in classic references such as: Strunk, W. Jr. and White, E.B., 1972, The Elements of Style, 2<sup>nd</sup> ed., New York, NY: MacMillan. In addition, I expect you to adhere to the following guidelines, unless you have a strong justification for doing otherwise.

- Your thesis must meet all formatting guidelines of the school.
- Define unfamiliar terms before using them.
- Every chapter must begin with an overview of the contents of that chapter. Similarly, every section and sub-section must begin with a brief overview of that section. One paragraph is usually appropriate for each chapter or major section. One sentence may suffice for a short section. “Tell the reader what you are about to tell them.”
- Use short, simple sentences. Each sentence should express a single idea.
- Use short, simple paragraphs. Each paragraph should express a single thought. Most paragraphs will be three to six sentences in length.
- Use brief examples to illustrate unfamiliar concepts.
- All units of measure should be in the SI system. If the U.S. customary units provide meaning, include them in parenthesis.
- If your research involves some form of modeling or analysis, develop the equations in the body of your text. Use “Microsoft Equation” or something similar to typeset your equations. Place each equation on a separate line and number your equations sequentially (Equation X).
- Avoid the use of first person adjectives whenever possible.
- In your writing, develop your ideas from general to specific. Explain the forest before the group of trees before the specific tree before the specific leaf on the specific tree before the specific bug on the specific leaf on the specific tree.
- Where possible, use schematics, pictures, graphs, and tables rather than words. Captions should be placed above tables and below figures. Use tables when absolute numbers are important and graphs when trends are important. Always discuss a table or figure before presenting it. Explain to the reader how they should interpret the figure to avoid ambiguity.

Please let me know if you would like to discuss these guidelines in further detail.

## References: ASME Citation Guide

Within the text, references should be cited in numerical order according to their order of appearance. The numbered reference citation within text should be enclosed in brackets.

Example: It was shown by Prusa [1] that the width of the plume decreases under these conditions.

In the case of two citations, the numbers should be separated by a comma [1,2]. In the case of more than two references, the numbers should be separated by a dash [5-7].

List of References. References to original sources for cited material should be listed together at the end of the paper; footnotes should not be used for this purpose. References should be arranged in numerical order according to the sequence of citations within the text. Each reference should include the last name of each author followed by his initials.

(1) Reference to journal articles and papers in serial publications should include:

- last name of each author followed by their initials
- year of publication
- full title of the cited article in quotes, title capitalization
- full name of the publication in which it appears
- volume number (if any) in boldface (Do not include the abbreviation, "Vol.")
- issue number (if any) in parentheses (Do not include the abbreviation, "No.")
- inclusive page numbers of the cited article (include "pp.")

(2) Reference to textbooks and monographs should include:

- last name of each author followed by their initials
- year of publication
- full title of the publication in italics
- publisher
- city of publication
- inclusive page numbers of the work being cited (include "pp.")
- chapter number (if any) at the end of the citation following the abbreviation, "Chap."

(3) Reference to individual conference papers, papers in compiled conference proceedings, or any other collection of works by numerous authors should include:

- last name of each author followed by their initials
- year of publication
- full title of the cited paper in quotes, title capitalization
- individual paper number (if any)
- full title of the publication in italics
- initials followed by last name of editors (if any), followed by the abbreviation, "eds."
- publisher

- city of publication
- volume number (if any) in boldface if a single number, include, "Vol." if part of larger identifier (e.g., "PVP-Vol. 254")
- inclusive page numbers of the work being cited (include "pp.")

(4) Reference to theses and technical reports should include:

- last name of each author followed by their initials
- year of publication
- full title in quotes, title capitalization
- report number (if any)
- publisher or institution name, city

## Sample References

[1] Ning, X., and Lovell, M. R., 2002, "On the Sliding Friction Characteristics of Unidirectional Continuous FRP Composites," *ASME J. Tribol.*, 124(1), pp. 5-13.

[2] Barnes, M., 2001, "Stresses in Solenoids," *J. Appl. Phys.*, 48(5), pp. 2000–2008.

[3] Jones, J., 2000, *Contact Mechanics*, Cambridge University Press, Cambridge, UK, Chap. 6.

[4] Lee, Y., Korpela, S. A., and Horne, R. N., 1982, "Structure of Multi-Cellular Natural Convection in a Tall Vertical Annulus," *Proc. 7th International Heat Transfer Conference*, U. Grigul et al., eds., Hemisphere, Washington, DC, 2, pp. 221–226.

[5] Hashish, M., 2000, "600 MPa Waterjet Technology Development," *High Pressure Technology*, PVP-Vol. 406, pp. 135-140.

[6] Watson, D. W., 1997, "Thermodynamic Analysis," *ASME Paper No. 97-GT-288*.

[7] Tung, C. Y., 1982, "Evaporative Heat Transfer in the Contact Line of a Mixture," Ph.D. thesis, Rensselaer Polytechnic Institute, Troy, NY.

[8] Kwon, O. K., and Pletcher, R. H., 1981, "Prediction of the Incompressible Flow Over A Rearward-Facing Step," *Technical Report No. HTL-26, CFD-4*, Iowa State Univ., Ames, IA.

[9] Smith, R., 2002, "Conformal Lubricated Contact of Cylindrical Surfaces Involved in a Non-Steady Motion," Ph.D. thesis, <http://www.cas.phys.unm.edu/rsmith/homepage.html>