

## 69307 - Materials and surface treatments for prosthesis and implants

### Información del Plan Docente

<b>Academic Year</b>	2016/17
<b>Academic center</b>	110 - Escuela de Ingeniería y Arquitectura
<b>Degree</b>	547 - Master's in Biomedical Engineering
<b>ECTS</b>	3.0
<b>Course</b>	1
<b>Period</b>	Second semester
<b>Subject Type</b>	Optional
<b>Module</b>	---

### **1.Basic info**

#### **1.1.Recommendations to take this course**

#### **1.2.Activities and key dates for the course**

### **2.Initiation**

#### **2.1.Learning outcomes that define the subject**

#### **2.2.Introduction**

### **3.Context and competences**

#### **3.1.Goals**

#### **3.2.Context and meaning of the subject in the degree**

#### **3.3.Competences**

#### **3.4.Importance of learning outcomes**

### **4.Evaluation**

### **5.Activities and resources**

#### **5.1.General methodological presentation**

Lectures  
Problems  
Lab sessions  
Laboratory visits  
Case study  
Tutorials  
Assessment activities

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### 5.2.Learning activities

**A01 Lectures** : Classroom presentations comprising the main contents of the subject. The most relevant techniques for surface modification and characterization of materials in the field of Biomedical Engineering will be presented.

**A02 Problems** : Simple examples and exercises including quantitative calculations will be solved by the students in class sessions.

**A03 Lab sessions** : Materials selection processes and basic techniques for surface modification or characterization of biomaterials will be shown in 2-hour lab sessions. The students will prepare an essay describing the experiments performed and the results obtained.

**A04 Laboratory visits** : This activity includes visiting advanced characterization laboratories (such as PVD, XPS, AFM, etc.) available at INA and ICMA institutes. The students will prepare an essay describing the techniques shown.

**A05 Case study** : 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 show their results in a defense session including either oral or poster presentation.

**A06 Tutorials** : Individual or group sessions with the aim of discussing the materials and topics presented in both theoretical and practical classes.

**A08 Assessment** .

### 5.3.Program

#### 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

#### Surface treatments

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

#### Coatings

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

#### Surface characterization techniques

- 4.1. Composition (XPS, AES, SIMS, EDS)
- 4.2. Microstructure (optical and electron microscopy, AFM)
- 4.3. Roughness (profilometry, AFM)

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- 4.3. Coating thickness (Calotest, ellipsometry)
- 4.4. Mechanical properties (hardness, elastic modulus, tribology)
- 4.6. Corrosion

### 5.4.Planning and scheduling

The schedule for both classroom and laboratory sessions will be established by the EINA. The specific scheduling for classes, lab sessions and other activities will be announced at the beginning of the course and through the Moodle2 platform.

Specifically, the estimated study load for the learning activities programmed is:

- A01 Lectures** : 16 classroom hours + 20 hours personal work
- A02 Problems** : 4 classroom hours + 4 hours personal work
- A03 Lab sessions** : 4 hours + 5 hours personal work
- A04 Laboratory visits** : 2 hours + 2 hours personal work
- A05 Case study** : 15 hours personal work
- A08 Assessment** : 2 hours written exam + 3 hours defense and discussion

### 5.5.Bibliography and recommended resources

- |           |   |
|-----------|---|
| <b>BB</b> | Biomaterials surface science / edited by Andreas Taubert, Joo F. Mano, and J. Carlos Rodríguez-Cabello Weinheim : Wiley-VCH, Verlag GmbH & Co. KGaA, [2013]   |
| <b>BB</b> | Láminas delgadas y recubrimientos : preparación, propiedades y aplicaciones / José M. Albella (Editor) ; con la colaboración de O. Sánchez e I. Jiménez Madrid : Consejo Superior de Investigaciones Científicas, 2003  |
| <b>BB</b> | Surfaces and interfaces for biomaterials / edited by Pankaj Vadgama . - 1st pub. Boca Raton [Florida] : CRC Press ; Cambridge (England) : Woodhead , 2005   |
| <b>BB</b> | Tecnología de superficies en materiales / José Antonio Puértolas Ráfales, Ricardo Ríos Jordana, Miguel Castro Corella, José Manuel Casals Bustos (eds.) ; [José Ignacio Arnaudas Pontaque, Ricardo Ibarra García, Francisco Villuendas Yuste ... (et al.)] Madrid : Síntesis, D.L. 2010 |