

**4A06 Engineering physics Capstone Design Project**  
Undergraduate Studies  
Fall, Winter 2024-2025  
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) in **BSB B157**

**Fall term:** Wednesdays 11:30 am to 2:30 pm and Fridays 8:30 am to 11:30 am

**Winter term:** Wednesdays 8:30 am to 11:30 am and Fridays 8:30 am to 11:30 am

**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**

Ethan Diak  
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**COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION**

<b>COURSE INTENDED LEARNING OUTCOMES</b>
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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.

<b>MATERIALS AND FEES</b>
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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. In 2023-2024 the amount provided was \$160 per student. This is subject to change and will be confirmed as soon as possible.

<b>COURSE FORMAT AND EXPECTATIONS</b>
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You will work as an engineering Team comprising ***not more than 3 students 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.

You will be assigned a TA who will meet with you weekly for one hour. ***All team members are to be present for these meetings.*** Your report that you present in person with the TA must include a summary of the work you have done that week, the work you are planning for the following week, and a summary of any problems and challenges you are having. The main goal is to keep you on track. These weekly reports will also form one component of **Report 1** and **Report 2**. A grade of 5% is assigned to these weekly reports and your attendance at the weekly meetings. See details below.

**In some situations, it may be necessary to resolve issues related to a lack of contribution from a Team member.** There may be a **skill deficit** that prevents one team member from making what the other team members feel is an adequate contribution. The standard available remedy is as follows: Grades for the course will be the same for each member of the Team, however the student with the skill deficit (**mentee**) is to be mentored by the other Team members (**mentor(s)**) to build the needed skill set. In recognition of the additional mentoring role, the mentor(s) will each receive a gift card of value \$25. You need to set up a meeting with instructor Adrian Kitai to trigger this remedy. There should be absolutely no shame or embarrassment involved in coming forward to make this arrangement as needed.

If a team member fails to make a fair contribution that relates to issues other than a skill deficit then the complainants should meet with instructor Adrian Kitai and grade adjustments among the team members or even more drastic action might be necessary on a case-by-case basis.

You must alert the instructor in a timely manner to enable an appropriate remedy to be implemented. If groups claim that a specific team member was not contributing and this becomes known to the instructor only at the end of the course, it will be too late to take appropriate action. The entire group will collectively have to pay the price for the problem.

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

By late 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 engineering design and revamping your builds, culminating in a critical in-course demo event to be scheduled in late February. This demo event will be organized in a **Departmental Showcase Event**

**Marks at the Departmental Showcase event will be given for this critical 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 remaining 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**, however following a well-documented design and analysis process is also a critical element. Your reports must capture this clearly. Mathematical design can be useful and important, but the design tools you use will depend on your project. Your TA will guide you as to an appropriate type and level of design to strive for.

7) In the second 6 weeks of the first semester, the

8) You will have time to complete your written submissions during the second 6 weeks of each semester. Report 1 due in late November 2024 must describe your project and project next steps. Report 2 due in late March 2025 must describe your project and project achievements and must include a video. Format requirement details will be provided during the course.

<b>COURSE SCHEDULE</b>
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See calendar.

<b>ASSESSMENT ( SUBJECT TO GRADES SUBTRACTED BY FAILURE TO CONTRIBUTE TO AND ATTEND WEEKLY MEETINGS)</b>
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Component	Weight
Demo in mid October	20%
Demo and Showcase in mid February	25%
Weekly reports	5%
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%

<b>ACCREDITATION LEARNING OUTCOMES</b>
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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. <b>Outcomes</b>	Indicators
<b>Applies appropriate knowledge of math in engineering work</b>	01.1 - Competence in Mathematics
<b>Applies appropriate knowledge of natural science foundations in engineering work</b>	01.2 - Competence in Natural Sciences
<b>Applies appropriate knowledge of engineering science foundations in engineering work</b>	01.3 - Competence in Engineering Fundamentals
<b>Applies appropriate knowledge of specific Eng Phys foundations in engineering work</b>	01.4 - Competence in Specialized Engineering Knowledge
<b>Proposes proper merit functions, specifying constraints in projects</b>	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.
<b>Mathematically models solutions in the project in a way that reflects reality</b>	03.2 - Selects appropriate model and methods and identifies assumptions and constraints.

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

**Specifies creative solutions for both choice of and solution to projects  
Follows health and safety procedures through design and with its solution  
Demonstrates a knowledge of appropriate codes and standards applicable  
Uses advanced design tools to solve engineering problems of relevance**

**Maintains good working conditions in the team throughout the design project**

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  
Keeps up with deadlines and budgets**

**Extends knowledge by using undergrad knowledge as not an end, but a springboard on which to look beyond and seek new information as appropriate**

04.2 - Recognizes and follows engineering design principles including appropriate consideration of environmental, social and economic aspects as well as health and safety issues.

04.3 - Proposes solutions to open-ended problems.

04.5 - Includes appropriate health and safety considerations

04.6 - Determines and employs applicable standards and codes of practice.

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

07.3 - Constructs effective oral or written arguments as appropriate to the circumstances

11.2 - Plans and effectively manages time, resources, and scope

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](mailto: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.