University of Pavia

IUSS School of Advanced Studies

Civil Engineering for Mitigation of Risk from Natural Hazards

Course: Dynamics of Structures
Lecturers: Dr. Halûk Sucuoğlu, Dr. Gerard O'Reilly
Teaching Assistant: Serkan Hasanoğlu
Date: 25/09/2023 – 21/10/2023
Classroom: Aula 1-17, Piazza della Vittoria 15, Pavia

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%

Course schedule

Week	Date	Lecture hours Italian Time	Tutorial hours GMT	Subject Dynamics of Structures	Tot h
1 (GOR)	25/09/23 Mon	09:00-12:00		Equation of motion for SDOF systems, its solution	3
	26/09/23 Tue	09:00-12:00		Free vibration response, viscous damping, Response to harmonic excitation	3
	27/09/23 Wed	09:00-12:00		Response to general excitation, response spectrum	3
	27/09/23 Wed		14:00-16:00	Problem session- Solution of homework problems	2
2 (GOR)	02/10/23 Mon	09:00-12:00		Generalized SDOF systems	3
	03/10/23 Tue	09:00-12:00		Numerical evaluation of dynamic response	3
	04/10/23 Wed	09:00-12:00		**Midterm Exam**	3
	04/10/23 Wed		14:00-16:00	Problem session- Solution of homework problems	2
3 (HS)	09/10/23 Mon	09:00-12:00		Equations of motion for MDOF systems, static condensation	3
	11/10/23 Wed	09:00-12:00		Free vibration analysis, modal expansion, damping in structures, damping matrix	3
	13/10/23 Fri	09:00-12:00		Modal response analysis of undamped systems	3
	09/10/23 Mon		14:00-16:00	Tutorial on numerical integration	2
	11/10/23 Wed		14:00-16:00	Solution of midterm questions	2
	13/10/23 Fri		14:00-16:00	Tutorial on the modelling of MDOF systems	2
4 (HS)	16/10/23 Mon	09:00-12:00		Modal response analysis of damped systems	3
	18/10/23 Wed	09:00-12:00		Element forces, modal contribution factors	3
	20/10/23 Fri	09:00-12:00		Torsional response of 3D systems	3
	16/10/23 Mon		14:00-16:00	Tutorial on forced vibration analysis	2
	18/10/23 Wed		14:00-16:00	Tutorial on homework problems	2
	21/10/23 Sat	09:00		**Final Exam**	3