IPS Instituto Politécnico de Setúbal
Escola Superior de Tecnologia do Barreiro

Curriculum Unit Sheet

Structural Dynamics and Earthquake Engineering

Academic Year:

2018/2019

Course	Master's degree in Civil Engineering								
Scientific Area	Structures								
ECTS Credits	6.5	**Curriculum Unit code**	MEC115	**Year**	1	**Semester**	1	**Type**	Compulsory
Prerequisites									

Contact Hours

Lecture Sessions	15	**Lecture-Practical Sessions**	30	**Practical and Laboratory Sessions**	
Tutorial	7.5	**Placement**		**Seminar**	
Fieldwork		**Other**	7.5	**Autonomous Study**	115.5

Responsible	Cristina Cruz Ferreira de Oliveira	**Position**	Adjunct Professor
Lecturers		**Position**	

Learning Outcomes

The main objective is to initiate students to the study of Structural Dynamics. Earthquake Engineering problems are studied based on previous knowledge. Basics of Engineering Seismology and Geotechnical Engineering are revised in seismic structural response context. At the end of the course students will acquire the ability to perform seismic analysis of structures in the context of Eurocode 8.

Syllabus

Characterization of a dynamic problem. Dynamic action. Structural system discretization. Formulation of the equations of motion. One degree of freedom oscillator. Multiple degrees of freedom linear system. Characteristic equation. Vibration modes. Modal coordinates. Modal superposition method. Stodola Method. Simplified Rayleigh method. Introduction to earthquake engineering. Basics of seismology. Seismic action definition. Analysis of seismicity. Seismic hazard analysis. Seismic zoning. Descriptive models of seismic actions. Local effects. Seismic structural analysis (2D and 3D). Analysis using modal response spectra. Simplified methods for seismic analysis. Seismic behaviour of buildings. Earthquake-resistant structural design. Capacity Design. EUROCODE 8.

Teaching Methodologies

Overall exposure of materials using presentations (with animations and images) in Power-Point. Presentation of practical examples. Self-learning of theoretical and practical proposed problems. Use of computer programs for dynamic analysis of structures. Classes will be held in computer rooms where students use computer programs to solve problems that were previously solved manually. In class-oriented guidance tutorial will discuss the proposed resolutions of problems, with guidance from teachers, but aimed at empowering learning.

Evaluation

The evaluation is composed by two tests of equal importance in the final grade (AF between 0 and 20). The minimum grade in each test is 8. There will be a final exam if mean AF<10.

Evidence of the syllabus coherence with the curricular unit's intended learning outcomes	The learning strategy allows the student to understand the dynamic structural behaviour in general, and then to extrapolate that knowledge to the specific problem of the seismic action effects, in a modern perspective of Earthquake Engineering. Particular attention is paid to problems involving the seismic behaviour of buildings, including the correlation of architectural typology, materials, and construction process used, with structural models and adopted seismic analysis methods. The whole learning process is accomplished, first by the theoretical study, and followed by the solution of problems that reflect the reality of professional activity. The study is in the context of Structural Eurocodes (particularly of Eurocode 8) and fulfil polytechnic goals.
Evidence of the teaching methodologies coherence with the curricular unit's intended learning outcomes	Subjects are presented together with animations and photographs, so not only the mathematical expressions are presented (with the corresponding deduction). This allows the student to be motivated. The use of computer programs in classrooms, simultaneously with the manual resolution of problems, favors the connection between theoretical and practical application, which fits into the context of the polytechnic aim. This approach also allows the students to understand that the computer program is merely a tool. Classes conducted in the laboratory, using physical didactic models, aims to facilitate the assimilation of basic concepts of structural dynamics (natural frequency of vibration and resonance). The practical individual work can benefit knowledge acquisition by students. Students are encouraged to individual study at home, and in small groups in tutorial sessions in the classroom.
Bibliography	C Chopra, A. K. (2006) - Dynamics of Structures – Theory and applications to earthquake engineering, 3rd edition. Prentice Hall. Clough, R. W. ; Penzien, J. (1993) - Dynamics of Structures. 2th ed. McGraw-Hill International Editions. Estêvão, J.M.E. (2012) - Efeito da ação sísmica no comportamento de edifícios de betão armado com alvenarias de enchimento. Tese de doutoramento, 452 p. Instituto Superior Técnico, UTL. Sen, T.K (2009) - Fundamentals of Seismic Loading on Structures. Wiley. Lopes, M. - Coordenador (2008) - Sismos e Edifícios. Edições Orion. IPQ (2010) - NP EN 1998-1. Eurocódigo 8: Projeto de estruturas para resistência aos sismos. Parte 1: Regras gerais, ações sísmicas e regras para edifícios. Instituto Português da Qualidade, Caparica, Portugal. IPQ (2010) - NP EN 1998-5. Eurocódigo 8: Projeto de estruturas para resistência aos sismos. Parte 5: Fundações, estruturas de suporte e aspetos geotécnicos. Instituto Português da Qualidade, Caparica, Portugal.
Observations	