

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	2020/2021	Year of study	2	Level	2-2
Type	Semestral	Semester	1	ECTS credits	6.0
Code	5024-419-2101-00-20				
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. Penzien, J. ; Clough, R. , Dynamics of Structures, McGraw-Hill, 2nd Edition, New York and London, 1993.
2. Filho, A. Alves; Elementos Finitos - Análise Dinâmica, Editora Érica , São Paulo, 2005.
3. RSA, Regulamento de Segurança e Ações em Estruturas de Edifícios e Pontes. Decreto Lei nº. 235/83, Portugal
4. Eurocode 8 - EN1998-1 Design of structures for earthquake resistance – Part 1: General rules, seismic action and rules for buildings, CEN, 2004
5. Guia das aulas, apontamentos, caderno de exercicios e outros elementos de trabalho fornecidos pelo docente.

#### 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 - 60%
  - Final Written Exam - 40%
2. Alternative 2 - (Regular, Student Worker) (Special)
  - Final Written Exam - 100%

#### Language of instruction

English

## Electronic validation

João Carlos Almendra Roque	Luís Manuel Ribeiro Mesquita	Manuel Teixeira Brás César	Paulo Alexandre Vara Alves
29-10-2020	29-10-2020	30-10-2020	02-11-2020