Universidad Zaragoza

Academic Year/course: 2023/24

69706 - Modeling the mechanical behaviour of musculoskeletal tissues

Syllabus Information

Academic year: 2023/24
Subject: 69706 - Modeling the mechanical behaviour of musculoskeletal tissues
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 633 - Master's Degree in Biomedical Engineering
ECTS: 3.0
Year:
Semester: Second semester
Subject type: Optional
Module:

1. General information

The subject entails an understanding of the mechanical behaviour of biological tissues under different physiological and pathological conditions. In addition, the student will be provided with the necessary skills to define a model of any biological structure taking into account its main characteristics from a mechanical point of view (large deformations, anisotropy, strain rate dependence, etc.). The student must also be able to understand its limitations and interpret the results that can be obtained from the modelling.

https://www.un.org/sustainabledevelopment/es/These approaches and objectives are aligned with some of the Sustainable Development Goals, SDGs, of the 2030 Agenda (https://www.un.org/sustainabledevelopment/es/) and certain specific targets, so that the acquisition of the learning results of the subject provides training and competence to the student to contribute to some extent to their achievement:

- Goal 3: Ensure Healthy Lives and Promote Wellness for All at All Ages. Objective: 3.6: By 2020, halve the number of deaths and injuries from road traffic crashes worldwide.
- Goal 9: Industry, Innovation and Infrastructure. Objective: 9.5.Enhance scientific research and improve the technological capabilities of industrial sectors in all countries, in particular developing countries, among others, by fostering innovation and significantly increasing, by 2030, the number of R&D personnel per million population and public and private sector expenditures on research and development. Objective 9.b: Support the development of domestic technologies, research and innovation in developing countries, even ensuring an enabling policy environment for industrial diversification and value addition to commodities, among others.

2. Learning results

Competencies

- To possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context. (CB. 6)
- To know how to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study (CB.7).
- To integrate knowledge and face the complexity entailed by the formulation of judgments based on incomplete or limited information that includes reflections on the social and ethical responsibilities linked to the application of their specialized knowledge and judgments (CB.8)
- To communicate their conclusions and the ultimate knowledge and rationale behind them to specialized and non-specialized audiences in a clear and unambiguous manner (CB.9)
- To possess the learning skills that will enable the students to continue studying in a largely self-directed or autonomous manner (CB.10).
- To possess the aptitudes, skills and methods necessary to carry out multidisciplinary research and/or development work in any area of Biomedical Engineering (CG.1).
- To be able to use engineering techniques, skills and tools necessary to solve biomedical and biological problems (CG.2).
- To be able to learn continuously and develop autonomous learning strategies (CG.4).
- To be able to manage and use bibliography, documentation, legislation, databases, software and hardware specific to biomedical engineering (CG.5).
- To be able to analyse, design and evaluate solutions to biomedical problems through advanced knowledge and technologies in biomechanics, biomaterials and tissue engineering. (CO.3)

Learning results

- To know the main characteristics that define the mechanical behaviour of the tissues of the musculoskeletal system.
- To identify the mathematical models of behaviour (elastic, hyperelastic, inelastic, etc.) that best reproduce the properties of each type of tissue (bone, cartilage, ligament, muscle) under each type of load.

To know how to apply the finite element methodology to solve numerically the behaviour of biological structures.

3. Syllabus

The program offered to the student to help them achieve the expected results includes the following activities:

1. Musculoskeletal system: computational modelling of the biomechanics and mechanobiology of biological tissues.
2. Bone tissue
3. Dense connective tissue. Ligaments and tendons
4. Musculoskeletal tissue

4. Academic activities

The learning process designed for this subject is based on the following:

A01 Participative master class(18 hours): Presentation by the teachers of the main contents of the subject.

A03 Computer practice (8 hours)**.**

Several computer practices will be carried out. For the development of the practices there will be some scripts that the student will have to read before the practice, proposing a series of activities to be carried out during the same.

A05 Performance of practical application or research activities/work.

As the term develops, activities and works related to the subject and to the computer practices that will be carried out will be proposed.

A06: Tutoring: Personalized attention to students in order to review and discuss the materials and topics presented in the theoretical and practical classes.

A08Assessment: Set of theoretical-practical written tests and submission of reports or papers used in the evaluation of the student's progress. Details can be found in the section corresponding to the assessment activities. (1 hour)

The rest of the activities (including tutorials-A05, evaluations-A08, deliverables, and personal study) amount to 48 hours.

5. Assessment system

The student must demonstrate achievement of the intended learning results through the following assessment activities:

- E1: Final exam (40%).

Written exam, with a grade from 0 to 10 points, common for all groups of the subject. The test will consist of several theoretical and practical questions.

- E2: Computer practices, activities and tutored work (60%).

The evaluation of the practical sessions, activities and tutored work (60%) will take into account both the report presented and the suitability and originality of the proposed results. A series of tasks/activities will be proposed in the practical sessions script and the assignments will be directly related to each of them.

The student must obtain a minimum total grade of 4.5 points out of 10 in each of the assessment activities (exam and computer practices and tutored work).If this minimum is not obtained, there will be a global test in each of the calls established throughout the academic year, on the dates and times determined by the School. The global test will consist of an exam with theoretical and practical questions and questions related to the practical sessions.