The University of Jordan
Faculty of Engineering and Technology
Department of Civil Engineering

Bachelor of Science in Civil Engineering Program
Course Syllabus

1. Class Information for (0901553) Introduction to Earthquake Engineering

Course Name: Introduction to Earthquake Engineering
(Not required for any major. Elective for CE.)

Course Code	0901553	**Prerequisite**	((0931451) Reinforced concrete I
Credit Hours	3 (3 hours lectures)	**Co-requisites**	None
Semester of offering	Spring 2013/2014	**Prerequisite for**	None
Class Time	Sun., Tues., and Thurs.: (9:00 am – 10:00 am)	**Class Room**	Civil 103
Course Objectives	Teaching the basic concepts of earthquake resistant design to a B.S. level Civil Engineer involving; Causes of earthquakes, characteristics of earthquake ground motions. Earthquake magnitude and intensity measurements. Seismic response analysis of simple structures. Derivation of elastic response spectra and earthquake design spectra. Earthquake design criteria. Free and forced vibration analysis of frame structures. Modal spectral analysis and equivalent static lateral force method. Design codes, design applications.		

2. Instructor Information:

Instructor	**Anis S Shatnawi**
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Telephone:	+9762 6 5355000 ext 22737
Office Location:	Civil Engineering Department - C305
Office Hours:	Sunday and Tuesday (10:30 am – 11:30 am) + **open door**

3. Course Catalog:

The course covers the analysis of structures subject to earthquake-induced loads as well as the evaluation of different design techniques including equivalent static analysis, response spectra, capacity design and pushover analysis. Implementation in practice includes introduction to earthquake design codes (such as UBC97 and IBC-12) and ductile detailing practice for reinforced concrete buildings in earthquake zones (such as ACI 318-11 Ch21). The course catalog includes: Earthquake nature and characteristics, Plate tectonics, Faults, Seismic Waves, Earthquake magnitude, intensity, and frequency, Structural dynamics, Seismic damage to structures, Earthquake load prediction including equivalent statics, response spectra, and time history procedures, The basis of building code, earthquake load requirements for reinforced concrete buildings.

4. Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Understand plate tectonics. (a, e)
2. Understand ground motion magnitude, intensity, and frequency. (a, e)
3. Understand and compute ground motion intensity measures and attenuation relationships. (a, e)
4. Explain basic principles of seismology and earthquake engineering. (a, c, e, k)
5. Understand and apply the basics of structural dynamics in analysis of structures subjected to earthquakes. (a, e)
6. Determine the static base shear for a common building type. (a, c, e, k)
7. Distribute the base shear to various stories of the building using UBC, IBC, and other provisions. (a, c, e, k)
8. Understand and apply building code earthquake requirements in design of structural systems. (a, c, e)
9. Design a simple system to resist earthquake motion according to the provisions of the UBC97, IBC2009, and ACI-11. (a, c, e, I, k)
10. Use response spectra to estimate the seismic demands on a single-degree-of-freedom system.(a, c, e, k)

5. Weekly Outline

Week	Topic
1	Introduction, Earthquake Phenomena: - Structure of the Earth and World Tectonics - History of the Earth - Nature and Characteristics of Earthquakes, Earthquake Mechanism, Plate Tectonic Theory, and Elastic Rebound Theory.
2	Introduction, Earthquake Phenomena: - Faults and Fault Mechanisms - Location of earthquakes - Earthquake probability studies
3	Seismic Waves: - Propagation of Seismic Waves. - Earthquake Measurements: Size, Magnitude and Intensity. - Seismicity-Global and Local. - Seismicity, Seismic Hazard, and Seismic Risk.
4	Characteristics of Strong Earthquake Ground Motion: - Recorded ground motions, factors influencing ground motions. - Estimating ground motions. Review of Structural Dynamics: - Earthquake Vibrations. - Response of simple structures to Earthquake ground motion.
5	Seismic response of SDOF systems: - Free and Forced Vibrations for Single Degree of Freedom. - Seismic response of linear elastic single degree of freedom (SDOF) systems. - Response of building structures to earthquake excitation; Undamped free vibration: Eigenvalue analysis.
6	Elastic and inelastic response spectra: - Linear elastic response spectra, ; ductility - Seismic design spectra, code formulation including UBC97, IBC2012>

