University of Pavia

IUSS School of Advanced Studies

Civil Engineering for Mitigation of Risk from Natural Hazards

Course: Dynamics of Structures
Lecturer: Dr. Halûk Sucuoğlu
Teaching Assistant: Mr. Numan Eren
Date: 20/09/2021 – 19/10/2021
Classroom: Online

Brief Contents Description and Course Syllabus
It is commonly accepted that every structural engineering major should have a minimum introduction to dynamics of structures to serve as a prelude to more advanced courses in earthquake engineering, blast-resistant design, random vibrations and wind engineering. This course is designed to serve this purpose. It is a basic graduate level course which studies the vibration characteristics and dynamic response of structural systems to dynamic excitations generated by earthquakes, wind, impact and blast.

By the end of the course, the student is expected to have a basic understanding of:

- Discrete single-degree, multi-degree and continuous vibratory systems,
- Free and forced vibration response of discrete and continuous systems,
- Applications in structural design.

The only requirement for this course is a customary exposure to an introductory course on dynamics, such as the basic undergraduate course: Dynamics of Rigid Bodies. The knowledge of basic mathematics, particularly the solution differential equations and numerical methods are also used extensively in this course.

Suggested reading material
In addition to specific papers and handouts indicated/delivered during classes, the following general textbooks are recommended.
• Chopra A., “Dynamics of Structures”, Prentice Hall, Third Edition, 2007
• Clough R.W., Penzien J., "Dynamics of structures", Computers & Structures Inc, 2003

Software
• Matlab: The Mathworks, 2012. MATLAB 2012b Release, Statistics Toolbox, available at http://www .mathworks.com/products/matlab/.
• Seismosoft: “SeismoStruct - A computer program for static and dynamic nonlinear analysis of framed structures”. 2018. (http://www.seismosoft.com/seismostruct)
• SAP2000, Computers and Structures, Inc., 2020.
• Mazzoni et al.: “OpenSEES - The open system for earthquake engineering simulation”, PEER, UC Berkeley, 2006. (http://opensees.berkeley.edu)

Grading
Homework assignments: 35%
Midterm: 25%
Final exam: 40%
Note : Both exams will be take-home naturally, with limited time allowed.

Course schedule

Week	Date	Lecture hours GMT	Tutorial hours GMT	Subject Dynamics of Structures	Tot h
1	20.09.21 Mo	13:00-16:00		Equation of motion for SDOF systems, its solution	3
	22.09.21 We	13:00-16:00		Free vibration response, viscous damping	3
	24.09.21 Fr	12:00-15:00		Response to harmonic excitation	3
	24.09.21 Fri		16:00-18:00	Problem session	2
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2	27.09.21 Mo	13:00-16:00		Response to general excitation, response spectrum	3
	29.09.21 We	12:00-15:00		Generalized SDOF systems	3
	01.10.21 Fr	12:00-15:00		Numerical evaluation of dynamic response	3
	29.09.21 We		16:00-18:00	Problem session- Solution of homework problems	2
	01.10.21 Fri		16:00-18:00	Tutorial on numerical integration	2
3	04.10.21 Mo	13:00 GMT		Midterm Exam	3
	06.10. 21 We	12:00-15:00		Equations of motion for MDOF systems, static condensation	3
	08.10. 21 Fr	12:00-15:00		Free vibration analysis, modal expansion, damping in structures, damping matrix	3
	06.10. 21 We		16:00-18:00	Solution of midterm questions	2
	08.10. 21 Fri		16:00-18:00	Tutorial on the modelling of MDOF systems	2
4	11.10. 21 Mo	13:00-16:00		Modal response analysis of undamped systems	3
	13.10. 21 We	12:00-15:00		Modal response analysis of damped systems	3
	15.10. 21 Fr	12:00-15:00		Torsional response of 3D systems	3
	13.10. 21 Wed		16:00-18:00	Tutorial on forced vibration analysis	2
	15.10. 21 Fri		16:00-18:00	Tutorial on homework problems	2
	19.10. 21 Tue	13:00 GMT		Final Exam	3