

Course Unit	Statics		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
Type	Semestral	Semester	1	ECTS credits	6.0
Code	9089-322-1103-00-23				
Workload (hours)	162	Contact hours	T 30	TP 30	PL -
			TC -	S -	E -
			OT -	O -	

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. Use graphical and analytical methods to find out the resultant of a system of forces acting a point.
2. Apply equilibrium concept to a body and to a particle. Sketch the free-body diagrams. Identify equivalent systems of forces acting a rigid body.
3. Analyse and classify the equilibrium conditions of bodies and of systems of bodies.
4. Analyse isostatic frame structures - trusses and beams - and sketch up its diagrams of stresses.
5. Calculate centroids, centers of mass and moments of inertia. Calculate and interpret principal inertia moments and their directions.
6. Apply virtual work principle.

Prerequisites

Before the course unit the learner is expected to be able to:

1. Apply the fundamentals of Physics (Mechanics).
2. Apply mathematical calculus (differential, integral, matrixial and vectorial).
3. Handle basic computational tools as worksheets

Course contents

This course covers the basic laws of statics and the fundamentals of materials to provide a basis for advanced mechanics modules and the engineering project. It is intended to provide students with most usual methods to analyze and solve simple structural engineering problems.

Course contents (extended version)

1. VECTORS. SYSTEM OF UNITS
 - Vector concept. Vector properties. Rectangular components.
 - Vector operations: sum; inner product and outer product of vectors.
 - Newton laws.
 - Systems of units.
2. STATICS OF PARTICLES
 - Resultant of a system of forces.
 - Graphical sum of vectors. Parallelogram rule.
 - Equilibrium of a particle. Free body diagram.
3. STATICS OF RIGID BODIES
 - Rigid bodies concept.
 - Principle of transmissibility. External forces.
 - Moment of a force in a point. Varignon theorem.
 - Moment of a force about an axis.
 - Equivalent systems of forces.
 - Equilibrium of rigid bodies. Free body diagram.
 - Analysis of external equilibrium conditions. Supports.
4. ANALYSIS OF STRUCTURAL ISOSTATIC SYSTEMS
 - Analysis of external, internal and global equilibrium conditions.
 - Types of loading: concentrated loads and distributed loads.
 - Reactions and stresses. Axial stress; shear stress and bending-moment stress.
 - Analysis of trusses. Nodes method. Sections method (Ritter's method).
 - Analysis of plan structural reticular systems.
 - Analysis of beams. Diagrams of stresses
5. MASS GEOMETRIC PROPERTIES
 - Center of geometry (centroid). Static moments. Center of mass.
 - Moments of inertia. Product of inertia. Matrix of inertia.
 - Steiner's theorem. Pappus-Guldinus theorems.
 - Principal axes and principal moments of inertia.
6. PRINCIPLE OF VIRTUAL WORK
 - Work of a force.
 - The instant centre of rotation.
 - Principle of virtual work. Application to structures.

Recommended reading

1. Mecânica Vectorial para Engenheiros – Estática, Beer/Johnston, McGraw-Hill (531. 2-2/BEE/MEC e 531. 2-1/BEE/MEC).
2. Mecânica – Estática, Hibbeler, LTC - Livros Técnicos e Científicos (531. 2-1/HIB/MEC).
3. Traité de Génie Civil. Vol 1, François Frey, École Pol. Lausanne (624. 04-2/FRE/ANA).
4. Statics & Dynamics, . Bedford/Fowler, Prentice-Hall.
5. Curso de Mecânica, Vol 1 e 2, Adhemar da Fonseca.

Teaching and learning methods

Theoretical classes: oral exposition of the subject contents supported by audiovisual media. Analysis and discussion of the exposed contents with practical examples of engineering applications. Theoretical-practical classes: discussion and analysis of the concepts accompanied by practical exercises. Individual and/or group study of the taught contents. Resolution of application exercises.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final)
- Intermediate Written Test - 50%
- Final Written Exam - 50%
2. Alternative 2 - (Regular, Student Worker) (Supplementary, Special)
- Final Written Exam - 100%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation			
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