7	Multi-Degree of Freedom Systems: Forced vibration analysis under earthquake excitations (modal superposition)
8	Earthquake Design Procedures - Equivalent Static, Response modification factors. - Fourier, Response Spectrum. - Design Spectra, and Inelastic design spectra.
9	**Midterm Exam**
10	Time History Dynamic Analysis of Structures - 2D Systems
11	Codes of Practice - Uniform Building Code, UBC97 - International Building Code, IBC 2012, ASCE7-10
12	Seismic Provisions of RC Structures (ACI-11 Code): - Earthquake-resistant design - Ductility, code provisions of Special Design Considerations.
13	SEISMIC DESIGN PRINCIPLES FOR R/C STRUCTURES: Capacity design principles in R/C structures.
14	Seismic Resistant Detailing of Concrete Structures - Columns, Beams, Shear walls
15	Preliminary Design of multi-story RC buildings
16	**Final Exam**

6. Textbooks and Learning Material:

a. Required Books

	Book 1	**Book 2**	**Book3**
Title	**Uniform Building Code -** Chapter 16 and other Related Sections**,**	**International Building Code (IBC 2012).** International Council of Building Officials**, 2009.**	***Building Code Requirements for Structural Concrete*** (**ACI318M-11**)
Author(s)	International Council of Building Officials	International Code Council	American Concrete Institute
Publisher	International Council of Building Officials	ICC	American Concrete Institute, Farmington Hills
Year	**1997.**	2012	2011
Edition	**1997**	2012	2011

b. References

Books	1. Amr Elnashai, Luigi Di Sarno (2008). Fundamentals of Earthquake Engineering. John Wiley & Sons, Ltd. ISBN: 978-0-470-02483-6, Hardcover 366 pages October 2008. 2. **ASCE/SEI 7-10: Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineer,** 1801 Alexander Bell Drive, Reston, Virginia 20191. 3. **Jordanian Code for Earthquake Resistant Structures, 2005.** 4. Dowrich, D.J., Earthquake Resistant Design, John Wiley and Sons, 1988. 5. Anil K. Chopra, Dynamics of Structures - Theory and Applications to Earthquake Engineering , Prentice Hall, 2001. 6. F. Naeim, Jackman and Hall , *Seismic Design Handbook*., 1989, 2001. 7. Bruce A. Bolt, "Earthquakes", Freeman, 1999 (4th) edition or later. 8. N.M. Newmark, and E. Rosenblueth (1971): Fundamentals of Earthquake Engineering, Prentice Hall. 9. Reinforced Concrete, A Fundamental Approach, Fifth edition-*ACI 318-05 Code edition*, by Edward G. Nawy, Prentice Hall, 2005. 10. FEMA-274, FEMA-274 (1997): NEHRP Guidelines for the Seismic Rehabilitation of Buildings + Commentary of same http://www.conservationtech.com/FEMA-publications/FEMA.htm 11. FEMA 306-308 (1999): Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings + Resources http://www.conservationtech.com/FEMA-publications/FEMA.htm
Journals	IBC, ASCE and ACI related Journals
Internet links	-

7. Assessment of Student Learning

There will be **three exams** given within the semester. Details regarding exam content, date time and etc. will be given in class as the exam dates draw near. The weight percentage are as follows:

Assessment Tool	Percentage	Learning Outcomes
Short Exam	10%	a,c,e
Term Paper Project	10%	a,c,e
Midterm Exam	30%	a,c,e
Final Exam	50%	a,c,e

- Short Exam is ***closed book and closed notes***.
- Midterm and Final Exams ***are open book and open notes***.
- Use of a calculator is recommended. You are required to bring your calculator to every class.
- Generally, **No make-up exams** will be held. Extremely emergency cases will be evaluated on a case-by-case basis.

