LAFAYETTE

MECHANICAL ENGINEERING

Honors Thesis Guidelines

Honors in mechanical engineering is an award given for excellence in scholarship and an independent research/design project completed during two semesters at Lafayette College. The following rules and criteria pertain:

Record of Scholarship. Students must have achieved a GPA of 3.0 or higher overall, and 3.20 in ME, to be eligible for honors in mechanical engineering.

Enrollment. Students completing an independent honors thesis must be enrolled in ME 495/6 (Thesis). At least two semesters of independent study are required for honors. The approval of the anticipated faculty advisor is required for registration for ME 495/6.

Substitution for ME 497/8. This course may substitute for the Senior Design requirement **only if** the project contains a **significant design component**. To allow ME 495/6 to substitute for ME 497/8, the student must submit a satisfactory petition for Course Substitution (available in the department office). This petition must include the student's honors thesis proposal.

The **Honors Thesis Proposal** includes (1) a brief **written proposal** (2-4 pages) describing the problem to be considered and the methods to be used, and the design component, to be submitted by the end of the second week of the fall semester, as well as (2) an **oral proposal presentation** given by the end of the third week. During the first two weeks of the semester, a **reading committee** should be formed, consisting of the advisor and one additional ME faculty member, and one faculty member from outside the ME department, chosen by the student and advisor.

The written proposal and the oral proposal presentation will be reviewed by members of the reading committee and the ME department faculty, who will ask questions, and who may request clarification or alteration before approving it. The thesis student and faculty advisor should schedule the presentation, allotting 15 minutes for the student to present their proposed thesis project and at least 15 minutes for questions and discussion. At this time, a written timeline and budget proposal should be submitted to the ME Department Head.

NOTE: If the student would like to substitute ME 495/6 for ME 497/8, the proposal must contain a description and justification of the planned **design component** of the project.

*What does it mean to have a **design** component?*

It means that part (or all) of your project is a task that requires you to use the design process in order to creatively solve a problem. This must be explicitly addressed in both the proposal and the written thesis, as described elsewhere in this document.

To quote from the ABET definition of design: "Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic science and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing and

evaluation. The engineering design component of [the project should] include the following features: development of student creativity, use of open-ended problems, development and use of modern design theory and methodology, formulation of design problem statements and specification, consideration of alternative solutions, feasibility considerations, and detailed system description. Further it is essential to include a variety of realistic constraints, such as economic factors, safety, reliability, aesthetics, ethics and social impact."[1]

The description of the design component in both the proposal and the thesis must include justification that the design component meets this definition.

Oral Presentations.

Proposal: The student will present a proposal of the thesis project, including the scope of the work, major goals, design component, and the approximate budget and timeframe, to the student's thesis committee members and ME department faculty.

(Optional) Design Reviews: When deemed appropriate by the faculty advisor, students completing thesis projects will present informal "status reports" on their work to their advisor and committee members. These Reviews are discussions between the student and committee members about the progress in the project, challenges faced, and future steps.

Fall: An oral presentation must be given by the student before the end of the fall semester. Typically, all ME seniors will give presentations on their design projects or independent work.

Spring: An oral presentation must be given by the honors candidate at or prior to the submission of the written thesis. The oral presentation must be announced so that interested students and faculty can attend. Typically, a Research Symposium will be organized in late April or early May to provide the opportunity for seniors to present their research.

At least two faculty members besides the advisor must attend the presentations. The faculty advisor and committee for the thesis will evaluate the final (spring) oral presentation and provide comments on the written thesis.

Written Honors Thesis. The thesis must be submitted far enough in advance of the oral presentation for the entire reading committee to have time to read and evaluate it. In general, the student should expect to provide the faculty advisor and committee members with corrected final copies of the thesis. A final UNBOUND copy is also submitted to Skillman library for binding and cataloging in Special Collections.

Once you have written and revised (and revised) your thesis, incorporating the feedback from your advisor and committee members, you must collect the signatures of your committee on the Final Honors Nomination form (available from the Registrar's website) and submit this form to the Registrar's office.

Honors will be awarded on the basis of the honors thesis, oral presentations and the student's grade point average. The student must earn an A for thesis work in ME495 and 496 to earn honors.

If any of these conditions are not met to the full satisfaction of the thesis advisor and the ME department faculty, the project may be converted to an Independent Study, and the student will no longer be eligible to graduate with honors.

[1] Accreditation Board for Engineering and Technology, Inc. Annual Report, New York, 1988

SUMMARY OF DEADLINES: (for May graduates; others should consult faculty advisor)

Written proposal for honors thesis: by end of second week of fall semester. Oral proposal presentation: by end of third week of fall semester.

Fall oral presentation: by second Monday in December.
* *Note*: individual advisors may require a written report at the end of the fall semester.

Oral presentation of thesis: by second Friday in May.

Submission of **completed** thesis to faculty advisor and committee: by second Friday in May.

What is a thesis?

