

MECHENG 2DA3
Mechanical Engineering Design Elements
Undergraduate Studies
Winter 2024
Course Outline

CALENDAR/COURSE DESCRIPTION

Design synthesis, fundamental principles of standard design elements, mechanical and fluid power elements, component specification and optimization.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): Registration in Level III of any Mechatronics Engineering program
Antirequisite(s): MECHENG 2D03

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Julia E. de Lange
JHE 326
delangej@mcmaster.ca

Office Hours:
Fridays 3 – 5 pm (on MS Teams Channel)
Or by appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Linnea Campbell
campbl11@mcmaster.ca
ABB 270

Lewis Gross
grossl@mcmaster.ca
KTH B104

Yu (Joe) Zhang
zhang21@mcmaster.ca
KTH B105

Office Hours:
In-tutorial
Or by appointment

COURSE OFFERINGS

Lectures
Tuesdays, 7-10 pm
BSB B136

T01
Tuesdays, 6-7 pm
ABB 270

T02
Tuesdays, 6-7 pm
KTH B104

T03
Tuesdays, 6-7 pm
KTH B105

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

Avenue to Learn (hereafter: *Avenue*) is used to administer the course. These tools are used to increase efficiency. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, usernames 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 this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor. *Avenue* can be accessed via the following link:

<http://avenue.mcmaster.ca/>

The course will be delivered in-person. In the event that the course is required to be delivered online, the instructor may modify the course structure and assessment details to more appropriately support an online format. In the event of a poor weather day, the class may be flipped to an online delivery format in relatively short notice. All course

information will be communicated through *Avenue* - it is your responsibility to regularly check the course webpage to stay apprised of course news and any changes in our delivery format.

Lectures will be recorded using Echo360. Please note that from time to time there are technical issues that are not within the Instructor's control, including but not limited to sound issues and/or upload errors. I will do my best to address these errors throughout the semester, but the best way to avoid these is to join for in-person lectures.

We will also have a Microsoft Teams page, where I will periodically post announcements, answers to frequently asked questions (FAQ's), and office hours will be hosted here. Further, in the event that an online delivery mode is required – it will be held virtually on Teams.

COURSE INTENDED LEARNING OUTCOMES

By the end of this course, students should be able to:

1. Design a novel apparatus for performing a given task by clearly detailing objective statement, idea generation, analyses and compiling a decision matrix.
2. Critique an existing commercial product using engineering design principles with specific consideration for health and safety issues and utilize the design process to generate new concepts that address these issues.
3. Design a creative and complex device that utilizes several inventive transfers of energy in order to accomplish a simple task.
4. Determine the acceptable tolerance of a shaft and hole for a given nominal size and Engineering specification.
5. Determine the required strength of an adhesive under given loading conditions.
6. Analyze a bolted assembly and determine the maximum load the bolts are designed to withstand.
7. Design and solve a linkage system using both a mathematical and graphical approach.
8. Determine gear train variables for given input and output speed and assess whether the gear train can withstand specified operating conditions.
9. Design a manual transmission that is to be used in a commercially available automobile.
10. Select an appropriate bearing for a specified set of operating conditions and justify the selection.
11. Analyze a cam and follower mechanism and determine the motion characteristics of the follower (such as displacement, velocity and acceleration).
12. Select an appropriate type of drive (e.g., gears, belts, chains) for given design criteria.
13. Analyze mechanisms that provide mechanical advantage and determine the input forces necessary to perform a given task.

MATERIALS AND FEES

Required Texts:

None

Recommended Texts:

Shigley's Mechanical Engineering Design

By Richard Budynas and Keith Nisbett, Publisher: McGraw Hill, 11th edition, 2019

Calculator:

Only the McMaster Standard Calculator will be permitted in tests and examinations. This is available at the Campus Store.

Other Materials:

An aid sheet will be provided for examination assessments and will be posted on Avenue to Learn in advance of the assessment.

