

COURSE INFORMATION

Course Name:	Structural Analysis	Course Code: CIV ENG 3G04
Session Offered:	Fall 2021	
Calendar Description:	Structural analysis and modelling of linear elastic truss, beam and frame structures; stress resultants and deformations of statically determinate structures; methods for analysis of indeterminate structures; stiffness matrix method; plane frame computer analysis.	
Prerequisites:	CIVENG 2C04 and CIVENG 2P04	
Instructor:	Saber A. S. Fosoul	alesahes@mcmaster.ca
Teaching Assistants:	Moustafa Abdel-Mooty Ahmed Abdel Maksoud Saleh Ahmadi	abdelmom@mcmaster.ca abdela33@mcmaster.ca ahmadiss@mcmaster.ca
Lectures:	Mondays Tuesdays, and Fridays (see instructions on course website).	10:30 – 11:20 via MS Teams 11:30 – 12:20 via MS Teams
Tutorials:	Thursdays (see instructions on course website for virtual sessions).	10:30 – 12:20 at BSB B135
Website:	On the Avenue to Learn (http://avenue.mcmaster.ca). All announcements, course materials, assignment problems, solutions, etc. will be posted there. It is your responsibility to check the course website regularly.	
TA Office Hours:	Wednesdays This is best for specific questions related to the next assignment.	10:30 – 11:30 via MS Teams
Instructor Office Hours:	Mondays This is best for general questions regarding the course concepts that could not be sufficiently addressed during lectures.	11:30 – 12:30 via MS Teams
Accommodations:	Please feel free to reach out to discuss your unique circumstances. We will work with each other to arrange accommodations that may be needed to help you achieve your learning goals for this course.	

1. COURSE OBJECTIVES

This course aims to familiarize the students with different techniques for analyzing linear elastic structural systems. Emphasis will be placed on developing an understanding of methods of analysis that are applicable to both simple and complex structural systems.

As shown in the graphical abstract on the next page, the first half of this course will focus on analyzing determinate structural systems (e.g. beams, frames, and trusses), including determination of the stability/determinacy of the system, internal forces, drawing shear force and bending moment diagram, and deflections.

The second half of the course will be focused on analyzing indeterminate structural systems while the main goal of this section is still drawing shear force and bending moment diagrams.

At the end of each section, students will be introduced to the SAP2000 software.



1. Static Determinacy, Indeterminacy, and Instability
Internal/External

2. Trusses
Method of Joints
Method of Sections

3. Beams and Frames
Shear Force Diagram
Bending Moment Diagram
Qualitative Deflected Shape

4. Deflection of Beams: Geometric Methods
Direct Integration Method
Moment Area Method

5. Analysis of Indeterminate Structures
Slope-Deflection Method
Moment Distribution Method
Method of Consistent Deformation

6. Approximate Analysis of Rectangular Building Frames
Vertical Load
Portal Method
Cantilever Method

7. Matrix Structural Analysis
Beams
Frames
Trusses

$$k = \frac{EI}{L^3} \begin{bmatrix} 12 & 6L & -12 & 6L \\ 6L & 4L^2 & -6L & 2L^2 \\ -12 & -6L & 12 & -6L \\ 6L & 2L^2 & -6L & 4L^2 \end{bmatrix}$$

2. COURSE SPECIFIC POLICIES

The lectures will be delivered virtually using Microsoft Teams.

Please ensure you have access to “CIVENG 3G04 Structural Analysis” on MS teams. Lectures will be streamed live in dedicated channel during the scheduled class times.

All announcements, assignment problems, solutions, etc. will be posted on Avenue to Learn (<http://avenue.mcmaster.ca>). It is your responsibility to check the web site regularly for new postings.

All or portions of lectures and tutorials will be recorded and posted on the course website. You are under no obligation to appear or speak in the recording. If you choose to participate in an identifiable way, you are consenting to the recording being used as noted above.

REQUIRED COURSE TEXT

Kassimali, A. 2019. Structural Analysis, 6th Ed. Cengage Learning.

- Campus Store: ([Link](#)) Both the book and e-text are available.
- Cengage: ([Link](#)) Both the book and e-text are available. Students can also get an extra 10% off with this discount code: **DIGITALB2S1479**

SAP2000

You will be asked to install the latest version of SAP2000 on your computers. For this purpose, an educational license will be posted on the A2L by which you are able to analyze simple structures. Some assignments will ask you to analyze a simple structure by SAP2000 and compare your results with hand calculations. Using SAP2000 will not be a part of your term tests or final exam.

