Course guide
240IMA11 - 240IMA11 - Biomaterials

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN NEUROENGINEERING AND REHABILITATION (Syllabus 2020). (Compulsory subject).

Academic year: 2023  ECTS Credits: 4.5  Languages: English

LECTURER

Coordinating lecturer: MARTA PEGUEROLES NEYRA
Others: MARTA PEGUEROLES NEYRA
MONTSERRAT ESPAÑOL PONS

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEEBIO2. Design and develop biomaterials for medical applications, with therapeutic purposes or diagnosis, able to substitute and/or regenerate the living tissues, whether by themselves or integrated in complex devices.

TEACHING METHODOLOGY

Sessions will be taught in a theory, practical cases and laboratory practices format in which the subject’s specific competencies will be introduced. Present directed activities to work on spoken and written communication and team work will take place. Autonomous learning and the solvent use of information resources by means of non-presence directed activities will also be encouraged.

LEARNING OBJECTIVES OF THE SUBJECT

The course presents the study of biomaterials and materials for medical applications, designed to substitute and/or regenerate living tissues, with therapeutic or diagnostic aims. We review the different types of biomaterials, their characteristics and the interactions between biomaterials and the host organism. We also describe the techniques to assess the biocompatibility of materials.

The specific objectives are:
- To become familiar with common characteristics and distinctive features of different types of materials used in medicine and rehabilitation.
- To know the basic principles of biocompatibility of materials for medical applications.
- To identify the basic criteria that must be met for a material to be implanted in the human body.
- Understanding the biological principles that affect the body's interactions with biomaterials receptor (receptor response in the body) and relate them to the service behavior of biomaterial (biomaterial response and degradation).
- Biomaterials applied to neuroengineering and rehabilitation

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>27,0</td>
<td>24.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>13,5</td>
<td>12.00</td>
</tr>
<tr>
<td>Self study</td>
<td>72,0</td>
<td>64.00</td>
</tr>
</tbody>
</table>

Total learning time: 112.5 h
## T1. Introduction

### Description:
- Types of materials, concept of biomaterial
- Historical evolution of biomaterials
- Biocompatibility

### Related activities:
Participative lecture

### Full-or-part-time:
4h

- Theory classes: 2h
- Self study: 2h

## T2. Interactions host-biomaterial

### Description:
- Biological response of the host organism to biomaterials, biocompatibility.
- Cells and extracellular matrix
- Tests to evaluate in vitro biocompatibility ISO 10993, cytotoxicity
- Bacteria, in vitro evaluation
- Thrombogenicity, in vitro evaluation

### Related activities:
Participative lecture

### Full-or-part-time:
16h 10m

- Theory classes: 4h 30m
- Self study: 11h 40m

## T3. Hard biological tissues

### Description:
- Bone: constitution, structure and properties.
- Bone cells: osteoblasts, osteoclasts, osteocytes
- Bone formation and bone diseases

### Related activities:
Participative lectures
Laboratory sessions

### Full-or-part-time:
19h 10m

- Theory classes: 4h 30m
- Laboratory classes: 3h
- Self study: 11h 40m
## T4. Metallic biomaterials

**Description:**
- Metallic biomaterials, basic concepts
- Stainless steel, titanium c.p., titanium alloys, cobalt alloys, shape memory alloys: characteristics, properties and applications.
- Surface modifications: physical, inorganic chemistry, functionalization of biomolecules

**Full-or-part-time:** 20h 10m  
Theory classes: 5h 30m  
Laboratory classes: 3h  
Self study: 11h 40m

## T5. Polymeric biomaterials

**Description:**
- Soft biological tissues
- Polymeric materials: natural polymers, stable polymers, biodegradable polymers and hydrogels
- Mechanisms of degradation and medical applications
- Hydrogels and drug release, applications in neuroengineering

**Related activities:**
- Participative lectures  
- Laboratory session

**Full-or-part-time:** 19h 10m  
Theory classes: 4h 30m  
Laboratory classes: 3h  
Self study: 11h 40m

## T6. Composite materials

**Description:**
- Nervous system
- Neurological disorders or injuries
- Composites materials for applications in physical medicine and rehabilitation.

**Full-or-part-time:** 16h 10m  
Theory classes: 3h  
Laboratory classes: 1h 30m  
Self study: 11h 40m
# T7. Bioceramics materials

**Description:**
- Ceramic materials: inert, bioactive and reabsorbable ceramics.
- Calcium phosphate ceramics
- Composite materials
- Applications in orthopedic surgery and traumatology. Applications in Dentistry.

**Related activities:**
- Cooperative learning: group work
- Oral presentation of the work

**Full-or-part-time:** 17h 40m
- Theory classes: 3h
- Laboratory classes: 3h
- Self study: 11h 40m

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## GRADING SYSTEM

A student's grade will be:

\[
\text{Final Mark} = 0.3 \times \text{Final Exam} + 0.3 \times \text{Midterm Exam} + 0.2 \times \text{Lab Practices} + 0.2 \times \text{Exercises}
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## BIBLIOGRAPHY

**Basic:**

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## RESOURCES

**Other resources:**
- Teaching material available in Atenea.