

2008-2009

Department of Chemical and Biological Engineering

SENIOR THESIS GUIDE

A Compendium of Dates, Guidelines and Procedures

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Introduction

Congratulations on your decision to write a Senior Thesis in Chemical Engineering. This is a competitive and demanding but very rewarding project. Your interim (fall semester) and final (spring semester) grades will be assigned based on the quality and completeness of several assignments/milestones as well as your technical understanding of the material and your work ethic and perseverance.

This senior thesis guide represents an effort to better inform students of what to expect when completing a senior thesis. It is intended to provide tips on how to organize the research, writing and presentation of the thesis as well as provide key dates and deadlines. Failure to meet the appropriate deadlines may result in a reduction in grade and, in some instances, postponement of graduation.

Important Dates¹

December 2 or 3, 2007	Poster Presentation Present poster of research to-date with Senior Lab Class
December 12, 2007	Informal Progress Presentation Complete informal presentation of thesis progress to Faculty Advisor's research group
March 13, 2008	Draft Outline of Thesis Provide outline of thesis to Faculty Advisor and Senior Thesis Instructor
April 3, 2008	Select <i>Second Reader</i> for Thesis Notify Senior Thesis Instructor of second reader selected
April 27, 2008	Final Thesis Report Final draft of thesis provided to Faculty Advisor and second reader
May 1, 2008	Final Oral Presentation Oral examination/ final presentation of thesis to Faculty Advisor and second reader completed
May 10, 2008	Faculty advisor and second reader report grades for written and oral assignments to Senior Thesis Instructor

¹The presented dates are for students completing their senior thesis work in the fall and spring semesters. However, any two consecutive terms are acceptable. Please ask the Senior Thesis Instructor for corresponding dates to meet alternative timing.

Overview of Assignments and Grading

Interim Grade (Fall)		Final Grade (Spring)	
50%	Oral Progress Presentation	15%	Draft Thesis Outline
50%	Poster Presentation	50%	Final Thesis Report
		35%	Final Thesis Presentation/ Oral Exam

Poster Presentation

The poster presentations will take place on either **December 2 or 3, 2007**, most likely in the afternoon. The time and location will be determined during the fall semester and the students will be notified. The Senior Thesis Instructor will coordinate the poster schedule. Each student should remain with their poster until the faculty members assigned to grade their poster have completed their assessment. The poster grade will account for 50% of your interim (fall semester) grade.

The primary purpose of a display poster is to report information. Moreover, technical poster reports are becoming an increasingly acceptable way to present research results or to showcase equipment at technical trade exhibits. Thus, knowing how to create an effective poster can enhance your career skills.

Conveying information with a poster is accomplished by:

- Catching the viewer's interest and attention
- Making the poster easy to read and understand
- Telling a story

Keep in mind that if a viewer has to work hard to understand the message, s/he will not invest the energy to do so, and the poster will not be effective or enticing.

Poster Size

Each thesis student will be assigned one side of the large (4' x 8') departmental poster boards. You may provide your own colorful backdrop as needed and mount the visual aids to the backdrop with pushpins. You may also print out a large 4' x 8' poster in the ITLL and tack it to the poster board. Please do not glue anything onto the provided poster boards.

Poster Design

Be creative when designing your poster. Consider including the following visual elements to effectively illustrate information and provide viewing interest:

- Headlines
- Flow Charts
- Photographs
- Illustrations
- Diagrams
- Tactile Samples
- Graphs
- Tables
- Schematics
- Captions
- Cartoons

Be complete, but concise. Include enough information to provide a summary of the whole story, but not so much information that it looks like a written report was glued to the board. The viewer is depending on the poster to summarize the important, essential points to tell a brief and interesting, yet factual and convincing, story. Consider the audience: a presentation to interested freshmen would be different than for engineers who are familiar with the topic. An effective technique to focus poster design is to think

through how to briefly explain the objective, approach, and solution to a friend not engaged in the project. The main topics to include in your poster are summarized in the table on the following page.

TABLE 1. Topics to Include in Poster Exhibit

Executive Summary	Give a one page, thorough summary of your report.
Objectives	State the objectives of the work. Give sufficient background information to help the viewer identify the applicable field of study.
Theory and Equations	Give a synopsis of the applicable fundamental theory and a short summary of the important equations. A copy of the Calculation Flowchart can be used to tell the purpose of each equation.
Experimental Design and Apparatus	Show a schematic drawing of the experimental flow diagram and any simulation flow diagrams. Label the process with flow rates, temperatures, pressure, etc., and give volumes and manufacturer's information as needed.
Results	Include graphs and tables that describe the results. Be sure to provide the results that are predicted from theory and those computed with simulations and numerical solutions, and compare them with those from your experimental investigation.
Discussion	Discuss the trends of the results and the agreement or disagreement with theory. Give a quantitative analysis of the results. Discuss the magnitude and sources of errors, and comment on their effect on the results. Discuss the experimental objectives and any significant problems with the experimental procedures.
Conclusions and Recommendations	Summarize and assess the major findings. Give recommendations for materials, equipment, operating parameters, and any scaled-up designs.

