

MECH ENG 2C04 – Mechanical Engineering Design

Project - Fall 2024

Instructor: Dr. Elizabeth Hassan

Email: hassae3@mcmaster.ca

The information in this course outline is accurate at the time of writing but may be modified at the instructor's discretion. Any modifications will be made with an effort to minimize disruptions to student learning.

This course is being delivered fully in person

Lecture: Mon and Thu 130-220, room per Mosaic

Labs:

- Per your **group's** schedule, alternating between in lab and in shop
- You **must** attend **your** group's assigned time and location to manage room capacity and supervision
- A final schedule and TA contact information will be posted on Avenue

Office hours: 1100-1200 Monday Dr. Hassan's office or call Dr. Hassan on Microsoft Teams

"Office hours" are when I am planning to be there and available to work with students. You can come for feedback on an assignment before you submit, ask questions about something I covered in lecture, get help with your project, get advice on problems with your group, or anything else that you would like my help with.

Learning Outcomes:

By the end of the MECHENG 2C04, the student should be able to:

1. Work as an effective team member on a mechanical design project.
2. Generate multiple design alternatives.
3. Select an initial design solution.
4. Analyze and evaluate the design solution using a CAD generated model.
5. Prepare an invoice based on the contribution of the team members and material costs.
6. Construct a written design project report with engineering and manufacturing drawings.
7. Use CAD to generate data for manufacturing components using a 3D printer and laser cutter.
8. Present their design solution to an audience.
9. Proficiently use a solid modeling CAD system to create part and assembly models and to generate drawings and bills of material;
10. Properly dimension engineering drawings according to national standards;
11. Select appropriate views and use drawing conventions such as sectioning and auxiliary views to communicate part design information;

This course is intended to encourage you to develop **independent** engineering judgement. You may notice that this project is more open-ended than 1st year projects, and there is less “scaffolding”. This is intentional and designed to guide your development .

Graduate Attributes:

MECHENG 2C04 provides the student the opportunity to develop competence in the following CEAB graduate attributes:

| Graduate Attributes |
|---|
| 4.01 - Recognizes and follows an engineering design process. (This means an iterative activity that might include recognizing the goal, specifying the constraints and desired outcomes, proposing solutions, evaluating alternatives, deciding on a solution, and implementing.) |
| 4.02 - Recognizes and follows engineering design principles including appropriate consideration of environmental, social and economic aspects as well as health and safety issues. |
| 4.03 - Proposes solutions to open-ended problems. |
| 4.04 - Employs appropriate techniques for generation of creative ideas such as brainstorming and structured inventive thinking. |
| 4.06 - Determines and employs applicable standards and codes of practice. |
| 5.02 - Demonstrates an ability to use modern/state of the art tools. |

Contact guidelines:

- Dr. Hassan will be present at lectures.
- A TA and/or technician will be present during your labs.
- During the workday I'm very fast with email, but slower in the evenings and on weekends. You can expect that email will generally be replied to within 24h, but please include the course code (2C04) in the subject line for fastest response, and follow these guidelines:

| Topic | Contact |
|-------------------------------------|---|
| General Inquiries | Email or Teams message to Dr. Hassan |
| In class questions | Talk to me after class |
| Mark adjustments/ grading questions | Email to Dr. Hassan only, please do not use Microsoft Teams Regrading requests take a little bit longer to respond to than other emails because I need to be thoughtful about them. I use email for record keeping purposes. |
| Help with Inventor | During lab time, TA |

- If you need to speak with Dr. Hassan directly, you can talk to me at class, go to office hours, call during office hours on Microsoft Teams or make an appointment via email. Appointments outside office hours are very limited due to my heavy teaching schedule this term, please use office hours as much as you can.
- I cannot "check" individual homework during office hours or by email, because I can't do it for the whole class, it would not be fair. But I'm always happy to answer specific technical questions via email/Teams or during office hours.
- A Microsoft team will be set-up for the class, primarily for backup in case of instructor illness or presentation file sharing. No course materials, announcements or recordings will be posted on Teams, that is what Avenue will be used for.

