

Course Unit	Structural Dynamics and Earthquake Engineering		Field of study	Solid Mechanics and Structures	
Master in	Construction Engineering		School	School of Technology and Management	
Academic Year	2023/2024	Year of study	2	Level	2-2
Type	Semestral	Semester	1	ECTS credits	6.0
Code	5024-419-2101-00-23				
Workload (hours)	162	Contact hours	T 30	TP 30	PL -
			TC -	S -	E -
			OT -	O -	

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) João Carlos Almendra Roque

### Learning outcomes and competences

- At the end of the course unit the learner is expected to be able to:
1. Formulate the equations of dynamic equilibrium structures
  2. Determine the response of structures under any kind of dynamic action
  3. Characterize the seismic action based on regulamentar codes
  4. Understand the seismic phenomena and their consequences on structures dynamic behavior
  5. Adjust structural conception rules to the nature of the dynamic action type, particularly in the case of seismic actions

### Prerequisites

- Before the course unit the learner is expected to be able to:
1. Analyse static structures
  2. Use differential, integral and matricial calculus
  3. Apply basic principles of Physics (dynamics)

### Course contents

Fundamentals of Dynamic of Structures Theory . Dynamic equilibrium equations. SDOF and MDOF systems. Free and forced vibrations. Damping. Seismic action characterization. Dynamic analysis of structures. Methods and models for structural seismic analysis. Anti-seismic structural conception.

### Course contents (extended version)

1. Introduction to dynamics of structures
  - Static action versus dynamic action.
  - Types of dynamic actions. Deterministic and stochastic actions.
  - Mathematical models of analysis. Continuous and discrete models.
2. Fundamental theory of dynamic of structures
  - SDOF systems:
  - Dynamic equilibrium equation;
  - Free and forced vibrations; Damping; Response to any dynamic action;
  - Analysis vibration by Rayleigh method.
  - MDOF systems:
  - Dynamic equilibrium equations;
  - Modal Analysis; Superposition method.
3. Seismic action and structures:
  - Seismology and Seismic Enginneering. Historical review in Portugal.
  - Seismic action characterization. Regulamentar codes.
  - Response of SDOF and MDOF systems under seismic actions. Modal analysis.
4. Dynamic analysis of structures:
  - Regulamentar requirements. Ductility and behavior factors.
  - Methods for structural seismic analysis. Simplified and advanced methods.
  - Planar models in the analysis of frame-wall structures.
5. Anti-seismic rules in structural conception. Devices and solutions for vibrations control.

### Recommended reading

1. Soriano, H. L. Introdução à dinâmica as estruturas, Rio de Janeiro, Campus, 2014.
2. Penzien, J. ; Clough, R. , Dynamics of Structures, McGraw-Hill, 2nd Edition, New York and London, 1993.
3. Filho, A. Alves; Elementos Finitos - Análise Dinâmica, Editora Érica , São Paulo, 2005.
4. Lopes, M. (coordenação) - Sismos e edifícios, Edições Orion. 2008
5. EN1998-1 Design of structures for earthquake resistance – Part 1: General rules, seismic action and rules for buildings, CEN, 2010

### Teaching and learning methods

Presencial period (60 hours): the unit will be taught using a combination of expository lectures and practice lessons. Non-presencial period (102 hours): students will be provided with a study guide, support material and e-learning facilities to promote a self guided learning.

### Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary)
  - Practical Work - 50%
  - Final Written Exam - 50%
2. Alternative 2 - (Regular, Student Worker) (Special)
  - Final Written Exam - 100%

### Language of instruction

Portuguese, with additional English support for foreign students.

## Electronic validation

João Carlos Almendra Roque	Debora Rodrigues de Sousa Macanjo Ferreira	Manuel Teixeira Brás César	José Carlos Rufino Amaro
11-10-2023	19-10-2023	19-10-2023	31-10-2023