

General information about the course unit

Course unit name: Biomecànica

Course unit code: 560343

Coordinator: JOSEP MARIA FONT LLAGUNES

Other contents

Affiliated course unit taught at the Technical University of Catalonia (UPC).

Estimated learning time

Factor hours/ECTS	30
Distance or on-line activity	0
Self-learning activity	100
On-campus activity	50
Total number of hours	150
ECTS credits	5

Requirements

Students should have completed a basic course on Mechanics or the introductory course "Principles of Physics".

Knowledge of English.

Competences to be gained during study

On completion of the course unit, students should be able to:

- Develop biomechanical models of the human musculoskeletal system based on anatomical concepts and mechanical laws of motion.
- Analyze kinematic, dynamic and energetic aspects of human movement through these models.

Learning objectives

Referring to knowledge

In this course unit students will learn tools for the biomechanical analysis of human movement. This analysis will be done based on mathematical models taking into account the body topology, joint modeling and body-segment parameters.

Referring to abilities, skills

Students will develop skills and competences allowing them to:

- Apply kinematic and kinetic descriptors to human movements.
- Apply mechanical laws and principles to anatomical structures.
- Describe how musculoskeletal structures influence human movement.
- Analyze human performance from measured data.

Referring to attitudes, values and norms

This course unit will help students to develop in a number of areas, including effort, discipline, collaboration and teamwork, analysis of multidisciplinary problems, spoken and written communication, and preparation of multimedia material.

Teaching blocks

Section 0: Introduction

Section I: Kinematics

1. Frames, planes, axes
2. Point kinematics: position, velocity, acceleration
3. Rigid body kinematics: orientation, rotation, velocity and acceleration distributions
4. Kinematical chains

Section II: Vectorial dynamics

1. Particle dynamics: Newton's laws
2. Rigid body dynamics: Linear momentum theorem, angular momentum theorem
3. Tensor of inertia
4. Forces and moments, torsor

Section III: Muscle mechanics

1. Force-length characteristics
2. Force-velocity characteristics
3. Muscle model

Section IV: Biomechanical energetics

1. Power, work and kinetic energy
2. Work and kinetic energy in rigid bodies
3. Work in elastic bodies (muscles)
4. Power and energy balances

Section V: Analytical dynamics

1. Lagrange's equations
2. Application cases

Teaching methods and general organization

The course unit has a credit weighting of 5 ECTS credits: 3 are awarded for the theoretical content, 1 for the preparation and public presentation of a monographic theme, and 1 for participation in seminars and the resolution of the assignments set during the program.

Theory credits (3 ECTS):

The three theory credits will be taught through lectures introducing basic theoretical aspects. Additional audiovisual materials will be made available via the virtual campus (ATENEA).

Monographic theme (1 ECTS):

Students will work either individually or in groups of two to develop a "monographic theme". The topic of the work will be chosen by the student/group and has to be related to the contents of the course. Students are encouraged to use the recommended bibliography and internet resources to document the work. The work

should be described in a report (maximum 20 pages) to be submitted before the assignment presentation. The oral presentation should not exceed 15 minutes.

Seminars + Assignments (1 ECTS):

The course unit will include a cycle of seminars led by researchers in the field of biomechanics. Each seminar, lasting two hours, will consist of a presentation followed by a question and answer session with students.

The lecturers will propose assignments corresponding to the theory given at class. Those assignments will be delivered every two or three weeks through the virtual campus (ATENEA).

Official assessment of learning outcomes

Global course grade will be based on the following partial grades:

NW = Written assignments (1 assignment/2-3 weeks; 10 points)

NM = Monographic theme;

nr = written report (maximum length: 20 pages; 5 points)

no = oral presentation (15 minutes; 5 points)

NM = nr + no

NF = Final written exam (10 points)

Global grade = 0,2 NW + 0,3 NM + 0,5 NF

Reading and study resources

Basic bibliography:

- D.A. Winter, *Biomechanics and motor control of human movement*, John Wiley and Sons, Inc., 1990.

Complementary bibliography:

- V.M. Zatsiorsky, *Kinematics of human motion*, Human Kinetics, 1998.
- V.M. Zatsiorsky, *Kinetics of human motion*, Human Kinetics, 2002.
- C.L. Vaughan, V.L. Davis, J.C. O'Connor, *Dynamics of human gait*, Kiboho Publishers, 1992.
- P. Allard, I.A.F. Stokes, J.-P. Blanchi, *Three-dimensional analysis of human movement*, Human Kinetics, 1995.