

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	2025/2026	Year of study	1	Level	1-1
Type	Semestral	Semester	2	ECTS credits	6.0
Workload (hours)	162	Contact hours	T 30	TP 30	PL -
			TC -	S -	E -
			OT -	O -	
			Code 9089-849-1204-00-25		

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 analytical 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 vectorial, differential, 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. Introduction 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.
 - Vector and matrix review.
2. Chap. 2 - State of stress
 - Concept of stress.
 - Stress components: Normal stress. Tangential stress.
 - State of stress at a point. Stress tensor. Properties.
 - Principal stresses and principal stress directions
 - Mohr's circle for stress
 - Types of stress states. Plane stress.
 - Stress in a body. Principle of Saint-Venant.
3. Chap. 3 - State of strain
 - Displacement and deformation. Homogeneous deformation at a point
 - Strain components: Normal strain and Shear strain.
 - Strain state at a point. Infinitesimal strain tensor approximation.
 - Principal strains. Principal strain directions.
 - Mohr's circle for strains
 - Pure deformation and pure rotation.
 - Strain gauge: types, principles and configurations.
4. Chap. 4 - Constitutive laws - Stress-Strain relations
 - Uniaxial stress-strain curve. Examples for common materials.
 - Elastic and plastic behavior. Ductile and fragile materials.
 - Rheological models.
 - Hooke's law.
 - Elastic constants properties: Young's modulus; Poisson's ratio; shear modulus.
 - Generalized Hooke's law. Multiaxial stresses. Superposition effects.
 - Stress-strain relations.
 - Plane strain versus Plane stress.
5. Chap. 5 - Bars under axial loading
 - Assumptions for prismatic bars
 - Stresses and deformation of axially loaded members
 - Effects of temperature variation
 - Homogeneous cross-section bars
 - Inhomogeneous cross-section bars.
 - Statically indeterminate members. Compatibility equations.
 - Analysis of articulated structures statically indeterminate. Compatibility equations.
 - Design of straight prismatic bars. Safety conditions.
6. Chap. 6 - Bending of beams
 - Assumptions for prismatic members
 - Fundamental concepts and terms for bending theory
 - Pure bending. Circular and biaxial bending.
 - Bending stress distribution on cross section.
 - Design of straight prismatic bars. Safety conditions.

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 points): Chap. 1 to Chap. 4)
 - Final Written Exam - 50% (Examination 2 (10 points): Chap. 5 to Chap. 6)
2. Alternative 2 - (Regular, Student Worker) (Supplementary, Special)
 - Final Written Exam - 100% (Final Examination (20 points): Chap. 1 to Chap. 6)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

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16-03-2026	17-03-2026	17-03-2026	17-03-2026