McMaster University | Civil Engineering

2026-27 COURSE OUTLINE

COURSE INFORMATION

Course Name: Modern Methods of Structural Analysis **Course Code:** 4K04

Session Offered: Fall 2026

Calendar Description: Stiffness method; development and applications in structural analysis. Introduction to finite element method. Influence lines, elastic stability analysis of frames with and without sway effects. Application of computer programs.

Instructor: Dr. Mohamed Ezzeldin (ezzeldms@mcmaster.ca)

Teaching Assistants: Khaled Sobhy Emam (emamk@mcmaster.ca)

Mostafa Ahmed (ahmem199@mcmaster.ca)

Office Hours: To be announced based on class schedules.

Classes Schedule Day(s):	Tuesday	12:30pm-2:20pm
	Thursday	12:30pm-1:20pm
Tutorials Schedule Day:	Thursday	2:30pm-4:20pm

Location: As Per Mosaic

As of now, all lectures, tutorials and course activities will be in-person. This is based upon current university and public health guidelines and may be subject to changes during the term. Any changes to the schedule or course delivery will be communicated on the course announcements section on Avenue to Learn. Please check the announcements prior to attending class.

Recommended References:

Leet K, Uang C-M, Lanning J. 2020. *Fundamentals of Structural Analysis*, 6th Ed. McGraw-Hill

Kassimali A. 2020. *Structural Analysis*, 6th Ed. Cengage Learning

1. COURSE OBJECTIVES

This course focuses on analyzing real structures, a process that always involves simplifying the problem to a level that allows the forces and displacements to be solved with an acceptable level of accuracy. In this respect, we will examine several different analysis techniques. In the **first part** of the course, we will focus on methods of analysis for trusses, including approximate methods, energy methods (particularly the method of virtual work), and the matrix methods (i.e., the direct stiffness method) that are at the core of most modern structural analysis software packages (e.g., SAP2000). The **second part** of the course will apply similar methods to beams and frames. In addition, we will discuss how to use influence lines to identify critical loading cases for beams. In the **third part**, we will conclude the course by extending our discussion of matrix stiffness methods to finite element analysis using planar area elements. Throughout the course, we will discuss tools for quickly estimating the solution to common problems in structural analysis. Comparing these simple estimates with the results of more complex models will enable us to identify errors in the more complex models, and to identify the limitations of the simple estimates.

2. COURSE SPECIFIC POLICIES

Lectures and Tutorials: The lectures will present theoretical/design background and some illustrative examples. The tutorials will be used to demonstrate additional examples, provide assistance with problem-solving, and for special presentations. In certain situations, the tutorial session may also be used to give a lecture and vice versa; you will be notified in advance if this will occur. It is your responsibility to check the CIV ENG 4K04 course website (http://avenue.mcmaster.ca) on a regular basis.

Assignments: All assignments are to be submitted to the 4K04 course website as one file for each submission and the latest will be considered for grading (http://avenue.mcmaster.ca). The purpose of the assignment problems is to give you an opportunity to develop an in-depth understanding of the course material. While discussion with other students of the background and approach to the solution of problems is often beneficial, you need to ensure that you can actually solve each problem on your own (i.e., the way it will be during the final exam). All work that you submit for grading must be your own work. Assistance on working out these problems will be available during the tutorial sessions.

Assignment Submissions: Late submissions will be handled according to the following guidelines:

1. From 0-48 hrs late – 1% penalty for every late hour
2. No submission is allowed after 48 hrs.

MSAF assignments will be extended for 48 hrs following their original due dates

3. SCHEDULE

WEEK 1	Trusses: Hand Calculation Methods
WEEK 2	Trusses: Approximate Methods
WEEK 3	Trusses: The Method of Virtual Work
WEEK 4	Trusses: The Direct Stiffness Method
WEEK 5	Trusses: Large and Complex Problems
WEEK 6	Beams and Frames: Estimating by Inspection
WEEK 7	Beams and Frames: Approximate Methods
WEEK 8	Beams and Frames: The Method of Virtual Work
WEEK 9	Beams: Influence Lines
WEEK 10	Beams: The Direct Stiffness Method
WEEK 11	Beams and Frames: The Direct Stiffness Method
WEEK 12	Introduction to Finite Element Analysis
WEEK 13	Big Problems
FINAL EXAMINATION	Scheduled during the regular University Final Examination period established by the Registrar's Office

4. ASSESSMENT OF LEARNING	WEIGHT %
Assignments	25
One Mid-Term Test (Tentative: October 22nd, 2026, at 2:30 PM)	25
Final Exam	50

Notes

1. You must obtain at least 50% of the total possible marks in the combined test portion (37.5 out of 75), for the assignments to be counted in your final course grade.
2. There will be assignments approximately weekly during the term. Your lowest assignment grade will be omitted when calculating your total grade for assignments.
3. If a student misses the mid-term test, they need to contact the Associate Dean of Engineering in order to obtain permission for relief (Refer to the McMaster Undergraduate Calendar for the relevant policy). If a relief is granted, there will be no makeup test and the missed mid-term test will be re-allocated to the final examination.

5. LEARNING OUTCOMES

When you have successfully completed this course, you will have increased your knowledge base for engineering so that you will be able to:

- use exact and approximate hand methods to estimate the forces and displacements associated with trusses, beams, and frames [CEAB Indicators 1.3 and 1.4]
- use the method of virtual work to calculate the displacements of structures [1.4]
- create and use influence lines to identify critical loading locations in beams [1.4]
- use matrix methods (i.e., the direct stiffness method) to calculate the forces and deflections in planar trusses, beams, and frames under a variety of loading conditions, including geometric nonlinearities [1.4]
- use SAP2000 to facilitate these calculations [5.2]
- describe the fundamental assumptions of finite element analysis and identify situations that require it [1.4]

With this knowledge base, you will be able to:

- select a structural analysis technique, whether simple or sophisticated, that is appropriate for the complexity of the problem and the resources available [2.2, 3.2, and 5.1]
- critically examine the results of one analysis method using insights from other methods [2.2 and 3.2]
- identify the assumptions and limitations that are inherent in particular analysis methods [2.1 and 2.2]

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, 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.

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 requests 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