Course Unit	Applied Biomechanics			Field of study	Biomatrials and Biomechanics		
Bachelor in	Biomedical Technology			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	9600-752-1202-00-22		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			-	60	-	-	-	-	-	-

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): Luisa Maria da Silva Barreira, Luís Manuel Ribeiro Mesquita

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Solve fundamental problems of particle statics.
2. Solve fundamental problems for rigid body statics.
3. Solve fundamental problems of mass geometry problems.
4. Solve friction problems.
5. Solve fundamental problems for the dynamics of system particles.
6. Solve fundamental problems about the kinematics of rigid bodies.
7. Solve fundamental problems about rigid body kinematics.
8. Solve fundamental problems about rigid body dynamics.

Prerequisites

Before the course unit the learner is expected to be able to:
Understand differential, integral and matrix calculus and the basic principles from Physics.

Course contents

Chapter 1: Human body structure (1 week). Chapter 2: Motion laws (2 weeks). Chapter 3: Motion of particles (2 weeks). Chapter 4: Plane motion of bodies (2 weeks). Chapter 5: Statics (3 weeks). Chapter 6: Internal forces in the human body motion (2 weeks). Chapter 7: Moment and impulse (1 week). Chapter 8: Work and Energy (1 week). Chapter 9: Three dimensional motion (1 week).

Course contents (extended version)

1. Human body structure (1 week).
   - Notation for human movement.
   - Human body structure.
   - Physical properties of skeletal muscle.
2. Motion laws (2 weeks).
   - Vector analysis.
   - Position, velocity and acceleration.
   - Newton's laws of motion and their application.
   - Free body diagrams.
3. Motion of particles (2 weeks).
   - Conservation of linear momentum.
   - Centre of mass and its motion.
   - Moment of a force. Varignon theorem.
   - Angular momentum.
4. Plane motion of bodies (2 weeks).
   - Fix point rotation.
   - General plane motion.
   - Angular velocity and acceleration.
   - Conservation of angular momentum.
5. Statics (3 weeks).
   - Equations for static equilibrium.
   - Contact or reactive forces.
   - Friction forces in biomedical systems.
   - Human structure and internal forces.
   - Mass geometry. Centroid and centre of mass.
   - Moments of inertia and products of inertia.
   - Parallel axes theorem.
6. Internal forces in the human body motion (2 weeks).
   - Muscle force in motion.
   - Application to muscle-skeletal systems.
   - Application to orthopaedic systems.
7. Moment and impulse (1 week).
   - Principle of impulse and momentum.
   - Impulse and angular momentum.
   - Collisions.
8. Work and Energy (1 week).
   - Kinetic energy.
   - Work of a generalized force.
   - Potential energy.
   - Conservation of mechanical energy.
   - Multibody systems.
9. Three dimensional motion (1 week).
   - Reactive and contact forces calculation.

Recommended reading

1. Aydin Tözeren, "Human Body Dynamics – Classical Mechanics and Human Movement", Springer, 2000.
2. Vladimir M. Zatsiorsky, "Kinetics of Human Motion", Human kinetics edition, 2002.
3. Vladimir M. Zatsiorsky, "Kinematics of Human Motion", Human kinetics edition, 1998.
4. Susan J. Hall, Basic Biomechanics (Seventh edition), McGraw-Hill, 2015.

Teaching and learning methods

Theoretical exposition of the fundamental concepts should be presented at classes, complemented with practical exercises. The remaining period should be used to solve the proposed problems. Out of classes, students are invited to solve problems and to do specific projects.

Assessment methods

1. Final season - (Regular, Student Worker) (Final)
   - Final Written Exam - 35% (Final evaluation with a 2 h duration exam.)
   - Intermediate Written Test - 35% (Intermediate exam during semester.)
   - Laboratory Work - 30% (Working project during classes for 30 % final mark.)
2. Appeal season: - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100% (Final evaluation with a 2 h duration exam.)
3. Final season - (Student Worker) (Final)
   - Final Written Exam - 100% (Students with labour status may choose final exame for 100 % final mark.)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Luís Manuel Ribeiro Mesquita, Luisa Maria da Silva Barreira	Debora Rodrigues de Sousa Macanjo Ferreira	Joana Andrea Soares Amaral	José Carlos Rufino Amaro
16-02-2023	17-02-2023	25-03-2023	27-03-2023