Equipment/Text/Software:

- **There is no mandatory textbook for this class, my notes should be sufficient, posted on Avenue.**
- However, if you would like more depth or are just someone who learns better from a textbook, the following book is a great and inexpensive resource: “The Engineering Design Process: An Introduction for Mechanical Engineers” by Peter Ostafichuk, available at the bookstore or on Amazon
- For labs, you may use your own device with **Autodesk Inventor** (download for free at autodesk.ca) or the computer lab. If you cannot use the software due to your system limitations, you can access the Mechanical Engineering computer lab remotely or in person; instructions will be posted on Avenue.
 - I’m not really concerned with which version you use, but using the same version as your colleagues will make working with them easier, and any parts I provide will be easier to work with in the current version.
 - We can’t help you with Autodesk licensing issues. If you have those issues, the advice is to sign in and out of the Autodesk website or to uninstall previous versions and reinstall the new version.
- There may be some lectures or labs where you will be required to hand sketch. As long as the drawing is legible, either paper or digital is acceptable. Please have the equipment required to hand sketch ready for each lecture session.
- Course materials will be posted on Avenue and I will communicate with you only via your McMaster email account. Please check your McMaster email for updates.
- For details about equipment for the group project, please see the “Group Project” section of this outline.

Lectures

- Lecture will be in person in the room listed on Mosaic and in the course outline.
- In the case of instructor illness, a synchronous lecture will occur via Microsoft Teams, with an announcement on Avenue.
- There will be participation elements worth a small grade amount (in class assignments) during the lecture. These may or may not be possible to do without lecture attendance.

- Echo360 will be used to record the lectures, and posted with a 48 hour delay. These recordings are backup only, and the audio/video quality is not guaranteed.

Lab Activities:

- You will rotate through several spaces to allow for more hands on work, within the same lab period. Every week you will meet with your TA for a mini design review (mandatory). You will also have time for either the mandatory SHOP activity or optional CAD help if you need it.
- To manage the room capacity you need to go to your lab with your group.
- Once groups are finalized a lab rotation schedule will be posted on Avenue.
- You may miss one lab day per term with no penalty.

Assignments

- There are no exams in this class, therefore it is imperative that you treat the projects and assignments with the same care and attention as you would an exam since they are worth similar amounts to exams.
- All submissions must be digital, pdf files, via Avenue (other than part files). Make sure that photos, scans or pdfs of your drawings are legible so the TAs can grade them. Guidelines for digitizing assignments will be posted on Avenue. **Drawings submitted on lined paper, or drawings that are illegible for another reason will be given a grade of 0.**
- DO NOT EMAIL work to me or the TAs, even if you miss the deadline. I never accept work via email or Teams, **only** via Avenue.
 - Why? Grading work outside of Avenue is undesirable for a number of reasons (record keeping, accreditation, fairness, efficiency). It makes it harder on everyone when submission guidelines are not followed
- **In-class assignments:** At most classes (lecture) there will be an in-class assignment or quiz. It is possible some of these will require in class work. Assignments can be submitted for up to 24 hours after the end of class.
 - The lecture recordings will be posted after these assignments expire.
 - These will be available on Avenue either as a quiz or assignment, the name will be the date of the class.

- Grace period: 24 hours after end of class
- **All other work (EXCEPT INDIVIDUAL PARTS and GR2)** Hand in on Avenue, due at 1159 pm Friday
 - Grace period ends: 1159pm EST the following Friday (1 week)
- **Grace period:** no penalty, no need to email or MSAF; the Avenue dropbox will simply remain open.
 - In general, I recommend that you try to complete the work as it is assigned. This is intended to help you keep a schedule and past students have indicated that handing in as scheduled is important to their success in the course.
 - I implemented this policy because I want to grade your best work and I care about your stress level.
 - Use the grace period for any reason, no questions asked. If you think it's a good reason to hand in late, it probably is.
 - This is intended for the big and little things that happen in all our lives from time to time: you have a minor illness, you don't want to miss your mom's birthday, you have to work at your job, your varsity team has a game, you have a midterm in another class, your laptop breaks, your internet is slow etc.
 - Things that affect our ability to hand in work happen to all of us at some point, so I am extending you a bit of "grace" with this policy. In return, I ask that you do the same to your teammates and treat each other kindly as you work together.
 - Please note: At the end of the grace period, the dropbox will close, any assignment not submitted will be considered late and will receive a zero. If your internet breaks as you are handing in at the end of the grace period, that is unfortunate, but the end of the grace period is the end. Please hand in sooner to allow for that kind of problem, that's what the grace period is for.
 - Any work that has been handed in is eligible to be graded immediately. If multiple submissions are present, the most recent will be graded. However, once work has been graded, no new submissions will be considered, even within the grace period.
- The exceptions to the grace period are individual project part submissions, because we are producing them in bulk over the reading week, and the GR2, which has a slightly shortened grace period because of the end of term.

