INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Strength of Materials I			Field of study	Mechanics of Materials and Structural Concrete		
Bachelor in	Civil Engineering			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9089-322-1204-00-23		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	30	-	-	-	-	-	-

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. Understand the mechanisms governing the mechanics of deformable solids under external actions. know the fundamental concepts, principles and hypotheses underlying Elasticity Theory.
2. Apply anlytical and/or graphical tools to solve elasticity problems.
3. Characterize and interpret the state of stress and the state of deformation at a point. know the fundamentals of instrumentation and the experimental measurement of deformations.
4. Relate state of stress with corresponding state of strain. Know the Hooke's law and other ideal rheological models
5. Recognize typical uniaxial stress-strain curves of current materials in Civil Engineering (concrete and steel)
6. Analyse articulated structures, with homogeneous and/or heterogeneous bars, under axial actions
7. Design prismatic bars under axial stress or under pure bending (circular or biaxial)

Prerequisites

Before the course unit the learner is expected to be able to:
1. Use fundamental concepts of Physics
2. Understand statics of rigid bodies basics
3. Use vetorial, differencial, integral and matricial calculus
4. Use concepts of linear algebra and analytic geometry

Course contents

Introduction to continuum mechanics. Assumptions and fundamental concepts. State of stress theory. State of strain theory. Constitutive stress-strain relations. Introdution to strength of materials. Axial loaded bar elements. Bending of beams.

Course contents (extended version)

1. Chap. 1 - Introduction to continuum mechanics
   - Overview organization
   - Assumptions and elementary concepts
2. Chap. 2 - State of stress theory
   - Stress tensor and its properties
   - Principal stresses and directions
   - Mohr's circle for stresses
   - Saint-Venant's principle
3. Chap. 3 - State of strain theory
   - Strain tensor. Infinitesimal strain tensor.
   - Principal strains and directions
   - Mohr's circle for strains
   - Strain gauge operating principles
4. Chap. 4 - Constitutive relations
   - Ideal rheological models
   - Linear elastic materials. Hooke's law.
5. Chap. 5 - Axial loaded bars
   - Principles of prismatic bar theory
   - Stresses and deformations
   - Analysis of articulated structures
   - Sizing and design criteria
6. Chap. 6 - Bending of bars
   - Principles of bending theory
   - Pure bending. Circular and biaxial bending.
   - Sizing and design criteria

Recommended reading

1. Mecânica e Resistência dos Materiais. Vitor Dias da Silva, Ediliber Editora.
2. Mecânica dos Materiais, Ferdinand P. Beer, E. Russell Johnston Jr, John T. DeWolf.
3. Mecânica dos Sólidos e Resistência dos Materiais, J. F. Silva Gomes, Edições INEGI.
4. Elementos de apoio fornecidos pelo docente: Guia das aulas teóricas e Caderno de exercícios práticos .

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)
   - Intermediate Written Test - 50% (Examination 1 (10 valores): Chap. 1 to Chap. 4)
   - Final Written Exam - 50% (Examination 2 (10 valores): Chap. 5 to Chap. 6)
2. Alternative 2 - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100% (Final Examination (10 valores): Chap. 1 to Chap. 6)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

João Carlos Almendra Roque	Debora Rodrigues de Sousa Macanjo Ferreira	António Miguel Verdelho Paula	José Carlos Rufino Amaro
11-03-2024	12-03-2024	13-03-2024	16-03-2024