

### COURSE INFORMATION

<b><u>Course Name:</u></b>	Structural Dynamics and Seismic Design
<b><u>Course Code:</u></b>	4DD4
<b><u>Session Offered:</u></b>	Winter 2022
<b><u>Calendar Description:</u></b>	Introduction to linear elastic structural dynamics including single and multi degree-of-freedom systems. Introduction to seismic design philosophy including capacity design, ductility, and collapse mechanisms. Design, detailing, and analysis of selected lateral force resisting systems will be covered using current design codes.
<b><u>Prerequisite(s):</u></b>	CIVENG 3G04 and CIVENG 3J04 and credit or registration in CIVENG 4N04
<b><u>Antirequisite(s):</u></b>	CIVENG 4ED4 and CIVENG 4SD4
<b><u>Instructor(s):</u></b>	Dr. Georgios Balomenos ( <a href="mailto:balomeng@mcmaster.ca">balomeng@mcmaster.ca</a> ) <u>Office:</u> JHE 338 <u>Phone:</u> (905) 525-9140 x 24215
<b><u>TA(s):</u></b>	Georgios Efstathopoulos ( <a href="mailto:efstathg@mcmaster.ca">efstathg@mcmaster.ca</a> )
<b><u>Instructor Office Hour:</u></b>	TBD
<b><u>TA Office Hour:</u></b>	TBD
<b><u>Lectures:</u></b>	Tuesdays, Thursdays, Fridays 11:30am-12:20pm ( <u>CNH 106</u> )
<b><u>Tutorial:</u></b>	Wednesdays 1:30pm-3:20pm ( <u>PGCLL M16</u> )
<b><u>Website:</u></b>	Avenue to Learn ( <a href="http://avenue.mcmaster.ca">http://avenue.mcmaster.ca</a> )

**It is the responsibility of the students to check Avenue regularly.**

### 1. COURSE OBJECTIVES

This course will serve as an introduction to the principles of structural dynamics and seismic design. Topics covered (depending on available time) include:

- **Structural dynamics** (Single degree of freedom systems, Building codes)
- **Seismic design code** (Load combinations, Strength and Drift requirements)
- **Seismic design/detailing for concrete buildings** (Moment resisting frames, Shear walls)
- **Seismic design/detailing for steel buildings** (Moment resisting frames, Braced frames)

## 2. COURSE SPECIFIC POLICIES

### 2.1 Required Textbook(s):

- **Concrete Design Handbook** (2016), 4th Edition, 2nd Revised Printing. Cement Association of Canada, Ottawa ON (also used for CIVENG 3J04).
- **Handbook of Steel Construction** (2016), 11th Edition, 3rd Revised Printing. Canadian Institute of Steel Construction, Markham ON (also used for CIVENG 4N04).
- **National Building Code of Canada** (2015), 14th Edition, 2nd Revised Printing. Canadian Commission on Building and Fire Codes, National Research Council of Canada, Ottawa ON (**Hardcopy**: available at the Design Lab, **Electronic Copy**: available at the NRC website, <https://nrc.canada.ca>).

### 2.2 Recommended Textbook(s):

- Chopra, A.K. (2017). **Dynamics of Structures: Theory and Applications to Earthquake Engineering**, 5th edition, Pearson. ISBN-10:0134555120, ISBN-13: 9780134555126.
- Filiatrault A., Tremblay R., Christopoulos C., Folz B., Pettinga D. (2013). **Elements of Earthquake Engineering and Structural Dynamics**, 3rd edition, Presses inter Polytechnique. ISBN-10: 2553016492, ISBN-13: 9782553016493.

### 2.3 Assignments:

- Assignment must be submitted electronically on AVENUE Drop Box. Assignments sent via email will not be marked.
- Due dates will be indicated on the assignment sheets. **Late assignments will not be accepted.**
- Minimum standards of neatness will be expected for all assignments. These standards include neat, legible printing, use of a straight edge for straight lines, and use of an eraser to correct mistakes. Assignments will be returned UNMARKED if these standards are not met.
- Assignments are to be individual effort. Excessive collaboration on an assignment may constitute a violation of the *McMaster Academic Integrity Policy (Section 8)*.

