Universidad Zaragoza

Academic Year/course: 2024/25

69704 - Computer aided prosthesis and implant design

Syllabus Information

Academic year: 2024/25
Subject: 69704 - Computer aided prosthesis and implant design
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 objective of the subject Prosthesis and Implant Design using Computational Tools is to provide the student with the ability to discern which implant/prosthesis is the most suitable for a pathology, knowing how to distinguish between different types within a prosthesis/implant. The student will also acquire knowledge of the most common computational tools used in the design of prostheses and implants.

The subject focuses on the following aspects. First, the fundamentals of prosthetic and implant design will be reviewed in a general way, including both the types of implants and their biomechanical requirements.

We will also go into more detail on the above aspects, especially on the different types of biomaterials, as well as on their mechanical behaviour. The different types of implants (used in bone) that are defined according to the type of fracture will be presented in a general way. Subsequently, the mechanical and biological design factors that will be decisive in the functioning of the implant will be analysed. Once the mechanical and biological factors have been studied, the different types of prostheses indicated to solve bone fractures will be shown: hip, knee, etc. prostheses. Then, the rest of implants on the market in the dental, cardiovascular and other fields will be developed.

Finally, the legislation regulating the design of prostheses and implants in the United States (Federal Regulation of Medical Devices-FDA) and Europe (MEDDEV) will be analysed, studying the different protocols required for the implementation of a new design (clinical trials, biocompatibility, etc.).

Emphasis will be placed on the use of computational tools, mainly those based on the finite element method for the design of prostheses and implants.

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 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 be able to discern which prosthesis design is appropriate for a given pathology.
- To be able to evaluate the advantages and disadvantages of different prosthesis designs, defining the variables that should be modified to counteract poor results.
- To be able to use a computational tool for the design of a given prosthesis or implant.
- To be able to apply the existing regulations in the field of prosthesis design.

3. Syllabus

The program offered to the student comprises the following subjects:

1. Introduction
2. Design factors
3. Hip prosthesis
4. Knee prosthesis
5. Dental implants
6. Foot implants
7. Prostheses and implants for the spine
8. Cardiovascular implants
9. Regulations

4. Academic activities

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

A01 Participative master class (22 hours): Presentation by the teachers of the main contents of the subject.

A03 Laboratory/Computer Practices (6 hours) Computer and laboratory practices will be performed. For the development of the practices, there will be scripts that must be read before starting, with a series of activities to be carried out.

A05 Practical application or research work. The work to be done will be explained at the beginning of the term. The work will be presented in a written document of 15 to 20 pages, attaching the necessary material for the presentation of the content of the work.

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

A08 Assessment: Set of theoretical-practical written tests and presentation 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.

The rest of the activities (including tutorials-A05, evaluations-A08, deliverables, and personal study) amount to 45 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 a series of theoretical and practical questions and will have an estimated duration of 2 hours.

- **E2: Practical sessions and tutored work (60%).**

Graded from 0 to 10 points. The assessment of the internships (30%) will be done through the reports presented, as well as the tutored work (30%) done which consists on a computational study of an implant.

The student must obtain a minimum total grade of 4 out of 10 points in each of the tests (exam, practical sessions and tutored work). In order to pass the subject, the student must achieve an average grade of 5 taking into account both tests. If this minimum is not obtained, there will be a global test in each of the calls for exams established throughout the academic year on the date and at the times determined by the School. The overall test will consist of an exam with theoretical and practical questions.

6. Sustainable Development Goals

3 - Good Health & Well-Being
9 - Industry, Innovation and Infrastructure