MECH 498A

2021-2022 Guidebook

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Course Information

Instructor: Christian M. Puttlitz, PhD
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Class Hours: T, Th 12:30-1:45 in B4 Engineering

Required Text: None

Pre-requisites: Permission of the instructor. In general, the student must satisfy the requirements for admission in the Mechanical Engineering's Accelerated Master's Program (AMP, combined BS/MS) program. In addition, this course has the following course pre-requisites: C grade or better in MECH 301, MECH 325, MECH 402 (or concurrent registration), CIVE 363, and MECH 338.

Description: This is a capstone research practicum intended for seniors in the Mechanical Engineering Department. The practicum is taught over the course of two semesters, requiring the acceptable completion of 2 companion courses (MECH 498A and MECH 498B). This capstone experience is designed to give students the opportunity to integrate the technical skills and knowledge gained while completing their undergraduate curriculum through conducting a single-investigator research project. The student will work closely with a primary research adviser to propose and execute a project that will include a review of the open literature; application of a design of an experimental test facility, engineered component, system, or computational technique to a current research problem, and a project report summarizing the student's effort. Students taking this course are expected to be exceptionally well-prepared for graduate-level research in academia or industry. The quality of the final product should be equivalent to an archival journal publication or technical conference proceeding.

Course Objectives:

1. To provide students with a capstone design experience that integrates engineering fundamentals and design skills accumulated during their course of study to a defined research problem.
2. To develop single investigator skills for conducting graduate-level research, including reviewing the open literature, problem definition, research plan development, skill integration, and project execution.
3. To develop written and oral presentation skills for conveying complex engineering concepts and solutions.
4. To expose students to cutting-edge technology, instrumentation, computational software, and/or research areas of study.

Organization: Within the first week of the first semester, the student and primary research adviser will select a research topic area and form an examination committee that includes the primary advisor, the instructor of record (Dr. Puttlitz), and one CSU faculty member (can be within or outside of the Department of Mechanical Engineering). The student will then conduct a comprehensive review of the peer-reviewed literature and submit a written summary of the literature and background information (fundamental science, equations, etc.) to be graded by the instructor of record. Once completed, the student will draft a research proposal (in counsel with their faculty advisor) document and give a formal presentation to the committee for acceptance, grading and comment. It is expected that the student integrate their engineering

fundamental analysis and design skills into the execution of the project. The student will conduct the activities in their research plan. Midway through the second semester (MECH 498B), the student will give a progress update presentation to their committee. Finally, the student will submit a final research (publication quality) report and defend their results to a committee during an open forum oral presentation.

Expected Effort: It is expected that the time spent by the student on their capstone experience is substantial and befitting of a junior-level graduate student. Therefore, it is expected that students will spend no less than 15 hours per week on their research project and associated deliverables (i.e. literature review, etc.). If it becomes clear that this level of effort is not being put forth by the student, then the student's semester grade (as determined by the instructor of record and the examination committee) will be appropriately reduced.

Grading Plan
The first course (MECH 498A) grade will be weighted using the following scheme and fractional contributions of effort:

1. Literature review – 25%
2. Specific Aims page – 10%
3. Written proposal and preliminary data – 25%
4. Proposal presentation – 30%
5. Update presentations – 10%

Grades for each of the course grade components listed above will be determined by the student's examination committee and/or the instructor of record. As stated above, the student's grade may be deleteriously affected by a perceived lack of effort or progress throughout the course of each semester.

Required Lecture Attendance: A number of topics to be presented in MECH 486 (Senior Design Practicum) will be beneficial for completing your research project as well as serve you well beyond graduation. A list lectures that you will be required to attend will be distributed in the first 2 weeks of the Fall 2021 semester.

Tentative Key Dates:

3 September	Examination committee forms due.
14, 16 September	Update presentations 1.
6 October	Literature reviews are due.
15 October	Specific Aims page due.
2, 4 November	Update presentations 2.
19 November	Proposal documents are due.
30 November-3 December	Proposal and progress presentations.

All deliverables are due at noon on the date indicated unless arranged previously with the instructor. **One letter grade penalty is assessed for every 24 hours late**.

Confidentiality and Approval: The update presentations given to the entire class may constitute public disclosure of your research and associated designs and may limit your, your adviser, and your research collaborators' ability to protect intellectual property. It is therefore imperative that you discuss the content of your in-class presentations with your adviser and obtain their explicit approval prior to giving presentations in class. If it is impossible for you to limit the content of your presentation to avoid enabling disclosures, Dr. Puttlitz will make alternative accommodations so that you can still participate in the class assignments. In

addition, those who attend presentations are expected to exercise discretion in sharing the contents of those presentations.

