ISEL
ADEM
Área Departamental de Engenharia Mecânica

Curricular Unit Form (FUC)

Course:	**FIRST CYCLE IN MECHANICAL ENGINEERING**				
Curricular Unit (UC)	**Mechanics of Materials I**			Mandatory	X
				Optional	
Scientific Area:	**Mechanical Project, Manufacturing and Industrial Maintenance**				
Year: **2**	Semester: 1	ECTS: 5,5		Total Hours: **4,5**	
Contact Hours:	T: 45,0	TP: 22,5	PL:	S:	OT:	TT: 67,5
Professor in charge		Academic Degree /Title		Position	
Inês de Carvalho Jerónimo Barbosa		PhD		Invited 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)
The main objective of the course is to give students the basic concepts of the elasticity theory in the linear elastic regime, including the relations between the loads applied to a non-rigid body made of a given material and the resulting deformations. The objectives of the course also involve the concepts and the skills that form the foundation of all structural and machine design. After the course conclusion, the student is capable of: 1) Develop a clear insight into the relations between stress and strain for structural components subject to axial loads, torsion, bending and shear forces, acting individually or jointly. 2) Apply the Mechanics of Materials as a tool in the analysis of structural and mechanical systems. 3) Find the required dimensions of a member of a specified material to carry a given load subject to stated specifications of stress and deflections. 4) Study of systems, in a rational and coherent way, using computational tools based on symbolic computation.

Syllabus (max. 1000 characters)
1) Concepts of the Elasticity Theory: Normal and shear stresses; Principal stresses; Mohr's Circle; Equivalent and admissible stress; Coefficient of security. 2) Stresses and Deformations from Axial Loads: Hooke's Law; Deformation of axial loaded components; Statically indeterminate problems. 3) Geometric Properties of Areas: Center of gravity; 1st moment of area; 2nd moment of area; Polar moment of inertia; Parallel axis theorem. 4) Torsion of Circular Shafts: Stresses and deformations; Conditions of mechanical strength and

stiffness; Statically indeterminate problems.
5) Bending of Straight Beams: Equations of shear force and bending moment; Shear and bending moment diagrams; Normal and shear stresses; Differential equation of the elastic line.
6) Stability: Critical loads; Modes of instability; Euler formulation; Portuguese regulation for steel on buildings; Eccentric loading.
7) Reservoir Pressure: Stresses and deformations; Laplace equation; Design conditions.

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

The fundamental concepts of the course are introduced in the class, being based on real mechanical systems. It is intended that students understand the physics inherent to the problems and are able to interpret, in a critical way, the results obtained in the performed studies.
The sequence of the syllabus leads the student to understand, initially, the axial loads, torsion, bending and shear forces acting on structures and mechanical components. In a second stage, the student understands the damage caused by these loads by calculating the stresses and strains that develop in the elements as a result of the applied loads. It is then possible to find the required dimensions for the mechanical components by comparing the stresses applied with the admissible stress for the material. Finally, the student has the opportunity to apply the learned methods and methodologies as design tools using computational programs.

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

The teaching methodology of the course is conducted through lectures and practical classes. The lectures are presented in slideshow mode, which includes presentations on each topic, followed by practical examples where the purpose is that the student consolidates the learned concepts.
Practical classes involve problem solving analysis of real systems. During the semester, practical assignments are conducted and their reports are presented.
Continuous Assessment during the semester:
The assessment involves a computational (TC) and laboratorial assignment (TL), and two written tests during the semester (NT). Final grade (NF): $NF = 0.20 \times TC + 0.10 x TL + 0.7 \times NT$

Assessment by Exam: Includes only a written test.

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

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In teaching methodologies, different education strategies are used that allow achieving the objectives of the course. The concepts to be transmitted on each topic are given in lectures through slideshow presentations (made in PowerPoint). Also practical application examples are included in order to facilitate the consolidation of the concepts learned by the student. The support material is available to the student at the beginning of the semester through the Moodle platform, so that he can program in advance his study for the course. In practical classes the participation of students is encouraged through the resolution of exercises associated to real mechanical systems, where students apply the acquired knowledge. In the more complex cases, or with more mathematical or graphical requirements, symbolic computation programs will be used. The presentation of doubts and questions by students is encouraged, and these are explained with the participation of the whole class. It is intended, therefore, to encourage the participation of all in class, contributing to a more dynamic and participating learning. Some classes will involve carrying out laboratory work, where the student can check the consistency of the models studied with the real events.
The evaluation of the course is accomplished by computational and/or laboratory works and a written test (or exam). The aim is to assess not only the knowledge of the fundamental concepts associated with the program contents, but also the use of computer programs as design tools.

Main Bibliography (max. 1000 characters)

1) Beer, F. and Johnston, E., "Mechanics of Materials", McGraw Hill.
2) Hibbeler, R., “Engineering Mechanics: Statics”, Prentice-Hall.
3) Ugural A. C., “Mechanics of Materials”, McGraw-Hill.
4) E. J. Hearn, “Mechanics of Materials – Volume 1”, Butterworth Heinemann.
5) J. Infante Barbosa, “Apontamentos de Mecânica dos Materiais 1”, ISEL/IPL.