A thesis is an experimental, computational, and/or theoretical study of an important problem. In order for the thesis to substitute for Mechanical Engineering 497/8, it must contain a significant **design** component, which must be documented explicitly in the final thesis report as noted below, with justification of how this design component meets the ABET definition of design. Generally, topics are selected by the students from suggestions by the faculty.

The essence of any scholarly work is to establish the following:

- Definition of the problem; review of the literature
- Your particular contribution to this area
- Potentially rewarding areas of further research that others may use to guide their own work

The following questions may prove useful in organizing both your project effort and your writing:

What are you looking at?

You must begin by defining your problem. In the introduction of the thesis, you want to do this in a general way that gives the reader a sense of the project's scope and a basic understanding of your area.

Why are you looking at it?

Motivate your work. Establish who will benefit from your work and why.

Who else has looked at it?

Once your readers have a rough idea of what your problem is, you must clearly establish what the state of the art is in this area. This is particularly critical if you plan to claim that you have a better way of approaching or solving a problem than has previously appeared in the literature. If you are examining a problem that has been studied by others, but using a different technique that is of particular interest to you, say so and describe why you have chosen this approach.

How are you looking at it?

At this point, you should review your problem again but at a much higher level of detail, introducing any mathematical notation required and describing any subtle nuances of your problem that may in fact be the central component of your research but were too detailed to put in the introduction. It may be appropriate to describe one or more hypotheses which you feel your research will prove (or disprove). Not all work lends itself to initial statements of hypothesis; an implicit hypothesis that your method is better than others may be left implicit.

You should describe in detail your experimental design (or computational method): how you structured your data collection, problems you encountered, and how you conducted your experiments. Often, the design of the experimental facility itself may be a large component of your thesis work. This description should be sufficiently detailed to allow another researcher to duplicate your efforts. A key part of this description is a clear list of major assumptions you are making, and why you are making them. It will likely be useful to indicate which assumptions are perfectly reasonable and which are likely to affect your results but are required for time or budget reasons.

What are the limitations of your work?

One of the most difficult aspects of research is understanding exactly what you did *and what you did not do*. If you were limited by your data, explain how you think this might affect the generality of your conclusions. Discuss openly any shortcuts taken due to time, budget, or data availability constraints. Do not try to overstretch your work's relevance ("although measurements were taken only for Reynolds numbers << 1, the results may be applied to improve the design of supersonic aircraft") **or** believe you are getting off the hook by over-qualifying your work ("because of myriad restrictions, no valid conclusions can be drawn until more extensive experiments are carried out using incredibly expensive equipment.") Your job is to use what is available to you to make a meaningful contribution to your field of study; clearly drawing the line between what you did and did not do is central to the scientific method, since it helps define the state of the art.

What are your conclusions?

In view of the limitations considered above, what conclusions can you draw from your research? Because your conclusions are often inextricably entwined with the limitations of your research, both these questions are often answered simultaneously. In your thesis, your section on conclusions will typically be very brief, and should specifically and clearly describe your contributions to the field. Again, do not underrate your work, but do not claim to have solved problems that are not firmly substantiated in the body of the thesis.

What next?

Now that you are an expert in your particular area, you should have both a narrow understanding of a well-defined problem *and* a broader understanding of the field as a whole. It is now your responsibility to guide others in the field in directions that you feel will provide the greatest good. Such recommendations are usually based on an evaluation of the major weaknesses in your own work, in which case you might recommend how others (possibly with more time and money than you enjoyed) could overcome these weaknesses.

What comprised the significant design component of your project?

This should be at least 500 words, and must describe how your work has met the ABET definition of design (see p. 1 of these Guidelines).

Suggested Format:

Organizational and format guidelines will be provided by the faculty advisor. The description of the design component, however, is required if ME 495/6 is to substitute for ME 497/8. Unless otherwise directed, students should use a 1.2" left margin, and at least 1" other margins, and students should follow the reference format used in ASME journals. The following is a *suggested* outline, as the number of chapters and order of presentation may vary with thesis topic, advisor, and/or audience:

Title page

A Really Awesome Thesis about Cool Stuff

Optional Subtitle that Underscores the Aforementioned Coolness

Honors Thesis
by
Your Name Here

Advisor: Prof. Firstname Lastname
Department of Mechanical Engineering
Lafayette College
Easton, PA 18042

May, 20xx

Table of Contents

Abstract
An abstract is a brief distillation, written *after* experiment and analysis are complete, of the entire thesis. Should include your objectives, approach taken, most significant results, conclusions, and implications. ("What you did, why you did it, and what you learned.")

Chapter 1 Introduction

Chapter 2 Methods

Chapter 3 Results and Discussion [may be broken into two sections]

Chapter 4 Conclusions

References

Design Component
If ME 495/6 has been permitted to substitute for ME 497/8, the written thesis report **must** include a description of the **significant design component** of the project. This should be at least 500 words, and should describe how the student's work has met the ABET definition of design (see p. 1 of these Guidelines).