Course guides  
295762 - 295EM122 - Biomedical Materials

Unit in charge:  Barcelona East School of Engineering  
Teaching unit:  702 - CEM - Department of Materials Science and Engineering. 
Degree:  MASTER'S DEGREE IN MATERIALS SCIENCE AND ADVANCED MATERIALS ENGINEERING (Syllabus 2019). (Optional subject). 
Academic year: 2020  
ECTS Credits: 6.0  
Languages: Spanish

LECTURER

Coordinating lecturer:  MONTSERRAT ESPAÑOL PONS  
Others:  Primer quadrimestre:  
MONTSERRAT ESPAÑOL PONS - T10  
JOSE M. MANERO PLANELLA - T10

PRIOR SKILLS

Knowledge of biomaterials is recommended

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:  
CEMCEAM-03. (ENG) Realizar estudios de caracterización y evaluación de materiales según sus aplicaciones  
CEMCEAM-05. (ENG) Interpretar y aplicar normativas y especificaciones relativas a los materiales y sus aplicaciones

Transversal:  
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.  
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.  
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.  
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one’s knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one’s knowledge.

TEACHING METHODOLOGY

The subject includes classes in theoretical format and seminars. Attended activities will be carried out to work oral and written communication and team work through selected readings. Lab practices will also be carried out and autonomous learning and solvent use of information resources will be encouraged through non-contact directed activities.

LEARNING OBJECTIVES OF THE SUBJECT

The objective is that the student acquires knowledge of the applications of biomaterials in medicine and, therefore, be able to relate properties and biological response of biomaterials and apply selection criteria to determine the more suitable for application. In addition, the different techniques of biological characterization in vitro and in vivo of biomaterials are described, as well as the interpretation of the results obtained through the different techniques. The specific objectives are:  
- Review the different types of biomaterials, their characteristics and biocompatibility.  
- Knowledge of the basic principles of biological characterization in vitro and in vivo to evaluate biocompatibility of biomaterials.  
- Description of the main applications of biomaterials in medicine
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>14,0</td>
<td>9.33</td>
</tr>
<tr>
<td>Self study</td>
<td>102,0</td>
<td>68.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>28,0</td>
<td>18.67</td>
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</tbody>
</table>

Total learning time: 150 h

CONTENTS

Evaluation of the cell / biomaterial interaction

Description:
- Cell / biomaterial interaction, biocompatibility
- Type of cell cultures: primary crop, secondary crop, cultivation
- Basic cellular responses: adhesion, proliferation, differentiation and apoptosis
- Evaluation of the cytotoxicity of a biomaterial: measurements of metabolic activity (LDH, MTT) and trials based on the principle of cell exclusion (immunofluorescence, ELISA)
- Evaluation of the bacterial / biomaterial interaction
- Evaluation of blood / biomaterial interaction

Full-or-part-time: 35h
Practical classes: 6h
Laboratory classes: 3h
Guided activities: 2h
Self study: 24h

Biomedical materials for cardiovascular applications

Description:
- Cardiovascular diseases; Endothelialization and thrombogenicity
- Cardiovascular stents
- Heart valves
- Cardiovascular grafts

Full-or-part-time: 29h
Practical classes: 5h
Laboratory classes: 4h
Guided activities: 1h
Self study: 19h
### Biomedical materials for dental and orthopedic applications

**Description:**

- Biomaterials for bone replacement: inert metals and ceramics
- Dental implants. Prosthesis of hip and knee. Osteosynthesis materials: plates and screws. Intervertebral disc
- Biomaterials for bone regeneration: bioceramics and bioavailable
- Biomaterials for condral repair and regeneration. Tissue engineering applied to orthopedic and maxillofacial surgery

**Full-or-part-time:** 34h
- Practical classes: 6h
- Laboratory classes: 3h
- Guided activities: 1h
- Self study: 24h

### Biomedical materials for ophthalmic applications, skin, adhesives and sutures

**Description:**

- Biomaterials for ophthalmic applications: Anatomy of the eye; soft and hard contact lenses; intraocular lenses; corneal implants
- Biomaterials for applications for skin replacement: Structure of the dermis; permanent and reabsorbable implants; tissue engineering applied to skin regeneration
- Adhesives, sealants and sutures: adhesion mechanisms; composition and characteristics of adhesive materials; stickers for soft tissue; adhesives for hard tissues; natural and synthetic sutures

**Full-or-part-time:** 27h
- Practical classes: 6h
- Laboratory classes: 2h
- Guided activities: 1h
- Self study: 18h

### Materiales biomédicos para la liberación controlada de fármacos

**Description:**

- Control of the release of a drug, between effectiveness and toxicity
- Control of release for dissemination
- Liberation control systems by penetration of water to the device
- Chemically controlled devices

**Full-or-part-time:** 25h
- Practical classes: 5h
- Laboratory classes: 2h
- Guided activities: 1h
- Self study: 17h

**GRADING SYSTEM**

\[
N_{\text{final}} = 0.40 \times N_{\text{ex final}} + 0.40 \times N_{\text{ex midterm}} + 0.10 \times \text{Laboratory} + 0.10 \times \text{Work}
\]

In case of reassessment, \[
N_{\text{final}} = 0.80 \times N_{\text{ex reassessment}} + 0.10 \times \text{Laboratory} + 0.10 \times \text{Work}
\]
BIBLIOGRAPHY

Basic:

Complementary:

RESOURCES

Audiovisual material:
- Presentacions en PPT. Presentations in PPT