McMaster University | Civil Engineering

# COURSE OUTLINE
# Fall 2024

## COURSE INFORMATION

**Course Name:** Statics & Mechanics of Materials **Course Code:** CIV ENG 2P04

**Session Offered:** Fall 2024

**Calendar Description:** Principles of statics as applied to rigid bodies. Internal forces, shear and bending moment diagrams, Stress and strain, elastic behaviour of simple members under axial force, torsion, bending and traverse shear, Principal stresses.

**Pre-Requisites**: Physics 1D03 and registration in Level II or above of Civil Engineering program

**Instructor:** Hisseine Ousmane
**Email:** hisseino@mcmaster.ca **Office Hours**: Thursdays at 10:30 AM to 12:00

**Teaching Assistants:**

**Office:**
Mohamad Tarabin (tarabinm@mcmaster.ca): 12:00 to 2:00 PM, Mondays
Ahmed Fageeri (fathelra@mcmaster.ca): 12:00 to 2:00 PM, Tuesdays
Yan, Zehao (yanz52@mcmaster.ca): 12:00 to 2:00 PM, Wednesdays
Zayyan Khan (khanz51@mcmaster.ca); 12:00 to 2:00 PM, Thursdays
Ayman Mudallal (mdallala@mcmaster.ca): 12:00 to 2:00 PM, Fridays

**Class Schedule Days:** **Lectures:** Mon., Wed., Thur. Time: 5:30 PM – 6:20 PM
**Tutorial:**

| | |
|---|---|
| T01: Tuesday | Time: 4:30PM - 6:20PM |
| T02: Tuesday | Time: 4:30PM - 6:20PM |
| T03: Tuesday | Time: 4:30PM - 6:20PM |
| T04: Tuesday | Time: 4:30PM - 6:20PM |

**Accommodation**: In keeping with university policy (see Section 7), if you have unique circumstances, please feel free to reach out so that accommodation may be arranged to help you achieve your learning goals for this course.

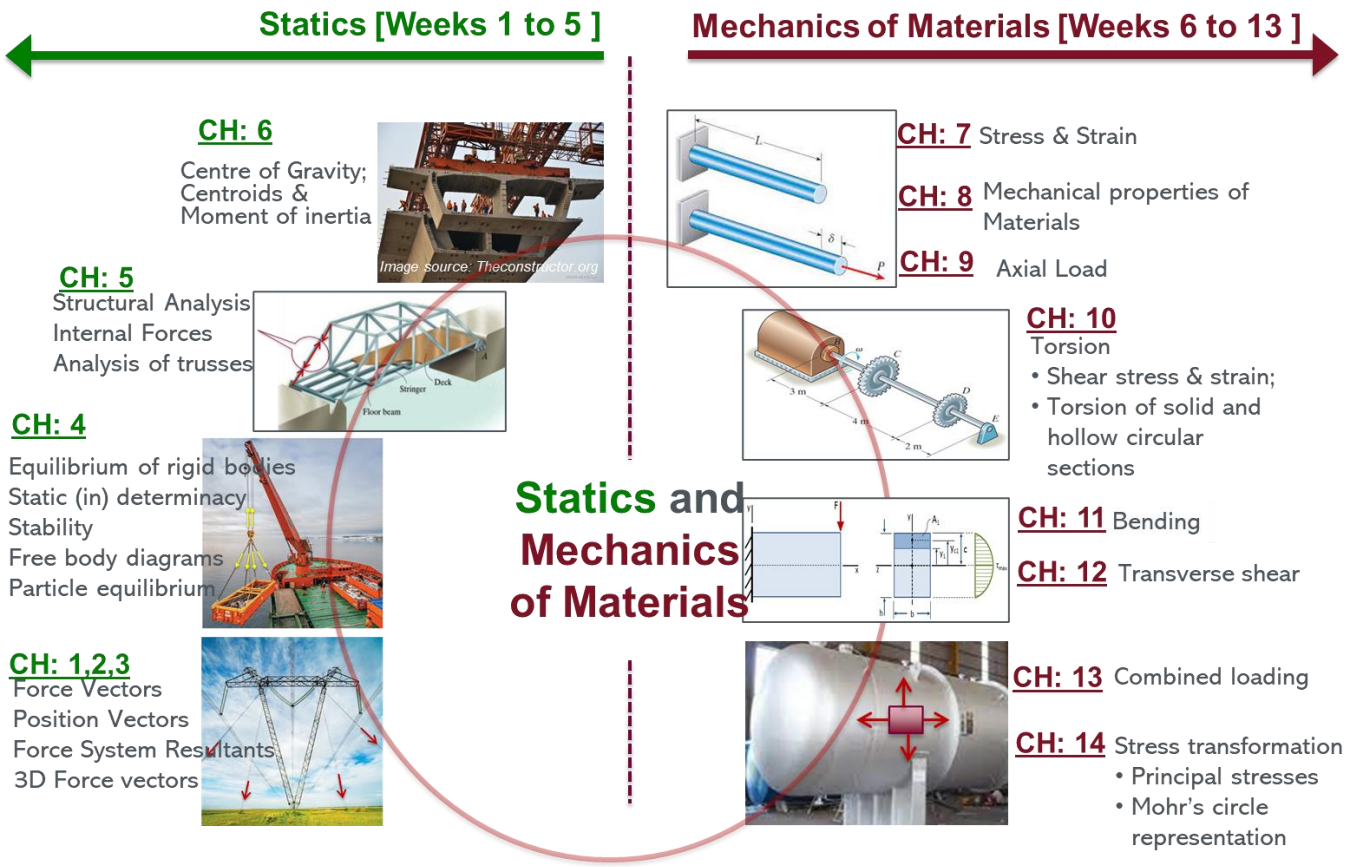
**Textbook:** R.C. Hibbeler, Statics and Mechanics of Materials in SI Units, 6th edition, Pearson

