CEMS 480 - Senior Thesis **2017**

Catalog Description

All students in the Ceramic Engineering, Biomaterials Engineering, Glass Engineering Science, and Materials Science and Engineering programs must complete a senior thesis. In each program, the topic reflects the type of material(s) named in the degree. In senior thesis research, students explore a research topic suggested by either the student or a faculty member. The student must then define a specific problem, propose a strategy for studying the problem, work towards the problem's solution, and write reports of her/his work. A faculty advisor provides guidance, but the student has the primary responsibility for decision making at all stages. In the thesis, the student can integrate knowledge of structure, properties, processing, and performance with design and realistic constraints.

Credit: Fall and/or Spring Semesters - CEMS 480 (4 credits total)

Course Objectives

Most courses have well-defined bounds; consequently, their objectives are quite specific. However, with the wide range of activities possible in senior thesis research, the objectives become less explicit.

Senior thesis research provides students with an opportunity to do an extended piece of independent research. The major objective is to provide the student with the experience of leading a project, i.e., to define a problem, design a strategy for solving the problem, work in the context of that strategy, and report on the results. The student makes the decisions and is not "another pair of hands" for the advisor.

As a student progresses through the thesis experience, he/she will develop in the skills in the following areas:

1. Organizing and applying skills and knowledge learned previously.
2. Learning about using a library in research applications.
3. Learning to organize time in a research activity.
4. Learning about limitations in the mechanics of doing research, especially with activities whose schedule and duration are beyond personal control.
5. Learning how to prepare reports which effectively and succinctly describe both progress and the final results and conclusions.
6. Learning about a specialty in greater depth.

Some additional benefits of doing thesis research are:

1. The thesis provides a transition between acquiring a technical education in school and its application in future employment, graduate school, etc.
2. The student may find a passion for research and want to continue in this area.
3. Exposure to new levels of responsibility may catalyze a desire for more knowledge. Some students find that thesis work strongly indicates education in graduate school.
4. Students acquire added self-confidence by solving a problem individually and interacting with the technical staff.
5. Students learn some of their personal limitations, but more importantly, they begin to discover how far one can go as an individual.
6. Finally, we hope the students have fun. Engineering work shouldn't be dreary and dull; we hope you'll discover a sense of challenge, excitement, and accomplishment.

Time Requirements

You should spend a minimum of 6 hours per week on your thesis research. Schedule regular time periods for this rather than working "whenever you get a chance". Most importantly, don't postpone activities needing early attention: ordering materials, getting machine shop work completed, scheduling work on heavily used equipment; or other activities that consume time. There are other people competing for limited facilities. Don't jeopardize your research progress by delaying action on work that requires time over which you have no direct control.

Thesis Advisors

Your thesis advisor serves two functions. The first is as a consultant; the second is as a supervisor. Both roles have their counterparts in production, research and development, etc.

As a consultant, your advisor provides guidance, information and suggestions. Advisors should have some expertise which will be helpful. If you are working on a new problem, a consultant won't know all of the answers. However, he/she should have sufficient background to help you find ways of obtaining answers. Ideal consultants make themselves progressively unnecessary as you develop your own abilities.

As a supervisor, your advisor authorizes expenditures and work performed by the technical support staff, including the library. Supervisors must also weigh your performance, measure your contribution to the work being done -- they must "grade" you.

Weekly Meetings

At the beginning of each semester, schedule regular weekly meetings with your advisor to discuss your progress. You and your advisor should work out the length and expectations for the meetings.

Research Proposal

You must submit a written proposal of your intended research to your advisor by not later than the end of the first half of the first semester. This proposal may be a simple outline of your plans or several pages of text. Discuss with your advisor how elaborate the proposal should be. It should include the following:

1. A clear, specific statement of the goals of your research.
2. A brief background of previous work on the topic.
3. An outline of the strategy you plan to follow. What preparations, measurements, etc. will you make? What equipment will be needed? What apparatus will need to be designed and what are the procedures that will need to be developed? How will this work shed light on the problems you've chosen?
4. A list of references that you've used to develop your proposal.