- There is **NO GRACE PERIOD ON PARTS.**
- If you miss the deadline or choose not to submit a part, you are responsible for fabricating the parts yourself with non-department resources (e.g. Makerspace, Mills Library, home printer). You may test your self-produced part as long as it is compliant with the rules.
- **Grading:** Rubric feedback will be posted on Avenue, if after reviewing the guide you think that your assignment has a grading error, send Dr. Hassan an email **detailing the error specifically** and I will re-grade your work. Do not email the grading TA, all grade changes are done by Dr. Hassan.
 - Keep in mind that I will re-grade the entire assignment, not just the criteria that you have identified. If that re-grading yields a lower grade, I will not adjust your grade, but if it yields a higher one I will.
 - **Questioning your grade will never result in a penalty for you.**
- Regrading requests take a little bit longer to respond to than other emails because I need to be thoughtful about them, and they aren't as urgent as questions about work that has yet to be handed in. I appreciate your patience.
- Your lowest 20% of in-class quizzes or activities will be dropped. For example, if 15 quizzes are handed in during the term, I will drop your worst 3.
 - The purpose of this scale to reward consistent participation. Even if you are not always correct or present, you can still achieve a high participation grade (since "perfect" is actually 80%)
- A MSAF results in an additional one week to complete your work, **not cancellation of that work.** If you miss the grace period and still wish to hand in work you must use a MSAF.
- **All course work MUST be handed in by the end of day (1159pm EST) Tuesday December 10, 2024, no extensions.**

Use of AI:

Students are not permitted to use generative AI in this course. In alignment with McMaster academic integrity policy, it "shall be an offence knowingly to ... submit academic work for assessment that was purchased or acquired from another source". This includes work created by generative AI tools. Also state in the policy is the following, "Contract Cheating is the act of

“outsourcing of student work to third parties” (Lancaster & Clarke, 2016, p. 639) with or without payment.” Using Generative AI tools is a form of contract cheating. Charges of academic dishonesty will be brought forward to the Office of Academic Integrity.

This includes the use of AI to generate ideas, sketches or renders for any purpose in this course.

Teamwork:

- Teamwork is a critical part of this class and a critical part of engineering practice.
- You may form your own groups as long as you are all in the same section on Mosaic. I cannot help you switch sections, Mosaic is beyond my control.
- If I need to add or move members to teams to meet everyone’s needs, I reserve the right to do so.
- If you need help finding group members, talk to your design review TA.
- Insufficient contributions to your team project **are a form of academic dishonesty** and will be dealt with accordingly.
- Harassing or abusive conduct is prohibited by your student code of conduct. There is zero tolerance for harassment or abusive conduct in this class.

Individual Project:

- Your parts are being produced in bulk over the reading week, therefore **there is no grace period on part submissions**
 - **If you miss the deadline you will need to produce parts with your own, non-department resources**
- **THE RULES ARE DIFFERENT FROM LAST YEAR’S CLASS. READ ALL DOCUMENTATION CAREFULLY.**
- A full rules document will be posted on Avenue.
- Your task is to build a part for a standardized robot to complete the specified task using the resources provided.

Group project:

- **THE RULES ARE DIFFERENT FROM LAST YEAR'S CLASS. READ ALL DOCUMENTATION CAREFULLY.**
- A full rules document will be posted on Avenue.
- Rules are subject to change by Dr. Hassan due to the uncertainty of this kind of work, but all changes will be in the students' favour (meaning they will make the challenge easier, not harder). Any changes will be posted on Avenue.
- Your task is to build a robot that moves forwards to a marker/barrier towing the most load as possible, as quickly as possible
 - All legs must meet the specification in the rules (legs must cover an arc of no more than 90 degrees)
 - No powered wheels
- You are welcome to use whatever external resources for part fabrication you wish, in addition to the fabrication budget provided to you in the rules.
- You must use the "kit" motors
 - You need to use the specified motors to keep the competition fair.
 - However you may purchase these motors from whatever source you wish (e.g. from past students). The bookstore has them packaged in a convenient kit, their kit price is probably the same or a little lower than other sources because they bought in bulk. **Please only buy one kit per group to leave enough for everyone.**
 - If you purchase elsewhere be careful, because there are motors that look the same but are different (eg they are servo only, they have lower torque, poor quality gears). Check that your motors are the same model number, motor data sheet posted on Avenue for reference.
 - Use of non-standard motors for propulsion disqualifies you from the competition and **you will get 0** on your prototype.
 - If you want to share parts with another team feel free, as long as it works on competition day it's ok.
 - You can use any other materials you wish from other sources, but you cannot use more than 8 AA batteries.

- Your kits come with limit switches, these are the only sensors you **need** for the project. You can use anything else you wish, but:
 - you cannot communicate with your robot (e.g. no bluetooth)
 - be careful using a different board or components (it would be easy to fry components with motor current draw if you aren't careful)
- One of your lab activities is plugging in and using your motors, make sure you have your kit or parts in time for that lab activity.