## 1. COURSE OBJECTIVES

This is the first course in structural mechanics and is aimed at developing your understanding of basic skills in statics and mechanics of materials, also referred to as strength of materials. The course comprises two parts:

- The first part focuses on fundamentals of statics, including equivalent force systems, equilibrium in two- and three- dimensions, internal forces, truss solution techniques, and shear and bending moment diagrams.
- The second part focuses on mechanics of materials, including fundamentals of stress and strain, response of members to axial, torsion, bending, transverse shear, and stress transformations.

A pictorial representation of the course content is presented below. The specific skills you will develop upon completing this course are presented in section 2.




## 2. COURSE SPECIFIC POLICIES

- **Lectures**: will discuss the theoretical foundation, analytical techniques, and applications to a variety of problems.
- **Tutorials**: will address additional examples and questions.
- **Term Project**: Students are required to work in teams of two members to carry out a project. Details will be provided throughout the course.
- **Practice Problems:** Weekly practice problems will be assigned and discussed in the tutorials. **They will not be handed in or graded**. Additional problems can be found in the textbooks and are highly recommended.
- **Weekly quizzes**: Every week there will be a quiz in the last 20 minutes of the tutorial. The quiz will be extracted from the practice problems. Therefore, while the practice problems are evaluated, students need to ensure they can solve these problems.
- **Homework Assignments**: There will be four assignments aimed at fostering an in-depth understanding of course materials. Since the homework assignments represent the types of questions expected during the term tests, you should solve them independently and submit them on Avenue to Learn (http://avenue.mcmaster.ca). Discussing the background and approach to the solution of problems is beneficial and permitted. However, you have to ensure that you are capable of working independently.
- **Term Tests**: There will be two term tests, one for the statics section and one for the mechanics of materials section. The term tests will be closed book. The necessary equations will be provided. During term tests and the final exam, you may use only the McMaster Standard Calculator. If you wish to appeal the grading of a test, this must be done within one week of the date on which the tests were returned.
- **Communications**: All email communication with the instructor and TAs must be sent from your **@mcmaster.ca** address and sent to the **@mcmaster.ca** addresses listed above. **Do not send email through the Avenue to Learn email system as this system is not monitored**. Lecture notes, problem sets, assignments, solutions, lab information and notices will be posted on Avenue. Students are expected to check and read all the materials posted on avenue (http://avenue.mcmaster.ca).
- **Assignment Submissions**: Late submissions will be handled according to the following guidelines:

1. From 0-24 hrs late – 25% Penalty
2. No submission allowed after 24 hrs.

MSAF assignments will be extended until one day before the solutions are posted as per the calendar on avenue

- **Courtesy:** Each student is responsible for maintaining an enriching learning ecosystem. Cellphone should be on either airplane mode or on silence. You are also expected to communicate (orally and in written) politely. **Offensive language or gestures are unacceptable**.
- **Attendance**: while there will be no attendance recording, all lectures and tutorials are mandatory.

