Degree competences to which the subject contributes

Specific:
CEMCEM-01. (ENG) Aplicar coneixements de matemàtiques, física, química, biologia i altres ciències naturals, obtinguts mitjançant estudi, experiència i, pràctica, amb raonament crític per a establir solucions viables a problemes tècnics.
CEMCEM-04. (ENG) Realitzar estudis de caracterització, avaluació i certificació de materials segons les seves aplicacions

Transversal:
02 SCS N2. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.
06 URI N2. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

Teaching methodology
- Participative lectures.
- Cooperative learning: group work

Learning objectives of the subject
The aim of the course is that students acquire knowledge of the applications of biomaterials in medicine and dentistry and thus be able to relate properties and biological response of biomaterials, and apply the selection criteria best suited for each application. In addition, students will become familiar with the various techniques of characterization in vitro and in vivo biological biomaterials, as well as interpretation of results obtained using different techniques.
## Study load

<table>
<thead>
<tr>
<th></th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time:</td>
<td>112h 30m</td>
<td>27h</td>
<td>13h 30m</td>
<td>0h</td>
<td>72h</td>
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<td>24.00%</td>
<td>0.00%</td>
<td>12.00%</td>
<td>0.00%</td>
<td>64.00%</td>
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</tbody>
</table>
# 240EM033 - Biomedical Materials

## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biological characterisation of biomaterials</strong></td>
<td>18h</td>
</tr>
<tr>
<td><strong>In vivo characterisation of biomaterials</strong></td>
<td>10h</td>
</tr>
<tr>
<td><strong>Biomedical materials for cardiovascular applications</strong></td>
<td>17h</td>
</tr>
</tbody>
</table>

### Biological characterisation of biomaterials

**Description:**
- Type of cell cultures: Primary cultures, cell lines, secondary cultures, co-cultures
- Basic cell responses: adhesion, proliferation, differentiation and cell death
- Evaluation of cytotoxicity. Tests measuring the metabolic activity using enzymes: LDH, MTT
- Assays based on the principle of cell exclusion. Immunofluorescence. ELISA assay detecting cell markers. PCR
- Bacterial cultures
- Characterization blood-biomaterial interactions, trombogenicity

### In vivo characterisation of biomaterials

**Description:**
- Design of an in vivo animal testing
- Animal models
- Analysis of the in vivo results

### Biomedical materials for cardiovascular applications

**Description:**
- Cardiovascular Diseases. Endothelization and thrombogenicity
- Heart valves
- Vascular Grafts
- Cardiovascular Stents
- Pacemakers
# Biomedical Materials

## Biomedical materials for orthopaedic and dental applications

**Learning time:** 25h  
- Theory classes: 6h  
- Laboratory classes: 2h  
- Guided activities: 2h  
- Self study: 15h  

**Description:**  
- The use of biomaterials for bone replacement. Osseointegration  
- Dental implants  
- Hip Prosthesis. Knee replacements  
- Osteosynthesis material: plates and screws  
- Intervertebral discs  
- Materials for bone regeneration: bioceramics and bioactive glasses  
- Biomaterials for repair and regeneration of cartilage  
- Tissue engineering applied to orthopedic and maxillofacial surgery

## Biomedical materials for adhesives, sealants and sutures

**Learning time:** 13h 30m  
- Theory classes: 4h  
- Guided activities: 2h  
- Self study: 7h 30m

**Description:**  
- Mechanisms of adhesion: mechanical interlocking, adsorption, diffusion, electrostatic forces  
- Composition and characteristics of adhesive materials. Adhesives soft tissues. Adhesives for hard tissue  
- Natural and synthetic Sutures

## Biomedical materials for ophtalmologic applications

**Learning time:** 7h 30m  
- Theory classes: 2h  
- Laboratory classes: 1h  
- Self study: 4h 30m

**Description:**  
- Anatomy of the eye  
- Soft and hard contact lenses  
- Intraocular lenses  
- Corneal Implants. Implants for glaucoma
## Biomedical applications for skin regeneration

**Learning time:** 7h 30m
- Theory classes: 2h
- Laboratory classes: 1h
- Self study: 4h 30m

**Description:**
- Structure of the dermis
- Absorbable and permanent implants
- Tissue engineering applied to regeneration of skin

## Biomedical materials for controlled drug delivery

**Learning time:** 14h
- Theory classes: 4h
- Laboratory classes: 2h
- Self study: 8h

**Description:**
- Control of the release of a drug: between effectiveness and toxicity
- Control of the release by diffusion
- Control Systems to release water penetration device
- Chemically controlled devices

## Qualification system

\[ N_{\text{final}} = 0.50 \times N_{\text{ef}} + 0.30 \times N_{\text{ep}} + 0.2 \times N_{\text{tg}} \]

- **Nfinal:** final mark
- **Nef:** mark final exam
- **Nep:** mark parcial exam
- **Ntg:** mark grup work

In case of reevaluation, the mark of the reevaluation exam replaces the mark of the final exam in the above equation.
Bibliography

Basic:


Others resources:

Audiovisual material

Presentacions en PPT disponibles a Atenea

Support material for the lectures