MECH 498 A&B Examination Committee Form

Student:

Committee Composition and Responsibilities

The student's research Examination Committee consists of the Research Advisor, a Second Committee Member, and the Instructor of Record. The committee will meet at least once near the end of the Fall semester to attend the student's research proposal presentation and provide input on the student's performance/grade. The committee will meet twice in the spring semester, once to attend the student's progress presentation and once to attend the student's final research presentation. The committee will provide input to the instructor of record with regard to performance and grading for these presentations.

Committee Members and Signatures

The Research Advisor must be a tenure-track or tenured faculty member in the Department of Mechanical Engineering. S/he is responsible for overall mentoring of the student and will closely monitor the student's progress towards the stated goals of the research project.

Name: Signature:

The Second Committee member must be a faculty member at Colorado State University. S/he is responsible for attending the aforementioned presentations and student performance evaluation.

Name: Signature:

The Instructor of Record is responsible for running the course and assigning the various grading components of the course.

Name: Christian Puttlitz Signature: not required

Student Update 1 Presentations – Format

Please adhere to the following guidelines for the first update presentation:

1. Please email your Powerpoint presentation in advance or bring it on a thumb drive so that it can be loaded before class on one computer in order to expedite moving from one student to the next.

2. Each student will be limited to 6 minutes of presentation time. Any presentation lasting less than 4 minutes, 30 seconds will also incur a penalty (so please practice and timing is important).

3. You will be limited to a total of 6 slides. In these slides you should answer the following:
    a. What is the problem that you are trying to address?

    b. Present an overview of the major ways that people have tried to address this problem in the past. This is where you should present some of the literature that you have been reading on the subject.

    c. In a very general sense, give a roadmap of how you plan to tackle this problem (i.e. what is the general methodology that you are going to use).

You will have completed 3 weeks in this course by the time you present this work, so I expect to see about 60 hours of effort in the product that you deliver in this presentation.

Please let me know if you have any questions.

Student Update Presentations Evaluation Form

This form will be provided and used for each student to evaluate their peers' presentations. The evaluations are blinded so that honest and constructive feedback can be provided. This form will be used for both the first and second update presentations in the Fall semester.

Student's name

What did you like about the student's presentation?

What do you feel could use some improvement?

Out of five points (five being the best), how would you rate this presentation:

Literature Review – Guidance Document

1. Format
    a. 1 inch margins (top, bottom, right, left)
    b. Arial font, 12 point
    c. Double spacing.

2. Length
    a. No less than 1700 words, no more than 2000 words.
    b. Word count does not include title page and references. Figure captions are included in the word count.
    c. You must include a word count on the title page.

3. Table of contents/figures
    a. A table of contents/figures is not necessary, but if you choose to include one then it should not be included in the word count.

4. Figures
    a. Any figure that you did not make yourself must be properly referenced.
    b. Figure captions must be “stand-alone” text. That is, the figure caption must provide information such that one doesn’t need to read the main text to understand the data or idea being presented in the figure.
    c. Try to limit your use of figures to 5 or less.

5. Equations
    a. Use a proper equation editor for all equations (do not cut and paste from one of your references).
    b. Define all variables in each equation so that the reader knows what they are or what they represent.
    c. Equations should be centered on their own text line.

6. Style
    a. This is not a book report. Do not summarize each and every article that you’ve read into its own paragraph. The idea is that you’re citing the work of others to develop the proper background for your project, to demonstrate what has already been done, and how you will improve or build upon these previously published efforts.

7. Sample
    a. An example of an excellent literature review will be posted to Canvas so that you have a sample of what is expected.

Literature Review Grading Rubric

Name: _____

Criterion (Score 0 if element is absent)	Below Expectations (1)	Meets Expectations (3)	Exceeds Expectations (5)	Score
Breadth of Review Outcomes: 1, 7	The review does not adequately cover previous work performed in this research field.	The review adequately covers previous work performed in this research field.	The review comprehensively covers previous work performed in this research field.	
Depth of Review Outcomes: 1, 7	The review does not provide adequate detail in the research field.	The review provides adequate detail in the research field.	The review provides a well-detailed account in the research field.	
Motivation Outcomes: 1	The literature review does not adequately demonstrate the need for the proposed work.	The literature review demonstrates the need for the proposed work.	The literature review highly motivates the need for the proposed work.	
Writing elements Outcomes: 3	The writing is not clear and contains numerous grammatical and/or spelling errors.	The writing is clear with some minor grammatical and/or spelling errors.	The writing demonstrates advanced communication skills with no evidence of spelling/grammatical errors.	
			TOTAL	

