

Mechanical Engineering MECHENG 4M06
Mechanical Engineering Capstone Design Project
Faculty of Engineering – McMaster University – Undergraduate Studies
Fall/Winter 2023/24

Course Outline

Calendar/Course Description

A major mechanical project including quantitative design. Analysis, optimization, validation and/or testing to be completed under the supervision or co-supervision of a faculty member holding an appointment in the Department of Mechanical Engineering. Includes lectures, one capstone project; both terms

Pre-Requisites

Prerequisite(s): Registration in Level IV Mechanical Engineering; or Level V Mechanical Engineering and Management or Mechanical Engineering and Society

Instructor Contact Information

Course Coordinator: Dr. Gary Bone.

The best way to reach Dr. Bone is to email gary@mcmaster.ca using your McMaster account. Please always include "4M06" as part of the subject line.

Project Supervisors:

Dr. R. Ahmed,
Dr. M. Aramesh,
Dr. G. Bone,
Dr. C. Ching,
Dr. J. Cotton,
Dr. S. Habibi,
Dr. M. Hamed,
Dr. E. Hassan,
Dr. P. Koshy,
Dr. C. Morton,
Dr. Z. Motamed,
Dr. C. Quenneville,
Dr. S. Tullis,
Dr. S. Veldhuis, and
Dr. F. Yan

Lectures

In-person lectures will take place from 2:30-3:20 pm on Tuesdays (in JHE-376), Thursdays (in MDCL-1105), and Fridays (in JHE-376). The lecturers will include Dr. Bone and invited speakers. **Attendance at these lectures is required.** The invited lectures will be related to the practice of engineering, or to the transition from student to employee. The lecture schedule will be posted on Avenue. Lectures only occur during part of the Fall term; there are no lectures in the Winter term. **Note: A quiz on the content of the invited lectures, worth 5% of the final grade, will be held on Oct. 17 during the lecture timeslot.**

Course Website/Alternate Methods of Communication

Course is hosted on Avenue to Learn (<http://avenue.mcmaster.ca/>) under MECHENG 4M06A. Please contact the course coordinator immediately by email if you are registered for the course, but do not have access to the course on Avenue.

All formal communication regarding course requirements, changes, project submissions, etc. will be announced in Avenue. It is assumed that all announcements on Avenue have been received by all students registered in the class.

Materials and Fees

There are no required texts for this course. Some lecture content may be posted in Avenue.

There is no course fee. The Department of Mechanical Engineering provides limited project funding to groups that meet the requirements, and in some cases, additional funding is provided by the Project Supervisor or Industrial Sponsor (if applicable).

Course Format and Expectations

The course is primarily based on the process and successful completion of a Mechanical Engineering design project as a group. Groups of 2-4 members may be self-formed, or may be assigned by the Course Coordinator. All projects must be approved by the Course Coordinator and one of the Project Supervisors. The list of available projects is posted on Avenue at the start of the term. Students are encouraged to contact potential Project Supervisors and submit their top five project preferences using an online form shortly after the project list is posted. Projects are then assigned, and in some cases, groups formed, by the Course Coordinator based on the submitted project preferences, and other factors. These form the majority of the projects. Some projects, particularly those proposed by students, are reserved for specific groups. **Please note that the project assignment process typically involves some compromises – not everyone will get one of their top choices and while unfortunate, this should not affect the group’s ability to perform to a high standard, and to gain value from the course.**

Each group will be supervised by a Project Supervisor (from the list provided above). The “Project Submission Form” provides the initial definition of the project. The group will work with the Project Supervisor to carefully refine the goals and other aspect of the project. Each project must involve mechanical design, analysis, building and testing. The group is expected to report directly and regularly to the Project Supervisor and document their progress in a mutually agreed upon way.

The majority of the time you spend on the course will involve working individually, working with your group, and consulting with your Project Supervisor. The Project Laboratories (Mechanical Engineering Machine Shop) and, in some cases, faculty research laboratories will be available for design-build-test elements of the project. You and your group will be responsible for scheduling meetings and work sessions according to the availability of your group and these additional resources.

Design journals documenting individual group members contributions to the project should be updated continuously using Notion (or equivalent) and shown to the Project Supervisor on a weekly basis.