The proposal is not a contract. Initial oversights, inaccurate estimates of time requirements, equipment breakdowns, etc. may force you to deviate from your original plan at a later time. This is taken into account by the faculty advisors. However, a well conceived plan, successfully performed, is high on the list of criteria for evaluating your research. Do your best to develop a realistic proposal.

Progress Reports

Before the end of the first semester, submit a summary, and an up-to-date report of your progress to your advisor.

Check with your advisor on the form this report should take. Your advisor must submit a grade at this time (see Grading below). Some advisors may require a semi-final draft of portions of the final thesis report (e.g. Introduction, Literature Survey, Experimental Procedure, etc.); this may be done in lieu of or as a part of this progress report.

In your weekly meetings you will probably concentrate on specific details of your work. The progress report will help both of you appraise your overall progress. In particular, comment on how closely you are following the strategy that you outlined in your proposal. Include any data, figures, etc. that will help your advisor determine how well you are meeting the objectives that you originally established. Update the list of references from those included in your proposal. Include additional details and progress when you update this report at the middle of the

second semester. These reports and the proposal will help you in preparing your final thesis report.

Final Thesis Report

At the end of the second semester you will prepare a final report of your thesis research. Instructions for its preparation are included with this course outline. Since there are some suggestions which can save you time later, you should review these instructions long before you begin writing.

The initial draft of the thesis report should be submitted to your advisor not later than two weeks before the end of classes. Frequently advisors will require the first draft before this date. This will allow sufficient time to read and comment on the draft and for you to prepare the final draft. Advisors are committed to returning the draft to you within one week from the time that you submit; however, it is unwise to unnecessarily delay a submission to your advisor ('boss' in the real world). The final thesis report must be in the format described herein, signed by your advisor, and ready for duplicating, by the last day of classes (not the last day of finals).

Submit the signed original and one copy of the final thesis report to the SoE Dean's office (BMH 160) and one copy to your advisor by the last day of classes. **The original should be unbound and does not need covers**. The copies should be bound use the gray covers with the Title Page printed on them (available in the Dean's office BMH 160).

Grading

Evaluation of your work will be based on how successfully you progressed toward solving the problem you defined, not whether you solved it. A regular grade is preferred for each semester, although a 'no report' grade may be used at the end of the first semester. Advisors must file with the Dean an explanation for any incomplete (I) grades submitted. Your advisor must estimate your progress based on the weekly meetings, the progress reports, and the final thesis report. The grade awarded answers the question: How well has the student defined a problem and progressed towards its solution?

Instructions for Preparing Final Reports

Contents

I. Introduction

These instructions were prepared to help you write the final report of your senior thesis research. The thesis report should be easy to read, organized to maximize communication, and relatively permanent. The following instructions are intended to help you meet these basic criteria. The rules are not created to aggravate you or to restrict you to a narrow set of rules, but rather to introduce you to the process and improve communication. In a few cases parts of these instructions may be inappropriate for best communicating your results. If you want to use a different style of presentation, ask your advisor. The advisor may allow whatever changes he/she believes would best meet your needs. You will need an original and at least three copies of your report. Except for Section VI these instructions deal with preparing the original.

II. Creating the Manuscript

The manuscript should be created using a word-processor or word-processing application such as Microsoft Word, or Word Perfect. Whichever is used must be capable of producing correctly formatted equations or expressions, chemical formulae, and the special characters used in scientific writing. The text should be typed either double-spaced or with 1 1/2 spacing, although footnotes and long quoted passages should be single-spaced.

The font size should be either 10 or 12 point and the font type should be one that is both easy to read and easy to format correctly. It is very important to make sure that the final version is error-free, as well as being attractive to look at. Use a spell-checker to avoid "typos", for example and pay particular attention to the symbols which you use. The final version should be printed on a good quality

paper, using a laser (or similar) printer. Dot matrix printers do not generally produce acceptable quality output.

To allow for binding the library copy (original) and to leave room for the page number at the bottom, the left-hand and bottom margins should be 1 1/2". The top and right-hand margins should be at least 1". Page numbers are located 1" up from the bottom of the paper and centered on the page.