Proofread Text

Read the written text out loud to assure it makes sense. Edit and choose words carefully for clarity. Assume that the opportunity to further explain or clarify does not exist. Remember to label graph axes with description and units of measure and to include error bars where appropriate.

Typeface

Using a variety of typeface sizes can relieve boredom for the reader and provide a tool to express the message. Use a font size of 18 to 44 point lettering for text and/or descriptions. Headlines should be even larger. Make no text so small that a viewer would have to squint and move in very close to read it. Can a viewer easily read the units on the X and Y graph axes? Look for awkward automatic hyphenation of words, especially in large headlines, and modify them to make natural, easy-to-read breaks in phrases.

Selectively use **bold** and *italic* typefaces to create emphasis, but do not overuse. Also beware of providing too much variety in typeface styles as it often distracts the viewer and decreases legibility.

Use the "drop test," by dropping the visual aid on the floor to see if it is legible. If it is not, use a larger font size. As a final review, stand back five feet from the poster and make sure every headline and text paragraph is easy to read. Some details (such as graph and image captions) may be acceptable with legibility at a closer distance of three feet.

Color

Introduce color to direct the viewer's eye throughout the poster. Work with a limited pallet of compatible colors, and use the concept of "color jump" to repeat the same colors throughout the poster. Consider alternate color(s) for the background of the board – it does not have to be white!

Contrast

Provide enough contrast between text and its background for easiest readability. For example, black letters on white background (or vice versa) provide excellent contrast. Black letters on yellow also work well, but red letters on black may not provide enough contrast for easy reading. In the latter case, the letters do not "pop" enough to work well. Step back from the poster and see how easy (or difficult) it is to read.

Poster Arrangement

Assess the arrangement and flow of the information presented on the poster. Does the viewer's eye naturally flow from the headline of the poster to the more detailed information *as if the story were being told in person*? Arrange the poster elements and use bullets, arrows, and framing cut from colorful paper to help direct the viewer's eye and keep the process interesting.

Neatness and Organization

Neatness counts! Avoid the use of visible tape. Make sure every piece is well adhered to the backdrop of the poster. Although posters are most impressive when headlines and information are lined up squarely, the occasional placement of headlines and other poster components at intentional angles can be dramatic and effective.

Ability to Answer Questions and Present Poster

Most poster sessions require the presenter to accompany the poster for a period of time. This aspect enables the viewer to gain additional information as desired. Thus, an important element is to anticipate the topics that might elicit responses and questions, requiring detailed answers from the presenter. Each visual aid should be evaluated so that a list of potential questions with answers can be prepared in advance.

You are expected to remain with your poster until the faculty members assigned to grade it have completed their assessment. Be prepared to talk through your poster presentation in five to ten minutes if a faculty member or a fellow student stops by your poster and asks you to explain your work. Please remember that the poster presentation will count for 50% of your interim (fall semester) grade.

Conclusion

Using logic, creativity, and consistency, posters can be an effective means of communication. If well planned and properly designed, posters can be fun, inexpensive, and efficient to create. Although posters are not easy to transport, they are of great value when they "speak for themselves" in a crowded room.

Additional Poster Resources:

- Text description of how to plan and deliver a poster presentation, compiled by Chemical and Process Engineering Dept at University of Newcastle upon Tyne:
<http://lorien.ncl.ac.uk/ming/Dept/Tips/present/posters.htm>

- A 29-page tutorial illustrating elements of layout and design for poster presentations, common errors in design and how to avoid them:
http://www.kumc.edu/SAH/OTEd/jradel/Poster_Presentations/110.html
- U.S. Dept of Energy site provides a rather comprehensive document series on effective poster design, including a Guidelines for Preparation of Online Poster Presentations:
<http://www.osti.gov/em52/workshop/tips-exhibits.html> and
<http://www.osti.gov/em52/workshop/em52-gl.html>
- Comprehensive resource introducing the poster concept, defining the different sections found on a poster and providing a bibliography:
<http://www.swarthmore.edu/NatSci/cpurrin1/posteradvice.htm>

Oral Progress Presentation

An informal presentation of progress on your thesis to the Faculty Advisor's research group must be completed by **December 12, 2007**. The goal of this presentation is communicate the:

- objectives of the thesis
- background information that places the investigation in perspective
- work accomplished to date; and
- a summary of what is expected to be accomplished.

