INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA

ADEM
Área Departamental de Engenharia Mecânica

Curricular Unit Form (FUC)

Course:	**SECOND CYCLE IN MECHANICAL ENGINEERING**					
Curricular Unit (UC)	**Computational Mechanics**				Mandatory	x
					Optional	
Scientific Area:	**Manufacturing and Mechanical Design**					
Year: **1**	Semester:	ECTS: 6.5		Total Hours:		
Contact Hours:	T:	TP:**67.5**	PL:	S:	OT:	TT:
Professor in charge		Academic Degree /Title		Position		
Maria Amélia Ramos Loja		**PhD**		**Assistant Professor**		

T- Theoretical ; TP – Theory and practice ; PL – Laboratory ; S – Seminar ; OT –Tutorial ; TT – Total of contact hours

Entry into Force	Semester: **Winter**	Academic Year: **2016/2017**

Objectives of the curricular unit and competences (max. 1000 characters)

With this curricular unit, one intends to transmit advanced fundamental knowledge in the context of the mechanical behavior of deformable bodies, as well as their implementation and processing in computational terms.

The apprehension and articulation of knowledge in the context of the elasticity theory and the knowledge in the structural analysis fields of common engineering systems/components, such as the thick-walled pressure vessels and other advanced topics in the study of plates, as well as the increasing trend on using composite materials, are relevant subjects in such a curricular unit.

Simultaneously, is considered of relevance in this context, an introduction to the dynamic behavior of elastic systems.

The successful conclusion of this curricular unit enables the student to understand and to anticipate the static and dynamic mechanical behavior of greater complexity deformable structures

Syllabus (max. 1000 characters)

Fundamental concepts in Engineering. Advanced aspects on symbolic and numerical computation. Finite element applications libraries.
Fundamental concepts of 3D Elasticity. Characterization of states of stress/strain. Invariants. Principal stresses/strains. Hydrostatic and deviator tensors. Displacement and strain fields. Equilibrium equations. Compatibility equations.
Thick-walled pressure vessels. States of stress/strain. Hoop, longitudinal and radial stresses. Elastic-plastic behavior. Failure criteria.
Plates. Orthotropic rectangular plates. Navier and Ritz methods. Static and free vibrations. Circular plates.
Composite Materials. Laminated composites. Laminated plates classical theory. Advanced composite materials.

Elastic Systems Dynamics. Virtual work principle and Hamilton principle in elastic systems dynamics. Equations of motion and equilibrium equations.

Demonstration of the syllabus coherence with curricular unit's objectives (max. 1000 characters)

The fundamental concepts of the present syllabus are introduced during classes, and whenever possible, they are based on real structural/mechanical systems. This allows students to understand their qualitative and quantitative related aspects. The sequence of the topics also allows a progressive comprehension of the mechanical behaviour of structures and their components, as a coherent whole with the knowledge in the context of the deformable bodies' mechanics. Some of these subjects the students were already introduced to, in the previous cycle of studies.

The comprehension of the different topics is aided by using applied teaching methodologies, oriented to the formulation and implementation of the problems' solutions. During lectures, different types of computational applications are used, thus allowing a better perception of the essential aspects in the study of structures distributions of stresses and strains as well as on the dynamic behaviour of simpler structures.

Teaching methodologies (including evaluation) (max. 1000 characters)

Lectures will be considered in two perspectives. A first one where the student is introduced to each subject, through expositions, presentations of each topic, followed by some practical examples to illustrate the topics, in order to consolidate taught concepts.

In the remaining classes one will proceed to the analysis and solution of typical problem cases, where the students will apply the knowledge acquired. Some of these classes will involve carrying out some work using symbolic computation and finite element analysis applications.

The evaluation of acquired knowledge and skills will involve carrying out computational projects (NTC) as well as one global assessment (NE). The final classification (NF) is the result of $NF = 0.60 \times NE + 0.40 \times NTC$.
The curricular unit can as well be concluded through a final exam.

Demonstration of the teaching methodologies coherence with the curricular unit's objectives
(max. 3000 characters)

In this curricular unit, different methodologies are used in order to achieve the intended objectives. Depending on the characteristics of the concepts to transmit, theoretical and a theoretical-practical classes are considered, trying to maintain a coherent and harmonious sequence that allow the students to comprehend the fundamental concepts associated to the syllabus. On this unit classes, one uses the potentialities of information technologies, centered on symbolic and numerical applications as well as on finite element analysis applications.
Using these computational applications enable the implementation of analytical methods that

without this type of applications were ineffective as they can involve heavy calculation work. Additionally they enable carrying out complex structures analyses by using numerical techniques as it is the case of the finite element method.
Students and future Masters in Mechanical Engineering will learn and acquire skills associated to deformable structures analyses, which is an important issue achievable though the range of knowledge contained in the syllabus, as well as the practice with oriented computational applications.

Main Bibliography (max. 1000 characters)

Oden, J.T. and Ripperger, E.A., Mechanics of Elastic Structures.

Szilard, R., Theory and Analysis of Plates. Classical and Numerical Methods., Prentice Hall International Editions.

Mechanics of Materials – Volume 1 e 2 – E. J. Hearn, Butterworth Heinemann.

Popov, E., Engineering Mechanics of Solids, Prentice-Hall

Reddy, J.N., Mechanics of Laminated Composite Plates: Theory and Analysis, CRC Press