Groups should endeavour to work consistently and diligently throughout the term, dividing work among group members such that all members are involved in all types of work. Individuals or Groups should attempt to resolve any conflicts they might have within their group and/or with their Project Supervisor, but the Course Coordinator can also be approached if a third party is needed. **The IEF (see section below) is used in situations where the group mark does not reflect the initiative or effort put forth by one or more group members (either reducing or increasing an individual’s grade relative to the group mark).**

Additional information:

- Average project effort per person must be 6 hrs/week in the fall term, and 12 hrs/week in the winter term. Project Supervisors will expect to observe progress based on this amount of effort.
- All written documents must be prepared using standardized templates/forms while adhering to the maximum space requirements for each of the boxes on the form (if applicable).
- Documents are to be formal engineering reports and need to be prepared to a professional standard. A logical, concise, and well-organized report is far better than a voluminous, rambling one. The Project Evaluators and Supervisors are expected to read and provide timely feedback and evaluations to the students and submit their completed rubrics to Avenue.
- Presentations are to be prepared to professional standards by each group. The students should directly approach the Presentation Evaluators for any feedback soon after the marks have been posted on Avenue. Evaluator feedback should be considered when preparing reports.
- Good communication with your Project Supervisor is critical to the success of the project. Schedule weekly meetings (preferably in-person). All group members must attend these meetings. Your supervisor may assign you demerit marks in consultation with the Course Coordinator for poor project meeting attendance. You and your supervisor will define the requirements for your Prototype / Proof of Concept Demonstration together.
- If your project leads to the creation of new Intellectual Property (IP), you may have certain rights regarding the ownership of that IP. Please be sure to discuss this with your Project Supervisor or the Course Coordinator, who may guide you to other McMaster resources. See, for example, McMaster's policies on Joint IP located at the following address: <https://secretariat.mcmaster.ca/app/uploads/Joint-Intellectual-Property.pdf>

Course Schedule

The detailed course scheduling information will be posted on Avenue. Some important dates are shown below. Submission deadlines will also be posted on Avenue.

Date/Range	Topic
Sep. 5	Introductory Lecture by Dr. Bone
Sep. 7	Q & A Session #1 with Project Supervisors
Sep. 8	Q & A Session #2 with Project Supervisors
Sep. 12 – Oct 6	Invited lectures held during scheduled class time (schedule will be posted on Avenue)
Sep. 14	Project Preferences Deadline – last day to submit your list of preferred projects using the online form provided via Avenue
Sep. 18	Assigned Project Groups will be posted on Avenue by the Course Coordinator
TBD (Mar/Apr)	Prior to Capstone Expo: Submission of supporting documents for Expo (poster, abstract, etc. – details TBD)
Apr. 9	Faculty of Engineering Capstone Expo

Assessment

Evaluation will occur at various times throughout the course and will be performed by the Project Supervisor, other faculty members, and the Course Coordinator. The requirements, rubrics and deadlines (if not listed here, or if the listed deadlines are updated) for each of the components listed below will be provided on Avenue.

Term	Component	Deadline	Weighting (%)
1	Quiz (based on the invited lectures)	Oct. 17	5 ^a
1	Scope of Work (SW) Document	Oct. 19	10 ^b
1	Group Presentation 1	Nov. 6 – Nov. 17	15 ^b
1	Project Report 1: Design Concept and Funding Request	Dec. 1	15 ^b
2	Prototype / proof of concept demonstration	TBD	10 ^{b,c}
2	Group Presentation 2	TBD	20 ^b
2	Final Project Report	TBD	20 ^b
2	Capstone Expo	Apr. 9	2.5 ^b
2	Student Self-reflection Document	TBD	2.5 ^a
Total			100

Note a: This is an individual mark (grade).

Note b: These are group marks that are normally, but not always, assigned equally to each group member. In cases where a notably unequal amount of initiative or effort was applied by the group members, an IEF, or “Initiative and Effort Factor”, is applied to the group mark to calculate the marks of each student within the group. **This “IEF” adjustment process can be initiated by individuals within the group or by the Project Supervisor.** The IEF is a number in the range of 0.0 to 1.0 (or higher than 1, in rare situations deemed appropriate by the Project Supervisor and Course Coordinator). An IEF of 0 represents negligible participation in the group’s efforts, and 1.0 (or more, at supervisor and coordinator’s discretion) indicates full initiative and effort (or going above and beyond the average group effort when a lower group mark does not represent the individual’s initiative and effort). **When the IEF adjustment is applied by the evaluator, the student’s individual mark will be calculated as follows:**
(Individual Mark) = (Group Mark) × (IEF).