Please submit a hard copy of the progress presentation to the Senior Thesis Instructor. The progress presentation counts as 50% of your interim (fall semester) grade, which will assigned by your research advisor.

Thesis Report: Outline and Final Draft

This section of the guide is a strictly informal set of guidelines that a student may use to orient him/herself as to the basic functions of a thesis. Since projects differ widely, it is impossible to develop a general outline that applies equally to all students. Regardless of how well you think your own research fits the following guidelines, you should talk to your advisor to determine the most appropriate style of presentation for your own work.

Organization

Consider that the essence of any scholarly work, which a thesis is supposed to be, is to:

- Define the problem and review the literature;
- Establish a particular contribution to this field or area; and
- Propose fruitful areas of further research that others in the field may use to guide their own endeavors.

In light of these three goals for your thesis, consider the following questions, which may help you to organize your research and written presentation of your thesis:

- What are you looking at?
- Why are you looking at it?
- Who else has looked at it?
- How are you looking at it?
- What are your contributions to it?
- What are the limitations of your work?
- What next?

The following table lists the sections that may be applicable to include in your thesis and should answer the aforementioned questions.

TABLE 2. Recommended Thesis Sections

Title Page	Report the thesis title, author, date and advisor(s).
Abstract	In less than one page, state the problem and main results and conclusions.
Table of Contents	Provide a list of the main headings and corresponding page number. A List of Tables and/or List of Figures may also be included.
Introduction	Define the problem or topic in a general way that gives a sense of scope and basic understanding of the problem area. Address why the topic is important, how it relates to the real world and why it adds to our knowledgebase. Establish who will benefit from the work and why.
Previous Work	Conduct a literature review and provide a concise survey of the field, including what state-of-the-art is and highlighting what has been done on the problem or project previously.
Experimental Methods	Describe relevant theory, equipment, computational tools or lab techniques. This description should be sufficiently detailed to allow another researcher to duplicate your efforts. List major assumptions and why you made them.
Results	Objectively present experimental or computational data.
Discussion	Discuss the trends of the results and the agreement or disagreement with theory or other investigations. Discuss the magnitude and sources of errors and comment on their effect on the results. Discuss how the results address the experimental objectives and any significant problems that were met or overcame.
Conclusions	Summarize the major findings and present recommendations for what should be done next.
References and Acknowledgements	Explicitly credit the work of others: because undergraduate research projects often relate closely to the ongoing work of other undergraduates, graduate students, and postdoctoral fellows in their laboratory, it is particularly important to give explicit credit to other collaborators and to reference any research, data, figures or text that were obtained or produced by someone

else. However, most of the research, results and conclusions presented in your thesis should be your own.

Tables, Figures & Other Tips

The thesis must be typed double-spaced, with the exception of footnotes and bibliography, which may be single-spaced. Additional guidance on formatting and adding figures or tables may be found at: http://www.colorado.edu/che/courses/chen4130/written_report.pdf

Bibliography

The list of references should appear at the end of the paper in alphabetical order if cited by author and by date or in numerical order if cited by numbers. Use ACS style guidelines for references: <http://chemistry.library.wisc.edu/writing/acs-style-guidelines.html>

Deadlines and Due Dates

A draft, detailed outline of your thesis report is due by 5pm on **March 13, 2008** to the Senior Thesis Instructor. The outline will count for 15% of your final (spring semester) grade, which will be determined by the senior thesis instructor with input from your advisor. It is recommended that you discuss this outline thoroughly with your research advisor before you begin writing your thesis.

The final thesis report is due to your thesis advisor and Senior Thesis Instructor, who will provide it to the second reader that you have selected, on **April 27, 2008**. The written thesis will count for 50% of your final (spring semester) grade and this grade will be assigned by your advisor and second reader (even weighting).

Final Thesis Presentation/ Oral Examination

A final presentation and oral examination of your thesis must be completed by **May 1, 2008**. You must schedule *in advance* a time when you can present to your thesis advisor and second reader.

The presentation should be approximately 20 minutes in length and clearly outline the:

- objective(s) of the thesis
- background information that places the investigation in perspective
- a summary of procedures and results; and
- conclusions and recommendations for future work.

Be prepared for 5-10 minutes of questions from your advisor and second reader. The final thesis presentation and oral examination will count as 35% of your final (spring semester) grade, which will be jointly assigned by your research advisor and second reader.