INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Applied Mechanics I			Field of study	Solid Mechanics and Structures		
Bachelor in	Mechanical Engineering			School	School of Technology and Management		
Academic Year	2022/2023	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9123-759-1205-00-22		

Workload (hours)	162	Contact hours	T -	TP 60	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): Luís Manuel Ribeiro Mesquita, Paulo Alexandre Gonçalves Piloto

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Understand the fundamental concepts and principles static of particles.
2. Analyze the rigid bodies systems. Equivalent systems of forces.
3. Understand the equilibrium of rigid bodies. Analysis of Trusses by the method of Joints and method of Sections.
4. Analysis of Frames and Machines. Frames which cease to be rigid body when detached from their supports.
5. Distribuited forces. Centroids and centers of gravity. Moments of inertia. Parallel-axis theorem.
6. Understand the of friction problems involving wedges, Square-Threaded Screws and Belts.

Prerequisites

Before the course unit the learner is expected to be able to:
Use the differential and integral calculus. Understand the Physics concepts.

Course contents

The static equilibrium of a particle in plane and in space. Rigid bodies. Equivalent system of forces. Varignon's theorem. Equilibrium of rigid bodies. Reactions at supports and connections. Analysis of Trusses. The method of joints. The method of sections. Geometry of bodies. Centroids. Center of gravity. Theorems of Pappus-Guldinus. Moments and product of inertia. Parallel-axis theorem. Ellipsoid of inertia. Mohr's circle. Friction analysis of wedges, screws and belts.

Course contents (extended version)

1. Introduction.
   - Fundamental concepts and principles.
   - Systems of units.
2. Statics of particles.
   - Forces in a plane. Force on a particle.
   - Resultant of two forces.
   - Rectangular components of force. Unit vectors. Addition of forces.
   - Equilibrium of a particle.
   - Newton's first law of motion. Free-body diagrams.
   - Forces in a space. Rectangular components of a force in space.
   - Addition of concurrent forces in space.
   - Equilibrium of a particle in space.
3. Rigid bodies. Equivalent systems of forces.
   - External and internal forces.
   - Principle of transmissibility.
   - Moment of a force about a point.
   - Varignon's theorem.
   - Rectangular components of the moment of a force.
   - Moment of a force about a given axis.
   - Moment of a couple.
   - Reduction of a system of forces to one force and one moment of couple.
   - Equivalent systems of forces.
4. Equilibrium of rigid bodies.
   - Introduction.
   - Equilibrium in two dimensions.
   - Reactions at supports and connections.
   - Equilibrium in three dimensions.
5. Analysis of structures.
   - Introduction.
   - Definition of a truss.
   - Analysis of trusses by the method of joints.
   - Analysis of trusses by the method of sections.
   - Frames and machines.
   - Frames which cease to be rigid when detached from their supports.
   - Analysis of a frame.
   - Analysis of a machine.
6. Distributed forces.
   - Center of gravity.
   - First moment of a point, line, surface and bodies.
   - Determination of centroids by integration.
   - Theorems of Pappus-Guldinus.
   - Composite bodies.
   - The moment of inertia of an area and mass. Determination of the moment of inertia by integration.
   - Parallel-axis theorem.
   - Principal axes and principal moments of inertia.
   - Ellipsoid of inertia.
   - Mohr's circle for moments and products of inertia.
7. Friction.
   - Introduction. Dry friction laws.
   - Coefficients of friction.
   - Angles of friction.
   - Problems involving wedges, square-threaded screws and belts.

Recommended reading

1. Beer P. Ferdinand, Johnston Jr. Russel, “Vector Mechanics for Engineers” – Statics and Dynamics, 7th edition; McGraw Hill.
2. Meriam J. L. , Kraige L. G. , “Engeneering Mechanics - Statics”, John Wiley & Sons, Inc.
3. R. C. Hibbeler, “Mecânica: Estática”; 8 ed. , LTC.
4. Piloto, P. A. G; “Applied Mechanics I”, Slides com apresentação do conteúdo programático (versão em inglês).

Teaching and learning methods

The lectures will be given with the theoretical exposition of the fundamental concepts necessary for understanding the program contents, complemented with the presentation of practical examples of application. A set of problems will be proposed. The practical problems and work will be assigned for the remaining hours. Resources used: Software FTOOL

Assessment methods

1. final season and appeal - (Regular) (Final, Supplementary)
   - Final Written Exam - 70%
   - Projects - 30%
2. final season and appeal- labour student - (Student Worker) (Final, Supplementary)
   - Final Written Exam - 100%
3. special season - (Regular, Student Worker) (Special)
   - Final Written Exam - 100%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Luís Manuel Ribeiro Mesquita, Paulo Alexandre Gonçalves Piloto	Debora Rodrigues de Sousa Macanjo Ferreira	João da Rocha e Silva	José Carlos Rufino Amaro
16-02-2023	17-02-2023	17-02-2023	04-03-2023