Specific Aims Page

This page is intended to outline what you are proposing to perform for your research project. It is strictly limited to one page and comprised of three components:

a. The **opening paragraph** introduces the problem that you are trying to address, motivates the need for your study, and states the overarching scope of your project.

b. The **specific aims** explicitly state what you plan to do. You should have no more than 3 specific aims. Under each aim you should generally outline the methods you are proposing to achieve the aims.

c. The **final paragraph** is usually very short (no more than 3 sentences), reframes the importance of your work, and states how successful completion of the aims/project will contribute to the field.

Format:

a. 1 inch margins (top, bottom, right, left)
b. Arial font, 12 point
c. Single spacing.

An example of an excellent specific aims page will be uploaded to Canvas for use as a model.

Specific Aims Grading Rubric

Name: _____

Criterion (Score 0 if element is absent)	Below Expectations (1)	Meets Expectations (3)	Exceeds Expectations (5)	Score
Motivation Outcomes: 1, 3	The motivation for the proposed specific aims is not adequately developed.	The motivation for the proposed specific aims is adequately developed.	The motivation for the proposed specific aims is well developed.	
Specific Aims Outcomes: 1, 2, 3, 6	The proposed specific aims are not sufficient in scope and/or not well delineated.	The proposed specific aims are sufficient in scope and are well delineated.	The proposed specific aims are well delineated and demonstrate a significant scope.	
Significance Outcomes: 3, 4	The significance of the proposed work is not adequately delineated.	The significance of the proposed work is adequately delineated.	The significance of the proposed work is well delineated.	
			TOTAL	

Student Update Presentations 2 – Format

Please adhere to the following guidelines for the second update presentation:

1. Please email your Powerpoint presentation in advance or bring it on a thumb drive so that it can be loaded before class on one computer in order to expedite moving from one student to the next.

2. Each student will be limited to 6 minutes of presentation time.

3. You will be limited to a total of 6 slides. In these slides you should answer the following:

    a. Briefly restate the problem that you are trying to address. (1 slide)

    b. Present the specific aims of your project. (1-2 slides)

    c. Present the preliminary experimental or computational work to date. This should be fairly substantial and be presented in 3-4 slides.

Hopefully you have reviewed the feedback from your peers from the first round of update presentations. Please try to improve your presentation style and technique based upon their comments.

As always, please let me know if you have any questions.

Proposal Document Guidelines

This is the final written deliverable for the Fall semester and represents the work accomplished to date in this course. This document represents the foundation for your project and sets the expectation level for what will be delivered by the end of the Spring semester. It will also be delivered to your committee members for their perusal prior to your presentation at the end of this semester (i.e., you will be closely examined on its content). Therefore, you should spend a good deal of time crafting this document in order to deliver the best product. Please let me know if you have any questions, I'm happy to sit down and review samples of your writing in advance of the due date. I will post an example proposal documents to use as a model on Canvas.

Please adhere to the following guidelines:

1. **Format**: Arial font, no smaller than 11 pt, 1 inch margins.

2. **Word count**: not to exceed 2500 words. References are not to be included in the word count. Please include a word count on the title page of the document.

3. **Sections:** please closely follow this format.
    a. *Specific Aims Page*: If you wrote a good aims page, then you should be able to cut and paste. This page should include an introductory paragraph that takes about the broad issue that you are trying to address and progressively focusses down to what you are trying to achieve. The specific aims should be next, followed by a concluding paragraph about how your project, if successfully completed, will contribute to the field or problem that is being addressed.

    b. *Significance*: This should be a distilled down version of your literature review that motivates why the problem that you're working on is important, covers the salient aspects of the field that you are working in, and the prepares the reader for any special experimental techniques that you will be using.

    c. *Preliminary Work*: This section describes all the work-to-date that you have performed on the project. This is an important section because this demonstrates your actual research effort up until now. A summary paragraph should be included that ties all the work together.

    d. *Approach*: This portion represents what you are proposing to do for the remainder of this semester and the entirety of next semester. It should be organized with respect to the specific aims and provide as much detail as possible about the methods that will be utilized to achieve each aim. The final portion of this section should include an analysis of what complications could arise during the project and what alternative methods or solutions you plan to use to overcome these potential pitfalls.

    e. *Timeline*: This section lays out the timing of the experiments that were described in the Approach section. It should include a Gantt chart with monthly time intervals (please DO NOT put in weekly increments) and a brief written description of the sequence of planned experiments and overlap between tasks. The timeline should end at Engineering Days (E-days).