## 3. TENTATIVE SCHEDULE

| Week#: Date | | Lecture Topics (can be slightly altered, depending on the progress) | Activities |
|---|---|---|---|
| WEEK 1: **Sep 2** | **Statics** | **Introduction**: General Principles | Intro + L1 |
| WEEK 2: **Sep 9** | | **Force system**: Force & Position vectors; Force system resultants; Moments | L2+L3+L4 |
| WEEK 3: **Sep 16** | | **Equilibrium of Rigid Bodies**; Free Body Diagrams; 2D&3D systems | L5+L6+L7 |
| WEEK 4: **Sep 23** | | **Structural Analysis:** Analysis of trusses; Determinacy and indeterminacy | L8+L9+L10 |
| WEEK 5: **Sep 30** | | **Structural Analysis:** Two force members; Zero force members; Analysis of frames and machines | L11+L12+L13 ***Midterm Exam: October 5*** |
| WEEK 6: **Oct 7** | | **Sectional Properties:** Center of Gravity; Centroids; Moment of inertia; Radius of Gyration; Parallel-Axis Theorem; Moments of Inertia of Composite Areas | L14+L15+L16 ***Project Phase1*** |
| READING WEEK: Oct 14 to Oct 20 — **Midterm Recess: No Lectures or Tutorial** | | | |
| WEEK 7: **Oct 21** | **Mechanics of Materials** | **Stress and Strain**: Normal stress; Shearing stress and bearing stress in connections; Strain; Mechanical Properties of Materials | L17+L18+L19 |
| WEEK 8: **Oct 28** | | **Axial loading**: Analysis of axially loaded member, Deformation of axially loaded member | L20+L21+L22 |
| WEEK 9: **Nov 4** | | **Torsion**: Analysis of members subjected to torsion: Shear stress and strain; Torsion of solid and hollow circular sections | L23+L24+L25 |
| WEEK 10: **Nov 11** | | **Bending:** Bending normal stress distribution; Eccentric axial loading; Deformation of a symmetric beam in pure bending; Shear and moment diagrams | L26+Review1+ Review2 |
| WEEK 11: **Nov 18** | | **Transverse shear**: Stress due to transverse loads; Shear stresses in common beams; Longitudinal shear on beams | L27+L28+L29 ***Project Phase2*** |
| WEEK 12: **Nov 25** | | **Combined loading: Shear stress distribution in thin-walled sections**; Critical shear stress; State of stress caused by combined loading | L30+L31+L32 |
| WEEK 13: **Dec 2** | | **Transformation of stress and strain**: Introduction to transformation of stresses, principal stresses and Mohr's circle representation | L34+L35+L36 ***Final Exam Review*** |
| **FINAL EXAMS**: Scheduled during the regular University Final Examination period established by the Registrar's Office | | | |
| NOTE: Additional topics may be addressed, or some topics may be skipped, depending on learning progress. | | | |

| 4. ASSESSMENT OF LEARNING | WEIGHT % |
|---|---|
| 4 Homework Assignments | 10% (2.5% each) |
| Weekly quizzes (best 5 quizzes) | 10% (2% each) |
| Midterm exam | 25% |
| Term Project | 20% |
| Final Exam (mandatory for all students) | 30% |

## 5. COURSE LEARNING OUCTCOMES

**Successfully completing this course increases your knowledge base for engineering so that you will be able to**:

1) Apply Newton's Laws and the principle of SI unit systems to solve engineering problems [CEAB Indicator 1.1, 1.2]
2) Draw and label free body diagrams of physical problems [1.2]
3) Apply the equations of static equilibrium to calculate resultant and reaction force vectors [1.1, 1.2]
4) Distinguish statical determinacy and indeterminacy [1.3]
5) Calculate and express the forces within members of a statically determinate truss under load [1.2]
6) Determine the moment of inertia of simple and composite areas [1.2]
7) Calculate the stresses and deformations within members under axial load, shear, flexure, and torsion [1.1, 1.2]
8) Calculate and express the forces within a bending member under load [1.1, 1.2]
9) Calculate the deformations and forces within simple statically indeterminate structures [1.2, 1.3]
10) Transform stresses on elements of plane stress and define principal stresses and orientation at a point [1.2, 1.3]