III. Format

A thesis has three main parts: the preliminaries, the main text, and the references.

a. Preliminaries

These include in the order listed, a Title page, Acknowledgments, Table of Contents, List of Tables, List of Figures, and an Abstract. The Table of Contents, List of Tables, and List of Figures should indicate the page of each item listed. Section VII includes a sample Table of Contents page.

b. Main Text

There are no hard and fast rules for the organization of the main part of the thesis. Always remember, however, that your first concern is to communicate with someone else. Avoid run-on sentences; eliminate words and phrases which are excess baggage. Impress the reader with the clarity of your expression, not the elegance of your prose nor the weightiness of your work. A good test of your presentation is to ask if another student could read your thesis and immediately proceed from where you ended with a minimum of delay and difficulty.

Clearly state the problem you studied. Present pertinent background or history of the problem so the reader sees your work relative to previous experiments and theories. This review should be annotated with references to the literature on the subject.

Describe how you conducted your studies and summarize your results. Discuss your results in light of what you expected and what other researchers have found. List the conclusions that you draw from your results. Finally, suggest any future work that might be useful. Remember you've spent substantial time on this work - maybe you can help the next person make even more progress than you did.

Indicate the larger divisions of the main text (e.g. Introduction, Experimental Procedure, Results, etc.) with consecutive Roman numerals and capitalized headings centered on the page. Start each of these divisions on a new page.

Indicate important minor divisions within a major division by consecutive capital letters and underlined headings located at the left of the page. Further subdivisions (if any) within minor divisions are numbered consecutively with Arabic numerals and underlined headings located at the left of the page. Headings (of any kind) should never be the last line of text on a page.

c. References

References are indicated in the main text by the use of consecutive superscript numbers. They are part of the sentence, so the period should come after the reference numbers. For example:

The recent results of Brown[1] and Smith[2,3] deviate significantly from the earlier work in this field [4-8].

In your List of References include all references indicated in the main text. The numbering must coincide with the superscripts in the text. Use complete references and the abbreviations for periodicals given in CASSI (Chemical Abstracts Service Source Index) of the American Chemical Society. The formats for common references are given in an appendix below.

A Bibliography of literature in the field which is not directly referenced may be added if appropriate. Some material isn't required to understand the main text, but should be included for completeness. For example, the details of a mathematical derivation, the design of a special apparatus, or a special method for reducing data (e.g. a computer program) might fall in this category. Put this material in appendices.

d. Units

All data in the text, tables, and figures must be expressed in the International System of Units (SI). In some cases, especially where mechanical properties are involved, the units may be unfamiliar to readers who commonly use older systems of units. To facilitate comparisons with older data, you might include the conversion factor between SI units and those older ones. Do this the first time the units are mentioned in the text and with each table or figure where the conversion factor might prove helpful.

For example, breaking strengths which were previously expressed in psi (pounds per square inch) would now be expressed in Pascals (abbreviated Pa; 1 Pa = 1 N/m^2). A result formerly reported as 12,000 psi would now be given as 8.28×10^7 Pa or 82.8 MPa (mega-Pascals) with a notation that $1.0 \text{ Pa} = 1.450 \times 10^{-4}$ psi.

IV. Figures and Photographs

Although most graphs and charts will be reproduced from data analyzed on a computer, some figures may still be drawn manually. In such cases, use India Ink and rulers or French curves. They should not be drawn free-hand.

Computer generated figures should be printed using a laser (or similar quality) printer. Most word-processing programs allow one to input figures into the main document so that they may be properly placed and sized. Make sure that figures are properly labeled and that the captions are complete enough to allow readers to understand the data being presented and to draw their own conclusions. Error bars should be indicated as appropriate. It is most convenient for the reader if you locate figures and tables immediately following the page on which they are first mentioned.

Allow 10 working days for reproduction, duplication, etc. The end of the semester is a very busy time. In fact, it would be best to have copies of photographs made as soon as you know that you will want them in the final thesis report. **You are responsible for the cost of this work unless the thesis has outside support.**

Photographs should be properly processed for permanence. Mount photographs with dry-mounting tissue only. Don't use rubber cement since it can deteriorate in a relatively short time. You will need one print of each photograph for each copy of the thesis. Xerographic copies of photographs are neither satisfactory nor acceptable.

