IPS Instituto Politécnico de Setúbal
Escola Superior de Tecnologia do Barreiro

Curriculum Unit Sheet

Strength of Materials I

Academic Year:

2019/2020

Course	Bachelor's degree on Civil Engineering						
Scientific Area	Mechanic and Structures						
ECTS Credits	6	**Curriculum Unit code**	CVN017	**Year**	2	**Semester**	3	**Type**	Compulsory
Prerequisites							

Contact Hours

Lecture Sessions	30	**Lecture-Practical Sessions**		**Practical and Laboratory Sessions**	22,5
Tutorial	15	**Placement**		**Seminar**	
Fieldwork		**Other**		**Autonomous Study**	94,5

Responsible	Rui Duarte Neves	**Position**	Adjunct Professor
Lecturers		**Position**	

Learning Outcomes

It is intended that the students acquire basic skills and knowledge in the field of Mechanics of Materials:(i) know the definition and physical meaning of the internal stress matrix components and the strain matrix components, as well as Hooke's law;(ii) know the physical meaning of Young modulus and Poission coefficient;(iii) evaluate strain and tension matrixes from results obtained with strain rosettes;(iv) evaluate stresses, strains and displacements in three-dimensional frame structures built by prismatic frames(homogeneous and heterogeneous) under axial forces and torsion. In particular, it is intended that students develop the ability to adapt to new situations and properly analyse the results.

Syllabus

1. MECHANICS OF CONTINUOUS MEDIA (4.5w)
Definition of stress. Vector of stress, Stress tensor. Symmetry of stress tensor. Cauchy's formula. Eigenvalues and eigendirections. Coordinate transformations. Mohr's circle. Different states of stress. Deformations. Small displacements hypothesis. Definition of strain – shear and normal strains. Strain at a point – strain tensor. Symmetry of strain tensor. Strain for a given direction. Principal strains. Mohr's circle for plane strain. Different states of strain. Generalized Hooke's law. Relationship between different elastic constants. Physical meaning of the elastic constants.
2. ENERGY METHODS (2.5w)
Stored energy in elastic members. Castigliano's theorem. Virtual work principles. Menabrea's theorem. Betti's Theorem.
3. TENSION AND COMPRESSION OF LINEAR ELEMENTS (4.5W)
The Saint-Venant problem. Tensile test of a mild steel specimen. Variable axial force. Variable cross section. Materials in series and in parallel. Effect of temperature variations. Initial stresses. Prestress. Hyperstatic problems. Virtual work principles. Method of unit virtual load Yielding and plastification of cross sections. Yielding and collapse of structures.
TORSION OF LINEAR ELEMENTS (3.5w)
Bars with circular cross section. Bars with ring sections. Tubular bars with thin walls. Rectangular section. Thin-walled sections. Method of unit virtual load.

Teaching Methodologies

Theoretical lessons (T) are used to expose the new concepts and some straight forward examples are shown, stimulating critical thinking of the students. Practical lessons (P) are used to apply the concepts to increasing complex exercises, some of them solved by the students in a semi-autonomous way.

Evaluation

Tests (2) or final exam.
Tests are written trials of 1h30 long. Test 1 (T1) evaluates the acquired knowledge of chapters 1 and 2. Test 2 (T2) evaluates the acquired knowledge of chapters 3 e 4. The mark in each individual test cannot be less than 8,0 (eight) points in a 0-20 scale.
Final exam (E) is a written trial of 3h00 long and evaluates the acquired knowledge of the full syllabus. The minimum mark is 9.5 points (9.5/20).
Evaluation options: Final mak = E; Final mark = 0.5xT1 + 0.5xT2. if the final mark is more than 16 points (in 20 possible the student shall attend an oral trial..

Evidence of the syllabus coherence with the curricular unit's intended learning outcomes	In a broad sense, the Syllabus is in direct correspondence with the aimed knowledge. Because of time limitations, the Theory of Elasticity is taught succinctly, emphasis being put on the most important issues (namely, strain and stress tensors and Hooke's Law).
Evidence of the teaching methodologies coherence with the curricular unit's intended learning outcomes	The methodology, namely the division into theoretical and practical lessons, is considered to be the most adequate for a sound learning of Strength of Materials: • Theoretical Lessons, for the transmission of concepts, formulations and fundamental hypotheses, as well as stimulating critical thought and the capacity to adapt to novel situations. • Practical lessons, to apply the theoretical knowledge to a variety of situations on practice.
Bibliography	Rui Neves - Resistência de Materiais I. ESTBarreiro/IPS, 2013. Álvaro Azevedo - Mecânica dos Sólidos. FEUP, 1996. Artur Portela; Arlindo Silva - Mecânica dos Materiais. Plátano, 1996. Vitor Dias da Silva - Mecânica e Resistência dos Materiais. ZUARI, 1999. Ferdinand Beer; Russell Johnston; John DeWolf – Mechanics of Materials. McGraw-Hill, 2006. Dinar Camotim - Apontamentos de Tracção e Compressão. IST, 2009. Carlos Moura Branco - Mecânica dos Materiais. Fundação Calouste Gulbenkian, 1998.
Observations	