

Academic Year/course: 2022/23

## 69707 - Materials and surface treatments for prostheses and implants

### Syllabus Information

**Academic Year:** 2022/23

**Subject:** 69707 - Materials and surface treatments for prostheses and implants

**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

## 2. Learning goals

## 3. Assessment (1st and 2nd call)

## 4. Methodology, learning tasks, syllabus and resources

### 4.1. Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, problem-solving, lab sessions, case studies, tutorials and assessment tasks.

### 4.2. Learning tasks

The course includes the following learning tasks:

- **A01 Lectures** (38 hours). Oral classroom presentations comprising the main contents of the course, supplemented with a repository of the lectures and other course-specific learning materials available via Moodle, will be done. Basically, the most relevant techniques for surface modification and characterization of materials in the field of Biomedical Engineering will be explained.
- **A02 Problem-solving** (8 hours). Simple examples and exercises including quantitative calculations will be solved by the students in class sessions.

Learning task A01 and A02 will be carried out by synchronous classes in the classroom physically or, depending of the health emergency through online classes (using a video-communication application). In the latter case, timetable will be maintained so that students will not modify their Master dedication and other subjects will not be disturbed.

- **A03 Lab sessions.** Material selection processes and basic techniques for surface modification or characterization of biomaterials will be shown in 2-hour lab sessions (6 hours). If the sanitary situation would be appropriated, this activity includes visiting advanced characterization laboratories (such as PVD, XPS, AFM, etc.) available at INMA institute. CES software (Cambridge Engineering Selector) of the Granta Design company will also be basically presented to make a materials selection related with biomedical Engineering applications. This lab-work will be carried out in three 2-hour sessions and in the laboratories of the Materials Science Area and the INMA Institute. In the case of on-line sessions, audiovisual and written documents will be prepared that allows the student to visualize and understand how the tests would be carried out, explaining the most significant details. The student must

prepare some reports describing the tests carried out and the results obtained in the different lab sessions (6 hours).

- **A05 Case study** (12 hours). The students will select a research article published in a scientific journal on some specific surface technique, material or application in the field of Biomedical Engineering. They will prepare a written report under the teachers' supervision and they will present their results in a defense session including either oral or poster presentation. Tutorials in order to orient and to supervise the students (individually or collectively) will be done mainly by email or by a video-communications application allowing a synchronous communication.
- **A06 Tutorials**. Individual or group sessions with the aim of discussing the materials and topics presented in both theoretical and practical classes. This task will be done mainly by email or by a video-communications application.
- **A08 Assessment**. 1 hour written exam + 2 hours defense and discussion. If the sanitary situation will not be favorable, then the written exam will be done using Moodle learning platform through a multiple-choice questions exam and the defense and discussion of the reports will be done on-line using a video-communications application.

### 4.3. Syllabus

The course will address the following topics:

#### Topic 1. Introduction

- 1.1. Surface Engineering
- 1.2. Types of biomaterials. Interaction with the biological environment
- 1.3. Examples of biomedical applications. The importance of surfaces

#### Topic 2. Surface treatments

- 2.1. Plasma-based technologies
- 2.2. Ion implantation
- 2.3. Laser surface modification
- 2.4. Thermochemical treatments
- 2.5. Mechanical treatments

#### Topic 3. Coatings

- 3.1. Plasma polymerization
- 3.2. Vapor deposition: PVD and CVD
- 3.3. Thermal spray
- 3.4. Sol-gel
- 3.5. Electrochemical coatings

#### Topic 4. Surface characterization techniques

- 4.1. Composition (XPS, AES, SIMS, EDS)
- 4.2. Microstructure (electron microscopy, AFM)
- 4.3. Roughness (profilometry, AFM)
- 4.4. Coating thickness (Calotest, ellipsometry)
- 4.5. Mechanical properties (hardness, elastic modulus, tribology)

### 4.4. Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the EINA website and the Moodle platform.

### 4.5. Bibliography and recommended resources

[http://biblos.unizar.es/br/br\\_citas.php?codigo=69307&year=2019](http://biblos.unizar.es/br/br_citas.php?codigo=69307&year=2019)