Appendix for Proposal Document

There are various accreditation requirement experiences that students in their capstone experience (i.e. this course) must have in order for their degree to meet the bar for ABET accreditation. Therefore, as part of the proposal document, you are required to add an Appendix (placed after your reference list) that is specifically responsive to the following 2 criteria:

1. Design and conduct engineering experiments, as well as analyze and interpret data.

2. Design a system, component, or process to meet desired needs within realistic constraints.

Please use these two headings specifically and detail how you are going to satisfy these two requirements. For many of you, this should be a simple cut and paste from the main body of your proposal document.

In addition, you must specifically address these criteria during your proposal presentation.

Finally, when you deliver your final document at the end of the Spring semester I will revisit the proposal document Appendix to make sure that you have followed through on these criteria. I must stress that these criteria are very important and represent two of the key experiences that you should gain from this course. As always, if you are having difficulty in crafting the Appendix to be responsive to these criteria, then please feel free to email me and I will be happy to sit down with you and discuss. In addition, please also use your advisor as an important resource since s/he should be very familiar with your research project and how these criteria can be satisfied during its performance.

Note: The Appendix does not count in the word count for the main body of the proposal document (limited to 2500 words). Please use as much space as you feel is necessary to respond to these criteria, but the Appendix should not be less than a single page (using the formatting rules outlined above for the main body of the proposal document).

Proposal Document Grading Rubric

Name: _____

Criterion (Score 0 if element is absent)	Below Expectations (1)	Meets Expectations (3)	Exceeds Expectations (5)	Score
Motivation and Background Outcomes: 1, 3, 4	The motivation for the study is not adequately developed and/or the background section is lacking.	The background and motivation for the study is adequately developed.	The background and motivation for the specific aims is well developed	
Proposed Work Outcomes: 1, 2, 3, 6, 7	The proposed work is not sufficient in scope and/or well delineated.	The proposed work is sufficient in scope and well delineated.	The proposed work is advanced in scope and well delineated.	
Research Progress Outcomes: 1, 2, 3, 6, 7	The quality and quantity of research work performed by the student is not satisfactory.	The quality and quantity of research work performed by the student is satisfactory.	The quality and quantity of research work performed by the student is exemplary.	
Writing elements Outcomes: 3	The writing is not clear and contains numerous grammatical and/or spelling errors.	The writing is clear with some minor grammatical and/or spelling errors.	The writing demonstrates advanced communication skills with no evidence of spelling/grammatical errors.	
			TOTAL	

Proposal Presentation Guidelines

This is the final presentation of the semester and will be delivered to your committee. I will send out a series of available one-hour blocks to schedule your presentation. It is your responsibility to coordinate with your two other committee members and schedule this presentation.

The presentation will be rigidly restricted to 15 minutes. Within the 15 minutes you should:

1. Present the problem that you are working and the necessary background information that will motivate the need for your project. (4 minutes)

2. The specific aims of your project. (1 minute)

3. The work that you have achieved to date (i.e., preliminary data); (4 minutes)

4. The research and methodology that you intend to perform in order to satisfy the specific aims. (5 minutes).

5. A timeline of the proposed tasks (1 minute)

In general, for a 15-minute talk you should have about 15 slides. I have put times associated with each section above that you might want to use as a rough way to distribute your time. Of course, these are only guidelines and each project may merit more or less time in each section.

MECH 498A – Proposal Presentation Evaluation Form

This presentation will determine 30% of the student's semester grade. It is intended that the student present the required background, specific aims of their work, research progress to date toward achieving those aims, and the proposed experiments that will achieve the balance of the aims. There is a 15-minute time limit that will be enforced.

Student:

Committee member:

Grading criteria (please grade on 1-4 scale, 1 = very poor, 2/3 = average, 4 = exceptional):

- Presentation delivery (Outcomes: 3):
- Content (Outcomes: 1, 2, 3, 6, 7):
- Research progress (Outcomes: 1, 2, 6, 7):
- Overall impression:

How would you rate this student compared to your former and current 1st year MS graduate students?

Do you feel the project can be reliably finished by Engineering Days (April 2022)?

General comments (please include any strengths as well as weaknesses that the student should try to improve upon):