Note c: The prototype/proof of concept demonstration mark is meant to demonstrate to your supervisor and any other stakeholders that your project is progressing well, and is on schedule or ahead of schedule.

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.

Graduate Attributes	Indicators
Problem Analysis, Design, Use of Engineering Tools, Individual and Teamwork	2.01, 2.02, 4.01-4.06, 5.01, 5.02, 6.01-6.03
Communication skills, Professionalism, Impact on Society & Environment	7.01-7.02, 8.01, 9.01
Economics and Lifelong Learning	11.02, 12.01

For more information on Accreditation, please visit: <https://www.engineerscanada.ca>

Equity, Diversity, and Inclusion

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

The Department of Mechanical Engineering is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our Department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Undergraduate Chair, Academic Advisor or to contact the [Equity and Inclusion Office](#).

Physical and Mental Health

For a list of McMaster University's resources, please refer to the [Student Wellness Centre](#).

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.

Authenticity / Plagiarism Detection

This course will use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. Students will be expected to submit their work electronically via Avenue to Learn where plagiarism detection software (a service supported by Turnitin.com) will be used so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform Dr. Bone by email at least 1 week before the assignment is due. No penalty will be assigned to a student who does not submit work to the Turnitin.com plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

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.

Submission of Request for Relief for Missed Academic Work

McMaster Student Absence Form (MSAF): 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”.

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. Unauthorized recording of lectures is not permitted.**

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.

The course coordinator and university reserve the right to modify elements of a course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course website weekly (or more often) during the term and to note any changes.

STUDENT SUPPORTS

WELLNESS

Student Wellness Centre

On-Campus Support for Medical and Mental Health Concerns. Doctors and Counsellors available. Located in PGCL, 2nd Floor.

Mon-Fri 9AM-5PM 905-525-9140 ext. 27700
<https://wellness.mcmaster.ca/contact-us/>

Main St. West Urgent Care Centre

For immediate health concerns that do not require the emergency room.

690 Main St W - Mon-Sun 9AM-9PM

Emergency Rooms

For **immediate, serious** health concerns.

St. Joseph's Healthcare Hamilton
50 Charlton Ave E

McMaster Children's Hospital
Students 17 and under

Telehealth Ontario

Telehealth Ontario is a free, confidential service you can call to get health advice or information. A Registered Nurse will take your call 24 hours a day, seven days a week.

Toll-free: 1-866-797-0000 Toll-free TTY: 1-866-797-0007

Phone Lines

Good2Talk

Confidential helpline providing professional counselling, info and referrals for mental health, addiction, and well-being

1-866-925-5454

LGBT Youthline

Confidential, non-judgemental & informed LGBTQQ2SI peer support.

Sun-Fri, 4-9:30 PM, Text 647-694-4275

SACHA (SEXUAL ASSAULT CENTRE - HAMILTON AREA)

Confidential, anonymous 24-hour nonjudgmental telephone support for adults who have experienced sexual violence at any point in their lives; will provide accompaniment to hospital or police station for survivors wishing to seek medical attention or report; counselling services & public education

905-525-4162

Empower Me (Graduate Students)

24/7 accessible counselling services to empower you to thrive, crisis support, mental health and well-being services.

1-844-741-6389

Bounceback

CBT skills-building for mild to moderate depression and anxiety for people 15 or older. If accessed through self-referral, the client's primary care provider will be notified.

1-866-345-0224

INDIGENOUS STUDENTS

Indigenous Student Services

Academic & social counselling, employment aid
LRW 1010

ext. 23788

indigenous.admin@mcmaster.ca
indigenous.mcmaster.ca

INTERNATIONAL STUDENTS

International Student Services

Advising services for international students and exchange students
GH 104

ext. 24254

iss@mcmaster.ca
iss.mcmaster.ca

STUDENT SUPPORTS

ACADEMIC

Student Success Centre

Academic skills assistance, job search, volunteering
GH 110
ext. 24254
studentsuccess@mcmaster.ca

Student Accessibility Services

Disability services, assistive technology support
MUSC B107
ext. 28652
sas@mcmaster.ca

TutorOcean

Student to Student Tutoring Services
<https://mcmaster.tutorocean.com/>

FINANCIAL

Office of Student Financial aid and Scholarships

Emergency funding, government funds, OSAP assistance, scholarships, work programs
GH 120
ext. 24319
<https://registrar.mcmaster.ca/aid-awards/>

FOOD

Food Collective Centre (FKA Mac Bread Bin)