COURSE FORMAT AND EXPECTATIONS

The course is organized as follows:

- 1 classroom-based lecture per week (instructed by Dr. de Lange)
- 1 tutorial per week (instructed by your TAs)
- 5 in-tutorial group assessments
- 5 individual assignments
- 1 in-class midterm test
- 1 final examination

COURSE SCHEDULE

Week: Date	Topic
Week 1: January 9	Introduction
Week 2: January 16	Design
Week 3: January 23	Shafts, Tolerances & Fits
Week 4: January 30	Gears, Gear Trains & Gear Strength
Week 5: February 6	Transmissions & Planetary Gears
Week 6: February 13	Drives & Fluid Power
Week 7 – READING WEEK	No class
Week 8: February 27	In-class midterm examination
Week 9: March 5	Cams & Cam Design
Week 10: March 12	Mechanisms & Linkages
Week 11: March 19	Connections (Welding & Fasteners)
Week 12: March 26	Bearings & Bearing Life
Week 13: April 2, 2024	Forensic Engineering Investigations
Week 14: April 9, 2024	Review and Final Exam Preparation

ASSESSMENT DETAILS

Component	Due Date	Weight
Assignments	5 throughout the semester	20%
Tutorial Assessments	5 throughout the semester	15%
Midterm Exam	February 27	30%
Final Exam	TBD	35%
Total		100%

Assignments

Assignments (5 in total, 4% each) will be given out one per unit(s) and will be due 1 week after being posted. Assignments are to be submitted INDIVIDUALLY to the “ME 2DA3” drop box online by the time specified. Graded assignments will be returned via the assignment return box. Once assignments have been returned, late submissions will no longer be accepted.

Tutorial Activities

Five in class activities (3% each) will be run through the semester in tutorial (see Course Schedule for dates). They will be completed in groups of 3-4, which will be self-formed.

Test and Final Exam

A 2-hour midterm test (in-class on February 27th) and 2.5-hour final exam will be held in April (date TBD by the registrar). The final exam period runs from Friday, April 12 to Thursday, April 25. The final exam must be written or else a final grade of 'F' will be awarded with the notation Did Not Write. The standard 'numeric to letter grade' conversion will be used to assign the appropriate letter grade at the end of the course.

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". Should a student need to use the McMaster Student Absence Form (MSAF) for an assignment or in-class activity, the value of that deliverable will be reallocated to the others within that category (e.g., if you miss an assignment, each of the others will now be worth 3.5%). If you miss the midterm, there will be an additional exam for you to write.

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. This course provides the students opportunities to develop the following measures of graduate attributes:

#	Attribute	Learning Outcome(s)
A01	Knowledge Base for Engineering	
1.03	Competence in Engineering Fundamentals	4, 5, 6, 8, 10, 11, 12, 13
A02	Problem Analysis	
2.01	Demonstrates an ability to identify reasonable assumptions that could or should be made before a solution path is proposed	8, 9, 13
2.03	Obtains substantiated conclusions as a result of a problem solution including recognizing the limitations of the solutions	5, 7, 10
A03	Investigation	
3.02	Selects appropriate model and methods and identifies assumptions and Constraints	7, 8
A04	Design	
4.01	Recognizes and follows an engineering design process	1
4.02	Recognizes and follows engineering design principles including appropriate consideration of environmental, social and economic aspects as well as health and safety issues	2
4.03	Proposes solutions to open-ended problems	7, 9
4.04	Employs appropriate techniques for generation of creative ideas such as brainstorming and structured inventive thinking	3

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](#).

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.

COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES

1. It is the students’ responsibility to regularly check the course webpage (e.g., *Avenue to Learn*) for updates and announcements related to this course.
2. All submissions are due at midnight (specifically, 11:59 PM on the due date)
3. Arrangements be made with the Instructor prior to any missed work/extensions/late submissions. Exceptions may be made regarding unforeseeable situations.
4. Late penalties will be applied at the Instructors discretion.

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.

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.



FACULTY OF ENGINEERING



Introducing TalkSpot, a mental health service exclusively for Mac Eng students.



Sometimes you just need a safe spot to talk.

TalkSpot is a mental health service exclusively for Mac Eng students. TalkSpot offers informal, confidential consultations with a counsellor through drop-in hours every weekday from 1 p.m. – 4 p.m. You can share what's on your mind to get perspective, problem-solve and hear suggestions for resources or supports.

Meet the TalkSpot Counsellor: Kaely Danahy, OT Reg. (Ont.)

- An Occupational Therapist, who previously worked for the Canadian Mental Health Association Waterloo Wellington, and a Mac Grad.
- A skilled listener passionate about post-secondary student wellness.
- Interests include: her very spoiled cat, Tomato, long-distance running, and an unapologetic love for reality TV.



[Learn more about TalkSpot](#)

BRIGHTER WORLD
eng.mcmaster.ca



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Our mailing address is:
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