

# Mechanical Engineering Undergraduate Research Courses

## Mech 493 and Mech 410C/F

In practice, Mech 493 and 410A/B are essentially identical in their goals, with the difference that 493 is a two-term, three-credit course, and Mech 410C/F is a pair of one-term, three-credit courses. Enrollment in the second course Mech 410F is contingent on approval of the project sponsor and course coordinator after the successful completion of Mech 410C; ordinarily, we expect that most students enrolling in 410C will continue in 410F.

It is expected that projects proposed for the final year research course will be suitable for both the 3-credit course Mech 493 and the 6-credit Mech 410 C/F, unless specifically indicated in the project description.

## Calendar Description

MECH 410C/F (3 each) Undergraduate Research I and II.

Research project directed by a faculty member in Mechanical Engineering. This course is not eligible for Credit/D/Fail grading. [0-5-1 each term] Prerequisite: Fourth-year standing and at least 80% average in third-year courses and permission of instructor.

MECH 493 (3) Introduction to Academic Research.

Research project directed by a faculty member in Mechanical Engineering. This course is not eligible for Credit/D/Fail grading. [0-5-1] Prerequisite: Fourth-year standing and at least 80% average in third-year courses and permission of instructor.

## Learning Objectives

1. To gain experience of the practice of academic research
2. To understand the difference in thinking style required when doing research compared to when doing coursework studies. This thinking involves the creation of new knowledge rather than the acquisition of existing knowledge.
3. To gain a deeper knowledge of a specialized area of interest.
4. To gain personal insights into the practice of research to provide data for student decisions regarding future study/career choices.

## Prerequisites

80% average in third year

## Research Project

A suitable research project will require the student to use and exercise mature thinking and research skills. The student should use their judgement, review the relevant literature, plan and conduct research work, reflect and analyze results, formulate conclusions and produce a concise written report. Overall the project should provide an intellectually challenging experience; that is, it should not be routine or mundane.

## Research Proposal (developed with project supervisor)

The students will prepare a research proposal with the guidance of their supervisors. The initial draft proposal (due in the second or third week of the term) is intended to help "kickstart" this process and should include your understanding of the research you are undertaking (what are you going to do?), and include pointers to the relevant background literature, the research motivation and questions/hypothesis, methods, and expected deliverables.

Before undertaking any writing students are advised to read [Professor Ashby's \(author of many papers and textbooks on materials\) very readable, and illustrated, guide to writing a research paper.](#)

The final proposal should be no more than 10 pages in length. It should have the following headings (or similar):

- Title (or Cover) Page – does not count toward the total page count.
- Abstract
- Table of Contents
- Introduction (including Statement of Problem, Purpose of Research, and Significance of Research)
- Background (including Literature Survey)
- Description of Proposed Research (including Method or Approach)
- List of References
- Budget and resources required

## Research Thesis

The final research thesis should have the following sections (or similar) in about 20 pages. The marking rubric is provided for supervisors as a guideline only:

1. Introduction (10%)
2. Literature Review (20%)

3. Methodology (15%)
4. Results (15%)
5. Discussion (20%)
6. Conclusions and Future Work (20%)

The Future Work section can be up to 2 pages in length, and it should be written as a research proposal for a MASc project.

## Course Timeline, Deliverables and Grading:

For Mech 493, students are expected to devote approximately 10% of their time, or 4-5 h/wk, to their thesis project as this is a 3-credit course taken over two terms. For Mech 410C/F, the expectation is doubled, as this sequence is three credits each term.

Deliverable	Deadlines		Evaluated by:	Grading Weight		
	General	2022W		Mech 493	Mech 410 C	Mech 410 F
Short (Draft) Proposal (~1 page)	term 1, week 4	Sept. 30, 2022	Supervisor	0%	0%	
Research Proposal (5 - 10 pages)	term 1, week 9	Nov 4, 2022	Supervisor	25%	50%	
Presentation of Research Progress + Research Progress to Date (~15 min)	during December exam period	By Dec. 22, 2022	Supervisors present	10%	50%	
Thesis (~20 pages)	start of April exam period	Apr. 17, 2023 <sup>1</sup>	Supervisor	40%		70%
Research Project Presentation (15 min & 15 min Q&A)	during April exam period	By April 28, 2023	Supervisors <sup>2</sup> present	20%		25%
Web Summary <sup>3</sup> (100-200 words + picture)	with thesis		Supervisor	5%		5%

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- 1 Earlier submission is encouraged.
  - 2 One presentation session will include approximately 4 students and their supervisors.
  - 3 Please use [this template](#) to submit your web summary.