V. Page Numbering

Each page in the thesis is numbered at the center of the bottom margin, 1" up from the bottom of the page. The preliminaries are numbered with small case Roman numerals. Start with the Acknowledgment page (the first page after the Title page) with Roman numeral ii. (Although the Title page is considered page i, the number isn't included in it.) Continue with successive pages using iii, iv, v, etc. Use Arabic numerals on all remaining pages, including text, figures, tables, appendices, references, bibliography, etc.

VI. Reproduction of Manuscript

You will need the original and three copies of your thesis. **You are responsible for the cost of reproducing the copies.** The library gets the original and one copy; **these should be turned into the SOE Deans Office by the last day of classes**. Your advisor gets the second copy and you keep the third.

In most instances the copies will be made xerographically. If the thesis has been supported by outside funds additional copies will probably be needed. The cost of duplication is usually borne by the source of this support. Check with your advisor if you have any question about this.

All copies of the thesis should be stapled between two heavy gray paper cover sheets available in the SOE Deans Office. **The original should not be stapled.** The

title of the thesis and your name should be typed on the front cover sheet just as it appears on the Title page.

VII. Sample Pages

The next two pages are samples taken from a typical thesis report. Title pages should follow the format of the first sample. The Table of Contents page shows a widely used organization of topics in a thesis which is based on experimental work. As stated earlier, you are not restricted to this particular organization of the main text; however, this example is appropriate for 80 - 90% of all senior theses.

THE FABRICATION OF COPPER-DOPED BARIUM TITANATE CERAMIC

by

Leslie B. Wedgeworth

A Thesis

Submitted to the Faculty of the

N.Y.S. College of Ceramics at Alfred University

in Partial Fulfillment of the Requirements

for the Degree of

Bachelor of Science in Ceramic Engineering

Advisor: Lynn H. Glass ¨_____

Alfred, New York

May 2017

SoE 2017

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VIII. Appendix - Formats for Literature References

Approximately one in every ten references found in the scientific literature contains incorrect information. Consequently, there is some advantage to including information which seems redundant. The formats given here follow the usage of the Journal of the American Ceramics Society. Author's initials should always be included with their names. Abbreviations of journal titles should follow CASSI (Chemical Abstracts Service Source Index).

A. Journal Articles

Author's Name, "Title of Article," Title of Journal, Volume [Number] Page Numbers (inclusive) (Year).

P.F. Becher, "Abrasive Surface Deformation of Sapphire," J. Am. Ceram. Soc., 59 [3-4] 143-45 (1976).

B. Books

Author's Name, Title; Page Numbers for Reference. Publisher, Address, Year.

J.I. Pankove, Optical Processes in Semiconductors; pp. 34-86. Prentice-Hall, Inc., Englewood Cliffs, NJ, 1971.

C. Edited Collections and Conference Proceedings.

Author's Name; Page Numbers (inclusive) in Title of Publication. Edited by (Editor's Name in Edited Collections). Publisher, Address, Year.

J. Washburn; p. 301 in Electron Microscopy and Strength of Crystals. Edited by Gareth and J. Washburn. John Wiley & Sons, Inc., New York, NY, 1963.

A Dietzel and L. Merker; pp. 81-92 in IVth International Congress on Glass, Paris, 1956. Federation des Chambres Syndicales de I'Industrie du Verre, Paris, France, 1957.

D. Government Documents

Author's Name, "Title of Document," Agency and Document Identification Number, Number of Pages (Year).

M. Bleiberg, R.M. Berman, and B. Lustman, "Effects of High Burnup on Oxide Ceramic Fuels," U.S.A.E.C. Tech. Rept. WAPD-T-1455, 142 pp. (1962).

E. Thesis

Author's Name, "Title of Thesis," School, Address, Year.

L.H. Rovner, "Diffusion of Oxygen in Magnesium Oxide," Ph.D. Thesis, Cornell University, Ithaca, NY, 1966.

For other reference types, check with the J. Am. Ceram. Soc. or with the Scholes Library staff.