Biomechanics

Academic Year: (2020 / 2021) **Review date: 25-01-2021**

Department assigned to the subject: Mechanical Engineering Department

Coordinating teacher: SANTOS CUADROS, SILVIA

Type: Electives ECTS Credits : 3.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics I
Physics II
Statistics
Programming
Machine Mechanics
Mechanics of Structures
Materials Resistance

OBJECTIVES

After successful completion of this subject, students will be able to:

1. Apply the knowledge acquired during the Bachelor to biomechanical studies used in research and/or companies.
2. Integrate all their knowledge to identify, formulate and solve multidisciplinary problems related to biomechanics.
3. Evaluate the kinematic and dynamic behaviour of the musculoskeletal system.
4. Know the mechanical behaviour of the different biological tissues, both hard and soft.
5. Make and manage bibliography, documentation, legislation, databases, specific software, and hardware applied to biomechanics.
6. Use the experimental techniques and engineering tools necessary for solving problems in the biomechanical field.
7. Design and carry out experimental tests in biomechanics, interpret the data and draw conclusions.
8. Interact with commercial finite element programs through code programming in Python and / or MATLAB.
9. Develop numerical models of finite elements and interpret the results correctly.
10. Communicate their conclusions and knowledge to audiences specialized in biomechanics.

DESCRIPTION OF CONTENTS: PROGRAMME

Block I. Introduction to biomechanics:

- Definition of biomechanics
- Biomechanical Foundations
- Biomechanics of the locomotor system
- Mechanics of hard tissues
- Soft tissue mechanics
- Multidisciplinary application of biomechanics (medicine, sports, ergonomics, road safety, etc.)

Block II. Experimental techniques in biomechanics:

- Anthropometry
- Analysis of human movements (tracking software)
- Videophotogrammetry
- Inertial sensors
- Electromyography
- Optical techniques (Digital Image Correlation)
- Motion simulation software (OpenSim)
- 3D printing and its applications in biomechanics
- Mechanical experimentation

Block III. Numerical modelling in biomechanics:

- Mechanical behaviour of biological tissues
- The finite element method in biomechanics
- Realistic numerical models: Patient-specific philosophy
- Design and manufacture of custom prosthetics

LEARNING ACTIVITIES AND METHODOLOGY

There will be master classes and exercises in the classroom, where the teacher will present the main contents of the subject and student participation will be encouraged by proposing exercises and discussing them. To gain a better understanding of the different topics, these classes will also be supported by experimental trials.

There will also be sessions in the computer room applied to the study of biomechanics, as well as 2 laboratory practices to apply the techniques presented in the subject to practical and realistic cases. These practical classes will be the following:

Practice 1. Analysis of a human movement.
Practice 2. Finite Element Model of bone structure.

Through Aula Global, the student will be informed of a personalized attention schedule in tutoring sessions, with the aim of solving possible doubts that the student may have about the contents treated in the subject.

ASSESSMENT SYSTEM

The student must demonstrate that they have achieved the expected learning outcomes through the following assessment activities:

- Two partial exams in which the theoretical concepts of the subject will be evaluated.

- Two practices sessions of the subject: the effort made by the students and the results obtained in the proposed practices will be assessed, all through the report of each practice.

- Implementation of a group work on the application of Mechanical Engineering in Biomechanics, and the presentation of the results.

The percentage weight of each of these assessment tests will be as follows:

- Partial exams of the theoretical content of the subject: 20%
- Course practices: 30%
- Biomechanical application work: 50%

% end-of-term-examination:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

BASIC BIBLIOGRAPHY

- Abaqus Abaqus user manual, SIMULIA, Abaqus.
- Arthur E. Chapman Biomechanical analysis of fundamental human movements ¿ Human Kinetics, Champaign, 2008
- Duane Knudson Fundamentals of Biomechanics, Springer, 2007

ADDITIONAL BIBLIOGRAPHY

- Gautam M. Puri Python Scripts for Abaqus. Learn by Example, Gautam M. Puri, 2011
- Revistas científicas Journal of Biomechanics, Journal of Applied Biomechanics, Elsevier, International Society of Biomechanics.