Biomechanics for health and wellness

Academic Year: (2024 / 2025) **Review date: 22-04-2024**

Department assigned to the subject: Mechanical Engineering Department

Coordinating teacher: SANTOS CUADROS, SILVIA

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics I
Physics II
Statistics
Programming
Machine Mechanics
Strength of Materials
Elasticity

OBJECTIVES

Once the student has passed this course, they will be able to:

1. Apply the knowledge acquired in engineering 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 behavior of the musculoskeletal system experimentally and numerically.
4. Create and manage specific bibliography, documentation, legislation, databases, software and hardware applied to biomechanics.
5. Use the experimental techniques and engineering tools necessary to solve problems in the biomechanical field.
6. Design and carry out experimental tests in biomechanics, interpret the data and draw relevant conclusions.
7. Develop advanced finite element numerical models and interpret the results correctly.
8. Communicate their conclusions and knowledge to audiences specialized in biomechanics.

DESCRIPTION OF CONTENTS: PROGRAMME

Block 1. Human movement analysis techniques
- Basic principles
- Techniques
- Applications

Block 2. Numerical modeling applied to biomechanics
- The finite element method
- Advanced aspects of the method
- Practical cases of finite elements in biomechanics

Block 3. Electromyography
- Theoretical principles
- Factors affecting electromyography
- Applications

Block 4. Analysis of health risks in ergonomics.
- Health risk analysis techniques.
- Ergonomic risk assessment.
- Ergonomic risk prevention methods.

LEARNING ACTIVITIES AND METHODOLOGY

Lectures and exercises will be held 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 achieve a better understanding of the syllabus, these classes will also be supported by experimental trials.

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

Lab session 1. Analysis of deformations and movement applied to biomechanics.
Lab session 2. Electromyography.

Biomechanical application work applied to realistic cases will be carried out, which will involve the complete development of a case study using finite elements. This work will be carried out by the student during some of the class sessions, with the support of the teacher.

Through Aula Global, the student will be informed of a personalized attention schedule in a tutorial regime, with the aim of resolving possible doubts that the student body may have about the contents covered in the subject.

ASSESSMENT SYSTEM

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

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. It is mandatory to attend the practice sessions to pass the subject.

- Implementation of a group work on the application of Mechanical Engineering in Biomechanics, and the presentation of the results. This work will be principally developed during some of the sessions of the course.

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

- Partial exams of the theoretical content of the subject: 30%
- Course practices: 30%
- Biomechanical application work: 40%

In addition, during the course additional exercises can be proposed to the students to obtain extra points.
Those students who do not pass the subject in the continuous evaluation will have the option of taking the ordinary exam with the following evaluation system:
- Continuous evaluation: 40%
- Ordinary exam: 60%

In the extraordinary evaluation, the mark will be the maximum between:
- 40% continuous evaluation + 60% extraordinary final exam
- 100% extraordinary final exam

BASIC BIBLIOGRAPHY

- Arthur E. Chapman Biomechanical analysis of fundamental human movements, Human kinetics, 2008

- Duane Knudson Fundamentals of biomechanics, Springer, 2007

- Radovan Zdero Experimental methods in orthopaedic biomechanics, Elsevier, 2017

- Simulia, Abaqus Abaqus user manual, Simulia, 2006

ADDITIONAL BIBLIOGRAPHY

- Bartel D. L. and Davy D. T. Bartel, D. L., & Davy, D. T. (2006). Orthopaedic biomechanics: mechanics and design in musculoskeletal systems, Pearson, 2006

- Fung Y. C. Biomechanics: mechanical properties of living tissues, Springer, 2013

BASIC ELECTRONIC RESOURCES

- Profesores de la asignatura . Apuntes y presentaciones de la asignatura: https://aulaglobal.uc3m.es/