Contribution of Course to Meeting Professional Component:

Engineering Science:	40%
Engineering Design:	60%

8. Grading Key

Grade	Percentage	Description	Grade Point
A	90-100	Excellent	4.00
A-	85-89		3.75
B+	80-84		3.5
B	75-79		3.0
B-	70-74		2.75
C+	65-69		2.5
C	60-64		2.0
C-	55-59		1.75
D+	50-54		1.5
D	45-49		1
D-	40-44	Fail	0.75
F	Less than 40	Fail	0.0
I		Incomplete	0.0

9. Teaching – Learning Process

The course will be taught using a variety of teaching models. These will include theory-led teaching, case-method education and project-based/team-based teaching. Teaching based on exposition of theory will be applied to engineering and construction science. Learning the fundamentals in math and physics, statics and dynamics, mechanics of materials, hydrology and surveying, transportation, and concrete and structural steel design effectively will be prerequisites to the development and application of structural engineering skills.

Case-method teaching will use real-world business experiences in order to demonstrate the application of general principles and to apply them to specific problems posed during the course of instruction. This pedagogy will be used in the teaching of construction contracts and administration, safety and business law.

Project-based and team-based education will be adopted; students will learn by doing, as much as they would in a natural sciences class. Project-based education will also give students an opportunity to learn how to assemble and coordinate necessary information, assert authority and delegate responsibility. This is particularly important in the construction industry, in which the essential tasks are the management of people and information.

It will be common in CE courses for all pedagogical approaches to be employed. The CED faculty members will bring together theory-based instruction and an intimate understanding of state-of-the-art professional practices. Jordan University will provide a universe of projects of all types that will be readily available to students to serve as a virtual laboratory. Drawings and specifications will be made available to students for classroom study and before visiting project sites. Faculty members who are actively involved in those projects will discuss the many unique and special problems encountered on these projects, as well as potential solutions. Field visits to project sites will be an essential part of the educational process.

10. Attendance

For undergraduate students, absence is marked at a maximum of 15% of total class time. Final dismissals will be posted at the JU Student Portal.

Final Dismissal will not be waived under any circumstances. Office of the student affairs will only accept excuse forms to allow the students for their make-up examinations but absence will not be waived and final dismissals will not be removed from the student's record.

Students will be considered late if they do not arrive on time for a lesson or they return late from a break. Instructors have the right to refuse entry to students who are more than 15 minutes late, but if entry is permitted, students must enter in such a way as not to disturb the lesson in progress.

Final Exams/Tests will be repeated when serious reasons similar to the following take place and documented evidence are submitted to the Office of the Dean on the day student returns to class.

- Hospitalization and Contagious Disease,
- Death, may God forbid, of an immediate family member (father, mother, sibling, husband, son, daughter, grandparent),
- Serious Car Accident,
- Al Haj

Undergraduate students who miss their final examinations and/or tests will bring the excuse for their absence to the Instructor and Deanship the day they return to class.

11.Academic Integrity

The mission of JU includes developing students' sense of ethics, morality, and social responsibility. Students at JU have the fundamental obligation to conduct themselves with utmost integrity.

The revised Academic Integrity Policy (AIP) – copies available on the Office of Assistant Dean for Student Affairs – has identified violations of AI punishable by serious penalties, including "dismissal" from JU. The types of violations identified in AIP, along with the description and examples of each violation, are:

1. Cheating
2. Plagiarism
3. Fabrication of data
4. Presenting false credentials
5. Collusion

At the beginning of each semester, your instructor will review the essential elements of AIP in class and will describe the intrinsic values of compliance, and the consequences of non-compliance (i.e., penalties) with the Policy. In addition, Deanship of Student Affairs undertakes a widespread AI Awareness Campaign at the beginning of each semester to educate students about AI issues and the ways students can avoid violations.

In view of resources provided by JU in this regard, all students are expected to strictly comply with the tenet of AIP and conduct themselves with highest degree of integrity and ethical conduct. Students in need of additional information or assistance are requested to seek help from Deanship of Student Affairs.

Failure to comply with the provisions of AIP will have severe consequences, including "dismissal" from JU.

12. Miscellaneous

- Mobile phones: A student whose mobile phone rings during class will be asked to leave the classroom and will receive a half absence. Should this happen during an exam, the student will not be allowed to retake the exam at another time, while at the same time receiving a full absence.

- Eating/Drinking/Smoking: Students will be requested to cease from engaging in these activities while in class.