THE UNIVERSITY OF WESTERN ONTARIO

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

CEE 9550B – SEISMIC ANALYSIS AND DESIGN OF BUILDINGS

COURSE OUTLINE – 2019-2020

The objectives are for the student to become able to:

- Understand the fundamentals of structure dynamics.
- Perform seismic analysis of buildings manually and using computer modelling.
- Apply the seismic provisions of the building code of Canada.
- Understand the concept of capacity design.
- Design seismic-resistant steel buildings.
- Design seismic-resistant reinforced concrete buildings.

Prerequisites:

Bachelor degree in Structural Engineering and CEE 9512a or equivalent

Contact Hours:

3 lecture hours per week.

Instructors:

A.Shehata, Ph.D. Candidate, email: ashehat7@uwo.ca; (Class 1)
Dr. A. Musa, P.Eng., email: amusa5@uwo.ca; (Class 2)

Lecture Notes:

Lecture notes prepared by Dr. El Damatty will be available for the students.

References:

Elements of earthquake engineering and structural dynamics, by Filiatrault, André., Cursus, 2013.

Dynamics of structures: theory and applications to earthquake engineering, by Anil K. Chopra. Englewood Cliffs, N.J., Prentice Hall, 1995.

Ductile design of steel structures, by Michel Bruneau, Chia-Ming Uang and Andrew Whittaker, McGraw-Hill, 1998.

Seismic Design of Reinforced Concrete and Masonry Buildings by Thomas Paulay and M. J. N. Priestley.

Units:

SI units will be used in lecture and examinations

Computing:

A number of assignments will involve computer modelling of structures using the commercial programs SAP2000 and ETABS. The two programs are available at the PC lab in the Spencer Engineering building.

Specific Learning objectives:

EARTHQUAKE GROUND MOTIONS CHARACTERISTICS

- **Causes and effects of earthquakes**
- **Seismic waves**
- **Characteristics of earthquakes**
- **Characteristics of ground record accelerations**
- **Attenuation relationship**
- **Return periods**
- **Design intensity**

RESPONSE OF A SINGLE DREGREE OF FREEDOM SYSTEM

- **Free vibration response**
- **Response to harmonic loads**
- **Response to earthquake loading using numerical integration (time history analysis)**
- **Concept of elastic response spectrum**
- **Seismic response of a single degree of freedom using the response spectrum procedure**
- **Seismic response of a single degree of freedom using the time history procedure**
- **Seismic response of generalized single degree of freedom systems**

SEISMIC ANALYSIS OF MULTI DEGREES OF FREEDOM STRUCTURES

- **Dynamic analysis of MDOF systems using the modal analysis procedure**
- **Dynamic analysis of MDOF systems using the time history procedure**
- **Linear seismic analysis using modal analysis**
- **Linear seismic analysis using time history approach**

CODE PROCEDURES FOR EARTHQUAKE RESISTANT

- **Inelastic behaviour and ductility**
- **Seismic provisions of the National Building Code of Canada NBCC (2005, 2010, 2015)**
- **Concept of capacity design**
- **Code Provisions for dynamic analysis**

SEISMIC DESIGN OF STEEL BUILDINGS

- **Seismic behaviour and design provisions of ductile moment resisting steel frames**
- **Seismic behaviour and design provisions of ductile steel braced frames**
- **Solved example: Seismic Design of a steel building**

SEISMIC DESIGN OF REINFORCED CONCRETE STRUCTURES

- **Seismic behaviour and design provisions of ductile moment resisting reinforced concrete frames**
- **Seismic behaviour and design provisions of ductile reinforced concrete shear walls**
- **Solved example: Seismic design of a reinforced concrete building**

Evaluation:

The final course mark will be determined as follows:

Class Participation	5%
Final Exam	35%
Final Project	35%
Assignments	25%
Total	100%

Use of English:

In accordance with Senate and Faculty Policy, students may be penalised up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Cheating:

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

Attendance:

Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Conduct:

Students are expected to arrive at lecture on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others.

Sickness and Other Problems:

Students should immediately consult with the instructor regarding any problem that could affect their performance in the course. Where appropriate, the problems should be documented (see attached). The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Notice:

Students are responsible for regularly checking their e-mail, the course owl site.

Consultation:

Office hours will be arranged for the students to see the instructor. Other individual consultation can be arranged by appointment with the instructor.