**Graduate Attributes and CEAB Indicators**

Through this course, you will develop in the following graduate attributes and indicators:

**1.** A knowledge base for engineering (Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.)
- **1.1.** Competence in Mathematics
- **1.2.** Competence in Natural Sciences
- **1.3.** Competence in Engineering Fundamentals

## 6. LABORATORY SAFETY

The Faculty of Engineering is committed to McMaster University's Workplace and Environmental Health and Safety Policy which states: "Students are required by University policy to comply with all University health, safety and environmental programs and policies". It is your responsibility to understand McMaster University's Risk Management system, which is supported by a collection of Risk Management Manuals (RMMs) that contain programs and policies in support of the Risk Management System. The RMMs are available from https://hr.mcmaster.ca/employees/health_safety_well-being/our-safety/risk-management-manuals-rmms/.
It is also your responsibility to follow any specific Standard Operating Procedures (SOPs) provided for specific experiments (see course lab manuals) and the laboratory equipment https://www.eng.mcmaster.ca/sites/default/files/civil_lab_health_and_safety_manual.pdf

Additionally, McMaster University's workplace health and safety guidance related to COVID-19 must always be followed (available from https://hr.mcmaster.ca/resources/covid19/workplace-health-and-safety-guidance-during- covid-19/).

## 7. COMMUNICATIONS

It is the student's responsibility to:

- Maintain current contact information with the University, including address, phone numbers, and emergency contact information.
- Use the University provided e-mail address or maintain a valid forwarding e-mail address.
- Regularly check the official University communications channels. Official University communications are considered received if sent by postal mail, by fax, or by e-mail to the student's designated primary e-mail account via their "@mcmaster.ca" alias.
- Accept that forwarded e-mails may be lost and that e-mail is considered received if sent via the student's @mcmaster.ca alias.
- Check the McMaster/Avenue email and course websites on a regular basis during the term.

## 8. POLICIES

### 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:

- plagiarism, e.g., the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- 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**

**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, 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 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.

**ONLINE PROCTORING**

**Some courses may** use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

**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.

**REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM 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".

The McMaster Student Absence Form is a self-reporting tool for **Undergraduate Students** to report absences that last up to 5 days and provides the ability to request accommodation for any missed academic work. Please note, this tool cannot be used during any final examination period. You may submit a maximum of 1 Academic Work Missed request per term. It is **your** responsibility to follow up with your instructor immediately regarding the nature of the accommodation. If you are absent more than 5 days or exceed 1 request per term you **must** visit your Associate Dean's Office (Faculty Office). You may be required to provide supporting documentation. This form should be filled out immediately when you are about to return to class after your absence.

**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.

**PROTECTION OF PRIVACY ACT (FIPPA)**

The Freedom of Information and Protection of Privacy Act (FIPPA) applies to universities. Instructors should take care to protect student names, student numbers, grades, and all other personal information at all times. For example, the submission and return of assignments and the posting of grades must be done in a manner that ensures confidentiality – see http://www.mcmaster.ca/univsec/fippa/fippa.cfm.

**ANTI-DISCRIMINATION**

The Faculty of Engineering is concerned with ensuring an environment that is free of all discrimination. If there is a problem, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer, or the Human Rights Consultant, as soon as possible.
https://www.mcmaster.ca/policy/General/HR/Discrimination_and_Harassment.pdf

**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.

## 9. MCMASTER GRADING SCALE

| Grade | Equivalent Grade Point | Equivalent Percentages |
|---|---|---|
| A+ | 12 | 90-100 |
| A | 11 | 85-89 |
| A- | 10 | 80-84 |
| B+ | 9 | 77-79 |
| B | 8 | 73-76 |
| B- | 7 | 70-72 |
| C+ | 6 | 67-69 |
| C | 5 | 63-66 |
| C- | 4 | 60-62 |
| D+ | 3 | 57-59 |
| D | 2 | 53-56 |
| D- | 1 | 50-52 |
| F | 0 | 0-49 |

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