### 2.4 Midterm Exam:

- It is your responsibility to make yourself available during the Midterm. There will be no alternative times to write the Midterm. **The Midterm is not MSAF-able (Section 8).**
- **If the Midterm is missed due to illness, accommodation may be requested from the Associate Dean's office.** If such a request is approved, the weight of the missed Midterm will be evenly distributed to the remaining Assessments of Learning (Section 4), i.e., to the Assignments/Presentation/Report.

### 2.5 Presentation/Report:

There will be four major structural systems presented in this course, i.e., concrete moment frames (**CMF**), concrete shear walls (**CSW**), steel moment frames (**SMF**), and steel braced frames (**SBF**). **For the first three systems**, the class will be divided into groups and each group will:

- Be assigned one of the systems.
- Give a presentation discussing the system where **everyone in your group should present.**
- Submit a report.

More details will be discussed in the class.

### 3. SCHEDULE

This schedule is provided as a rough guide and may change slightly depending upon the pace of lectures.

Week	Lecture Topics (subject to change)	Due Dates (subject to change)
1. Jan 10	Static versus Dynamic Analyses	
2. Jan 17	SDOF systems	
3. Jan 24	SDOF systems	<u>Jan 28</u> : Assignment 1
4. Jan 31	Ductility and capacity design	<u>Feb 04</u> : Assignment 2
5. Feb 07	Seismic design code concepts	<u>Feb 11</u> : Assignment 3
6. Feb 14	RC review	<u>Feb 18</u> : Assignment 4
<b>Feb 21</b>	<b>No Classes or Tutorials</b>	
7. Feb 28	Concrete moment frames ( <b>CMF</b> )	<b>Mar 02: Midterm Exam</b>
8. Mar 07	Concrete moment frames ( <b>CMF</b> )	<u>Mar 11</u> : CMF Presentations
9. Mar 14	Concrete shear walls ( <b>CSW</b> )	<u>Mar 18</u> : CMF Reports
10. Mar 21	Concrete shear walls ( <b>CSW</b> )	<u>Mar 25</u> : CSW Presentations
11. Mar 28	Steel moment frames ( <b>SMF</b> )	<u>Apr 01</u> : CSW Reports
12. Apr 04	Steel moment frames ( <b>SMF</b> )	<u>Apr 08</u> : SMF Presentations
13. Apr 11	Steel braced frames ( <b>SBF</b> )	<u>Apr 15</u> : SMF Reports
<b>FINAL EXAMINATION</b>	N/A	
<b>4. ASSESSMENT OF LEARNING</b>		<b>WEIGHT %</b>
Assignments		20%
Midterm Exam		30%
Presentation		20%
Report		30%

## 5. LEARNING OUTCOMES

- Be able to calculate earthquake forces on and design key components of various lateral load resisting system
  - Ability to identify a range of suitable engineering fundamentals (including mathematical techniques) that would be potentially useful for analyzing a technical problem [CEAB 2.2]
  - Recognizes and follows an engineering design process [CEAB 4.1]
  - Recognizes and follows engineering design principles [CEAB 4.2]
  - Obtains experience with open-ended problems [CEAB 4.3]
  - Presents instructions and information clearly and concisely [CEAB 7.2]
- Be able to articulate desired/expected behaviour of a structure under various hazard levels
  - Understands the role of the engineer in society, especially in protection of the public and public interest [CEAB 8.1]

## 6. LABORATORY SAFETY

- The course does not have a lab component.

## 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](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](http://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](mailto: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](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**

<b>Grade</b>	<b>Equivalent Grade Point</b>	<b>Equivalent Percentages</b>
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