Research:

You may be invited to participate in a research study being conducted by Dr. Hassan. You are under absolutely no obligation to participate and your participation will have no effect on your grade in this or any other course. Dr. Hassan will never know if you participate in any research study.

Course Grade Breakdown:

| Group – 49% | Individual – 51% |
|---|--|
| <ul style="list-style-type: none"> • Group Project (GR1, GR2) - 30% • Design Review -5% • Lab activities (SHOP and Mini DR) – 4% • Group Prototype testing – 10%* see below | <ul style="list-style-type: none"> • Individual Assignments (A1, A2, A3) – 23% • Individual prototype testing – 5% • CAD1-3 – 21% • Participation via Avenue Quiz – 2% |

Group Prototype/Report grade adjustment:

- I want to encourage creativity and I also recognize the uncertainty of producing a robot on a short timescale. Therefore, I created this grading policy so that prototype testing can never hurt your grade. This allows groups to learn from testing failures and write an excellent report to make up for it.
 - This policy does not apply to your individual prototype, only to the grade item “Group Prototype Testing”, worth 10%
- If your group prototype grade (%) is higher than your report (GR2) grade (%), I will use your prototype grade for the “Group Prototype Testing” grade item.

- If your group prototype grade (%) is higher than your report (GR2) grade (%), I will use a value equivalent to your report grade percentage for the “Group Prototype Testing” grade item.
- In either case, your report grade is unaffected and remains worth 20%.
- To make use of this policy your group must have some kind of a prototype score (eg weight and the judged categories even if the robot does not function)
 - If you do not bring a robot to at least one testing session for scoring, your prototype grade of 0 will remain regardless of your report grade.

Weekly Plan

Assignment numbering: A = Individual, GR = Group
CAD assignments are individual

Deadlines are the earliest an assignment can be due, I may adjust later if necessary.
Lecture topic schedule is approximate and may be adjusted based on class progress.

| Week of | | Lecture | Lab | Hand In, Due Friday midnight |
|---|--------|--|---|------------------------------|
| 0 | 2-Sep | No lecture Monday (Labour Day) Intro | No lab, form teams | |
| 1 | 9-Sep | Rules, Concepts, Concept Selection | SHOP1 + Mini DR | A1 |
| 2 | 16-Sep | Part design | SHOP1 + Mini DR + optional CAD help | |
| 3 | 23-Sep | Hand calcs | SHOP2 + Mini DR + optional CAD help | |
| 4 | 30-Sep | No lecture Monday – Truth and Reconciliation Day More part design | SHOP2 + Mini DR + optional CAD help | A2 |
| 5 | 7-Oct | Design Review | Design Review + optional CAD help | GR1 Individual Prototype |
| Reading Week – Enjoy yourselves | | | | |
| 6 | 21-Oct | Part refinement and assemblies | Test your parts + Mini DR + optional CAD help | |
| 7 | 28-Oct | Arduino coding | Test your parts + Mini DR + optional CAD help | |
| 8 | 4-Nov | Dimensioning | Test your kit + SHOP3 + Mini DR + optional CAD help | A3 |
| 9 | 11-Nov | Dimensioning and Assembly Drawings | SHOP3 + Mini DR + optional CAD help | CAD1 |
| 10 | 18-Nov | Tolerances and GD&T | SHOP4 + Mini DR + optional CAD help | CAD2 |
| 11 | 25-Nov | Tolerances and GD&T, DFMA | SHOP4 + Mini DR + optional CAD help | CAD3 |
| 12 | 4-Dec | Test your robot | Test your robot | GR2 Group Prototype |
| Hand in all work no later than midnight EST Tues Dec 10 2024 *No Extensions* | | | | |

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](#).

MENTAL HEALTH & WELLNESS

For a list of McMaster University's resources, please refer to the [Student Wellness Centre](#). [Talkspot](#) is a non-crisis mental health resource specifically for students in the Faculty of Engineering.

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](#), 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

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) 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 the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the 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

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.
 - Students may submit requests for relief using the MSAF once per term.
 - An automated email will be sent to the course instructor, who will determine the appropriate relief. Students must immediately follow up with their instructors. Failure to do so may negate the opportunity for relief.
 - The MSAF cannot be used to meet a religious obligation or to celebrate an important religious holiday.
 - The MSAF cannot be used for academic work that has already been completed attempted.

- An MSAF applies only to work that is due within the period for which the MSAF applies, i.e. the 3-day period that is specified in the MSAF; however, all work due in that period can be covered by one MSAF.
- The MSAF cannot be used to apply for relief for any final examination or its equivalent. See *Petitions for Special Consideration* above.

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.