Course guide
205610 - 205610 - Computational Biomechanics

Last modified: 11/04/2025

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering.

Degree: MASTER'S DEGREE IN RESEARCH IN MECHANICAL ENGINEERING (Syllabus 2021). (Optional subject).

Academic year: 2025 **ECTS Credits:** 4.5 **Languages:** English

LECTURER

Coordinating lecturer: Gil Serrancolí

Others:

PRIOR SKILLS

- Be familiarized with the methods of computational mechanics to calculate forces and moments of a mechanical system.
- Solve differential equations.
- Be familiarized with the computation of stresses/strains using finite elements.
- Analyze basic signals.

TEACHING METHODOLOGY

This subject contains an initial section covering the basic theoretical concepts, and a basic introduction to musculoskeletal simulations. The key component of this subject is the development of a research project using musculoskeletal simulations. The student will learn on how to estimate and predict simultaneously contact forces and moments, muscle forces, joint pressures and kinematics of a basic biomechanical model.

LEARNING OBJECTIVES OF THE SUBJECT

- Familiarize with the key concepts of biomechanical simulations
- Develop kinematics and dynamics analyses
- Develop a research project

STUDY LOAD

Type	Hours	Percentage
Self study	72,0	64.00
Hours large group	40,5	36.00

Total learning time: 112.5 h

CONTENTS

Introduction to biomechanical simulations

Description:
- Introduction to the subject
- Kinematics analyses
- Dynamics analyses
- Application of algorithms in real-time

Specific objectives:
- Introduction to the concepts used during the project

Full-or-part-time: 56h
Theory classes: 20h
Self study : 36h

Research project

Description:
- Development of a research project to be chosen with the responsible professor.

Specific objectives:
- Promotion of critical thinking
- Improvement of programming skills
- Introduction to research projects

Related activities:
Research project

Full-or-part-time: 56h 30m
Theory classes: 20h 30m
Guided activities: 36h

GRADING SYSTEM

Evaluation of theoretical concepts: 30%. A short exam after the initial phase of the subject (mid-semester), to ensure that the student follows the subject properly.
Evaluation of the practical concepts: 20%. At the end of the subject, the student will do a practical test related to the content of his/her research project.
Research project: 50%. It will be evaluated by doing a presentation at the end of the subject.

BIBLIOGRAPHY

Basic:
- Uchida, Thomas K.; Delp, Scott L.; Delp, David. Biomechanics of movement: the science of sports, robotics and rehabilitation [on line]. Cambridge, MA: MIT Press, 2020 [Consultation: 25/01/2023]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=6434343. ISBN 9780262044202.
- Yamaguchi, Gary Tad. Dynamic modeling of musculoskeletal motion: a vectorized approach for biomechanical analysis in three dimensions [on line]. New York: Springer, cop. 2005 [Consultation: 25/01/2023]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=3072325. ISBN 9780387287508.

RESOURCES

Other resources:
- OpenSim
- Matlab
- FEBio
- Specific SDK (Nuitrack, RealSense)