

4A06 Engineering physics Capstone Design Project

Undergraduate Studies

Fall, Winter 2022-2023

Course Outline

CALENDAR/COURSE DESCRIPTION

Engineering design capstone project synthesizing undergraduate Engineering Physics knowledge to select a meaningful real-world problem, and to engineer a solution by mathematically modelling the impact of design decisions and implementing them physically as part of an engineering team.

Two labs (three hours each), one capstone project; both terms

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): Registration in the final level of an Engineering Physics program

Antirequisite(s): IBEHS 5P06

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Adrian Kitai

Office Hours:

By appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Amanda Thomas

thomasaj@mcmaster.ca

Liam Flannigan

flannilg@mcmaster.ca

Tyler Kashak

kashakta@mcmaster.ca

Alexander Parent

parena1@mcmaster.ca

Ethan Diak

diake@mcmaster.ca

Kevin Ruiz

ruizk2@mcmaster.ca

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

MS Teams

COURSE INTENDED LEARNING OUTCOMES

By the end of 4A06 you will be able to:

1) Link your undergrad theoretical knowledge to the real world:

You will be able to identify a meaningful a real-world problem, and conceive, understand, build and demonstrate a solution to it.

2) Work effectively on a complex project in a Team:

You will be able to work in a Team and closely cooperate with your Team members in the context of a capstone project.

3) Understand the design process using a staged approach

You will be able to work through three critical stages of your design, culminating in an Expo-worthy live demonstration.

4) Communicate and document your design and design process effectively

You will be able to properly document your design and the rationalizations for specific design decisions in written, video and live formats.

MATERIALS AND FEES

As-needed for development of your specific project. For standard projects, modest department reimbursement funding with a limit to be determined is available for supplies per group. This is only available at the end of the course (i.e., in April), and only with presentation of receipts (please keep your receipts!) Interested groups may optionally select more ambitious projects than this allows and in those cases are especially encouraged to work with a client who can provide extra reimbursement funds and/or enter design competitions to help fund their project.

COURSE FORMAT AND EXPECTATIONS

You will work as an engineering Team comprising ***not more than 3 students (preferred) and not less than 2 students*** on a project of your choosing that is deemed satisfactory. ***There are absolutely no exceptions to these upper and lower student number limits.***

Assistance will be ***intensively provided in week 1 of the semester*** to choose and qualify your projects. You must have a qualified project by week 2.

The expectation is that your work intensity for this course will be at a maximum during two critical 6 week periods.

A log will be required that confirms your weekly work hours on this course during the two critical 6 week long design-and build phases to be described below. You and your Team members must sign off on this log.

A formal process will be available to resolve any grievances related to failure of contribution by any Team member. Grades for the course will be the same for each member of a Team with the possible exception in cases in which a grievance is registered.

You must start designing and building in weeks 1 - 6 of the Fall semester.

By mid October, you must demonstrate a physical proof of concept of your design. This proof of concept MUST involve hardware and it must show that the design is feasible. It is OK if it is held together by sticky tape and chewing gum at this point, but it is NOT OK to just present drawings and simulations.

What you have built by week 6 of Term 1 will be your proof of concept and it will be worth marks, sort of like a first midterm test.

The first 6 weeks of the winter term will be devoted to revamping your builds, culminating in a critical in-course demo event to be scheduled in mid February. This demo event will be a dress rehearsal for your end of course faculty-wide Exposition. **Marks will be given for this critical February milestone, sort of like a second midterm test. The expectation is that you will clearly validate the functionality of your projects with a live demo.**

4) The final weeks in February and March will be for final improvements to your builds but at this point, the scope of your work will be limited to **getting any remaining bugs out of what you demonstrated in February**. Then your fully debugged demo will be ready for the faculty-wide showcase in April.

6) The course will emphasize **designing and building**.

7) In the second 6 weeks of the first semester, the course will provide instruction in the design process and in entrepreneurship. Information allowing you to decide if you might want to start a company will be provided. Facilities and resources available through McMaster University and beyond McMaster University will be described in the context of the start-up company ecosystem. A few case studies will highlight and illustrate these concepts much more clearly.