The Food Collective Centre is a service run by students dedicated to cultivating stronger food systems in the McMaster and surrounding community. (MSU Service)
macbreadbin@msu.mcmaster.ca
<https://www.msumcmaster.ca/services-directory/14-food-collective-centre>

Neighbour 2 Neighbour

Food bank, community kitchen, community counselling, help with paying for utilities, and more. Hamilton Mountain.
905-574-1334 <http://www.n2ncentre.com/>

CRISIS SUPPORT

Barrett Centre for Crisis Support

Provides a safe environment in the community and responds to the needs of individuals, 16 years of age or older, who experience a mental health crisis and do not require a hospital stay. Confidential and free services 24/7/365
24 Hour Crisis Line: 905-529-7878, Toll Free: 1-844-777-3571

COAST (Crisis Outreach and Support Team)

Hamilton's crisis line is answered 24 hours a day, 7 days a week. The COAST mobile team, consisting of a mental health worker, and a police officer, will respond to crisis calls between the hours of 8 a.m. and 1 a.m. daily.
905-972-8338

Oakville Distress Centre

Distress Centre Halton provides telephone and online support to people to better cope with crisis, loneliness, and emotional stress. Also serves the Hamilton area.
905-849-4541

Assaulted Women's Helpline

Free, anonymous and confidential telephone and TTY crisis telephone line to all women in the province of Ontario who have experienced any form of abuse. Provides crisis counselling, safety planning, emotional support, information and referrals accessible 24/7/365.
Toll-free: 1-866-863-0511 TTY: 1-866-863-7868

Crisis Resources in the GTA

The CAMH Distress Crisis Resources web page lists a number of phone lines, response teams and hospitals in the GTA.
<https://www.camh.ca/en/health-info/crisis-resources>

STUDENT SUPPORTS

OTHER

Student Assistance Plan (Undergraduate)

Psychological counseling (offered in-person, over the phone, or over secure video) and academic-life services (legal consultation, financial consultation, life coaching, nutrition consultation and wellness resources offered virtually or in-person)

<https://www.msumcmaster.ca/services-directory/36-health-and-dental-insurance/student-assistance-plan>

Ombuds Office

Advice for students, staff, and faculty regarding academic and non-academic concerns.

MUSC 210

ext. 24151

ombuds@mcmaster.ca

mcmaster.ca/ombuds

SWHAT - Walk Safe Program

The Student Walk Home Attendant Team (SWHAT) is a volunteer service within the McMaster Students Union that will walk or bus with students during the evening hours 7 days a week, in all kinds of weather! (MSU Service)

Ext. 27500

swhat@msu.mcmaster.ca

Student Support and Case Management

Student rights & responsibilities

GH 207

ext. 23845

studentconduct.mcmaster.ca

Chaplaincy Centre

Pastoral support with personal counselling and bereavement support groups.

MUSC 231

ext. 24207

McMaster Engineering Society

Support from other McMaster Engineering Students

<https://www.macengsociety.ca/>

MSU PEER SUPPORT SERVICES

MSU Maccess

Maccess is a service that aims to build and maintain a campus that celebrates, advocates, and ensures inclusivity in the area of disability. A central aspect to Maccess is the provision of peer support by trained volunteers with lived experiences with disability such as chronic illness, mental illness, mental health concerns, neurodivergence, and additional identities.

Student Health Education Centre

SHEC is a peer-run health promotion, education, and referral service for McMaster University students. SHEC focuses on engaging with students about health-related issues through performances, peer support, fundraisers, and events. The service offers peer support, anonymous and confidential pregnancy testing, a resource library, condoms, lubricant, and menstrual products. SHEC's space is located in MUSC 202.

Women + Gender Equity Network

WGEN is a service that caters to women, transfolk, people who identify outside the gender binary, and all survivors of sexual assault. WGEN provides a safe(r) space and resource library on campus in MUSC 204. Volunteers in the space offer peer support and the service also runs a support group for survivors of domestic and intimate partner violence.

Pride Community Centre

The Pride Community Centre is a service of the McMaster Students Union. We provide a contact point for McMaster students that may identify as gay, lesbian, bisexual, transgender, queer, and/or any of the other diverse identities that make up our community. We offer educational programming and access to resources of interest, as well as peer support and a physical space for students to meet and socialize with each other. As advocates for gender & sexual diversity, the PCC's mandate upholds that LGBTQ+ students are entitled to a safe and supportive campus, absent of homophobia and transphobia, where the expression of one's gender & sexual identity is welcomed and respected.