3. SCHEDULE (TENTATIVE)		
Week	Lecture topics (subject to change without notice)	Assessment
1. Sep 6	Introduction/Definitions/Review	Introduction to tutorials
2. Sep 13	Determinacy/Stability/Trusses	Assignment 1
3. Sep 20	Analysis of Beams and Frames	Assignment 2
4. Sep 27	Direct Integration Method	Assignment 3
5. Oct 4	Moment Area Method/SAP2000	Assignment 4
Oct 11	Midterm Recess: No Lectures or Tutorial	
6. Oct 18	Slope-Deflection Method	Term Test 1 – October 21
7. Oct 25	Moment Distribution Method	Assignment 5
8. Nov 1	Method of Consistent Deformation	Assignment 6
9. Nov 8	SAP2000/Approximate Methods	Assignment 7
10. Nov 15	Approximate Methods	Term Test 2 – November 18
11. Nov 22	Matrix Method	Assignment 8
12. Nov 29	Matrix Method/Review	Assignment 9
Final Examination	Scheduled during the regular University Final Examination period established by the Registrar's Office	
4. ASSESSMENT OF LEARNING		WEIGHT%
Assignments		30%
Tests		20%
Final Exam		50%
<u>LECTURES AND TUTORIALS</u>		
<p>The classes and tutorials are the primary means for delivering the course material and for regular communication between the instructor/TAs and the class. The lectures and tutorials will be used to present theoretical background and some illustrative examples. The tutorials will also be used to demonstrate additional examples, provide assistance with problem solving, and complete a portion of the current assignment.</p>		
<u>ASSIGNMENTS</u>		
<p>The purpose of the assignment problems is to give you an opportunity to develop an in-depth understanding of the course material. All work that you submit for grading must be your own work. Assignments are to be submitted through Avenue to Learn, do not submit assignments by email. Late assignments will be penalized 25% a day. Exceptions or extensions shall be negotiated with the course instructor, not the teaching assistants. You are encouraged to discuss the feedback that you receive on any assessment with your TAs or the course instructor. If you believe that you have received an incorrect grade on any piece of assessment, you must return it to the person who marked it, together with a written explanation of why you believe the grade was incorrect, within one week of the day that the assessment was returned. This may result in the grade increasing, decreasing, or remaining the same.</p>		
<u>FINAL EXAM</u>		
<p>This will be a cumulative synchronous exam, to be scheduled during the regular University Final Examination period established by the Registrar's Office.</p>		

ACADEMIC INTEGRITY

As an example of the Academic Integrity Policy (Section 7), most problem set questions in this course will have a single correct answer. While you are encouraged to discuss your solution technique with your classmates, copying some or all of the solution from another student is considered an example of academic dishonesty. Term tests and the final exam are expected to be completed independently; both receiving and giving information regarding these assessments before all students have completed them are considered examples of academic dishonesty.

NOTE: You will be required to include a cover sheet attesting to your integrity for everything you wish to receive credit for in this course.

MSAFs

If you do not write a term test or submit an assignment at the scheduled time and you do not file a MSAF you will receive a grade of zero on the missed work. Additional details can be found at <http://mcmaster.ca/msaf/>.

5. LEARNING OUTCOMES

When you have successfully completed this course, you will be able to:

- understand and competently apply engineering fundamentals including equilibrium and compatibility [CEAB Indicator 1.3]
- identify from a suite of structural analysis methods an appropriate method to calculate the forces and deflections in statically determinate and indeterminate trusses, beams, and frames under a variety of loading conditions [CEAB Indicator 2.2]
- describe the fundamental assumptions employed in the derivation of various classical structural analysis methods [CEAB Indicator 3.1]
- use structural analysis program to model and analyse trusses, beams, and frames [CEAB Indicator 5.2]

To attain the learning outcomes stated above we will:

- examine the fundamental principles governing the behaviour of linear elastic structures
- review construction of axial, shear, and bending moment diagrams
- review the important distinctions between statically determinate and indeterminate structures
- become familiar with modelling truss, beam and frame structures, as needed for analysis
- investigate the use and merits of various classical techniques of structural analysis
- develop and apply matrix techniques for structural analysis of planar trusses, beams and frames
- investigate the use of approximate methods for the analysis of indeterminate structures

Graduate Attributes and CEAB Indicators

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

- Attribute: 1. Knowledge
 - Indicator: 1.3 – Competence in Engineering Fundamentals
- Attribute: 2. Analysis
 - Indicator: 2.2 – Able to identify a range of suitable engineering fundamentals (including mathematical techniques) that would be potentially useful for analyzing a technical problem
- Attribute: 3. Investigation
 - Indicator: 3.1 – Able to recognize and discuss applicable theory knowledge base
- Attribute: 5. Tools
 - Indicator: 5.2 – The ability to use modern/state of the art tools

6. COMMUNICATION

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.

7. 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](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>.

The following illustrates only three forms of academic dishonesty:

- 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.

8. 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