8) You will have time to complete your written submissions during the second 6 weeks of each semester. Report 1 due in late November 2022 must describe your project and project next steps. Report 2 due in late March 2023 must describe your project and project achievements and must include a video. Format requirements will be provided during the course.

COURSE SCHEDULE

See calendar.

ASSESSMENT

Component	Weight
Demo in mid October	20%
Demo in mid February	30%
Report 1 including signed-off log	10%
Report 2 including signed-off log	10%
Faculty wide expo at the end of the winter semester and video	30%
Total	100%

ACCREDITATION LEARNING OUTCOMES

The Learning Outcomes defined in this section are measured for Accreditation purposes only and will not be directly taken into consideration in determining a student's grade in the course. **Outcomes**

Indicators

Applies appropriate knowledge of math in engineering work

01.1 - Competence in Mathematics

Applies appropriate knowledge of natural science foundations in engineering work

01.2 - Competence in Natural Sciences

Applies appropriate knowledge of engineering science foundations in engineering work

01.3 - Competence in Engineering Fundamentals

Applies appropriate knowledge of specific Eng Phys foundations in engineering work

01.4 - Competence in Specialized Engineering Knowledge

Proposes proper merit functions, specifying constraints in projects

02.1 - Demonstrates an ability to identify reasonable assumptions (including identification of uncertainties and imprecise information) that could or should be made before a solution path is proposed.

03.2 - Selects appropriate model and methods and identifies assumptions and constraints.

04.2 - Recognizes and follows engineering design principles including appropriate consideration of environmental, social and

Mathematically models solutions in the project in a way that reflects reality

Iterates on design process correcting assumptions to converge on a solution in reality

Specifies creative solutions for both choice of and solution to projects	economic aspects as well as health and safety issues.
Follows health and safety procedures through design and with its solution	04.3 - Proposes solutions to open-ended problems.
Demonstrates a knowledge of appropriate codes and standards applicable	04.5 - Includes appropriate health and safety considerations
Uses advanced design tools to solve engineering problems of relevance	04.6 - Determines and employs applicable standards and codes of practice.
Maintains good working conditions in the team throughout the design project	05.3 - Creates, adapts, modifies and extends tools and techniques as appropriate to solve problems.
	06.2 - Develops and implements processes and methodologies to manage the effectiveness of a team
both in terms of the quality of the work produced by the team as well as the inter-personal relationships within the team.	
Is able to efficiently and professionally communicate with client throughout the process	07.3 - Constructs effective oral or written arguments as appropriate to the circumstances
Keeps up with deadlines and budgets	11.2 - Plans and effectively manages time, resources, and scope
Extends knowledge by using undergrad knowledge as not an end, but a springboard on which to look beyond and seek new information as appropriate	12.1 - Critically evaluates and applies knowledge, methods and skills procured through self directed and self identified sources, including those that lie outside the nominal course curriculum.

Academic Integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.** Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

1. plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. improper collaboration in group work.
3. copying or using unauthorized aids in tests and examinations.

COURSES WITH AN ON-LINE ELEMENT

McMaster is committed to an inclusive and respectful community. These principles and expectations extend to online activities including electronic chat groups, video calls and other learning platforms.

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities.

These expectations are described in the [**Code of Student Rights & Responsibilities**](#) (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated.

Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact [**Student Accessibility Services**](#) (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's [**Academic Accommodation of Students with Disabilities**](#) policy.

COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES

It is the students' responsibility to regularly check the course forum for updates and announcements. Under normal circumstances, missed deadlines are assigned a late penalty by multiplying the grade they would otherwise receive by a fraction that decreases linearly from 100% to 0% over the first 10 hours past the deadline.

SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

1. Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:

- Use the [**McMaster Student Absence Form**](#) (MSAF) on-line self-reporting tool. No further documentation is required.

2. For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has been used previously in that term:

- Students must report to their Faculty Office to discuss their situation and will be required to provide appropriate **supporting documentation**.
- If warranted, the Faculty Office will approve the absence, and the instructor will determine appropriate relief.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [RISO](#) policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.