IUSS
Scuola Universitaria Superiore Pavia

Course: Geotechnical Earthquake Engineering
Lecturers: D. LeBoeuf / J.-F. Semblat
Date: 09/01/2017 – 03/02/2017
Classroom: Sala del Camino@IUSS; Classroom 1-14@IUSS on 9/1 – 31/1 – 1/2

Course schedule

Week	Date	Lecture hours From____ To____	Tutorial hours From_13_ To_16_	Subject	Tot H
1 DLB	**GEE01** (9/1)	9 - 12		*Course overview – Lessons learned from earthquakes* ***Mini-Project 1*: Ground motions parameters for a dam or bridge site**	3
1 JFS	**GEE02** (10/1)	9 - 12		*Fundamentals of structural dynamics and vibrations*	3
	GEE03 (11/1)	9 - 12		*Introduction to Earthquakes and Seismicity, Seismic Rays vs Seismic Waves*	3
	GEE04 (12/1)	9 - 12		*1D wave propagation theory – Elastodynamics*	3
	GEE05 (13/1)	9 - 12		*2D/3D Wave propagation in soils*	3
2 JFS	**GEE06** (16/1)	9 - 12	*Tutorial*	*Seismic site effects - Amplification*	6
	GEE07 (17/1)	9 - 12		*Ground motion characteristics & Ground motions for design*	3
2 DLB	**GEE08** (18/1)	9 - 12		*Introduction to drained and undrained hydro-mechanical behaviour of soils*	3
	GEE09 (19/1)	9 - 12		*Behavior of granular soils under cyclic loading*	3
	(20/1)	-	-	-	
3 DLB	**GEE10** (23/1)	9 - 12		*Behavior of clays and plastic silts under cyclic* ***Mini-Project 2* : Dynamic response evaluation of the foundation soils for a dam/bridge site**	3
3 JFS	**GEE11** (24/1)	9 - 12		*Numerical modelling of seismic wave propagation (I)*	3
	GEE12 (25/1)	9 - 12		*Numerical modelling of seismic wave propagation (II)*	3
3 DLB	**GEE13** (26/1)	9 - 12	*Tutorial*	*Site investigations and liquefaction assessment: field performance-based methods*	6
	GEE14 (27/1)	9 - 12		*Consequences of liquefaction & Ground improvement methods*	3
4 DLB	**GEE15** (30/1)	9 - 12		*Seismic slope stability & landslides*	3
	GEE16 (31/1)	9 - 12		*Seismic evaluation of tailings and earth and rockfill dams*	3
	GEE17 (1/2)	9 - 12		*Introduction to soil-structure interaction (SSI) and seismic foundation design*	3
	(2/2)	9 - 12		*Oral presentations, Review problems, Exam preparation*	3
	(3/2)	9 - 12		***Exam (3 hr)*** *Mini-projects due date*	
					60

Brief Contents Description and Course Syllabus:

The course aims at introducing the students to the theories and methods of Geotechnical Earthquake Engineering (GEE).

After reviewing basic notions of engineering seismology such as definition of earthquake size, ground motion parameters, seismic hazard and ground motion selection and scaling for site specific studies, the course will focus on wave propagation in soils and site effects (wave conversion, amplification, attenuation, dispersion). It will then discuss ground motion characteristics for design purposes.

The second part of the course focuses on soil behaviour under monotonic, cyclic and dynamic loading and will introduce the student to the current methods available for evaluating liquefaction triggering as well as the consequences of liquefaction. Ground improvement methods and techniques will be presented and discussed.

Various numerical methods for dynamic response analysis are then discussed and compared in the third part of the course.

The fourth and last part of the course study will cover topics of engineering interest such as seismic slope stability, earthquake design of earth and rockfill dams, dynamic soil-structure interaction and the seismic design of foundations.

Instructors:

Denis LeBoeuf, denis.leboeuf@gci.ulaval.ca

Jean-François Semblat, jean-francois.semblat@ifsttar.fr

Textbook and optional references:

1.) Kramer, S.L. (1996), "*Geotechnical Earthquake Engineering*", Prentice Hall. – Required

2.) Semblat, J.-F. et Pecker, A. (2009), « *Waves vibrations in soils : earthquakes, traffic, Shocks, Construction Works* », IUSS Press, 499 p. - Required

3.) Idriss, I.M. and Boulanger, R.W. (2008), "*Soil Liquefaction During Earthquakes*", Earthquake Engineering Research Institute (EERI), MNO-12- Required

4.) NEHRP Consultants Joint Venture (2012), "*Soil-Structure Interaction for Building Structures*", NIST GCR 12-917-21, National Institute of Standards and Technology (NIST), 292 pages - Required (http://www.nehrp.gov/pdf/nistgcr12-917-21.pdf)

5.) Chopra, Anil K. (2011), "*Dynamics of Structures: Theory and Applications to Earthquake Engineering*", 4th Edition, Prentice Hall International Series in Civil Engineering and Engineering Mechanics,992 p. – Suggested

6.) Course notes.

Homework and Grading:

- 2 mini-projects (60%) (about 10-15 pages each)
- 1 oral presentation (10%)
- 1 exam (30%)

Consequences of liquefaction & Ground improvement methods

Site investigations and liquefaction assessment: field performance-based methods