240EM132 - Living Tissues and Biointerface

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 702 - CMEM - Department of Materials Science and Metallurgy
Academic year: 2018
Degree: MASTER'S DEGREE IN MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Teaching unit Optional)
ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2009). (Teaching unit Optional)
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MASTER'S DEGREE IN MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Teaching unit Optional)
ECTS credits: 4,5
Teaching languages: English

Teaching staff
Coordinator: Engel Lopez, Elisabet
Others: Mateos Timoneda, Miguel Ángel

Opening hours
Timetable:
Tuesday, de 18:00 a 19:00
Tuesday, Wednesday, Friday, de 14:00 a 15:00

Degree competences to which the subject contributes

Specific:
CEMCEM-11. (ENG) Gestionar la investigació. Desenvolupament e Innovació Tecnològica, atenent a la tranferència de tecnologia i els drets de propietat i de patents
CEMCEM-01. (ENG) Aplicar coneixements de matemàtiques, física, química, biologia i altres ciències naturals, obtinguts mitjançant estudis, experiència i, pràctica, amb raonament crític per a establir solucions viables a problemes tècnics.

Transversal:
01 EIN N2. ENTREPRENEURSHIP AND INNOVATION - Level 2. Taking initiatives that give rise to opportunities and to new products and solutions, doing so with a vision of process implementation and market understanding, and involving others in projects that have to be carried out.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
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**Teaching methodology**

The subject presents 4.5 ECTS. 2.5 are related to theory, 1 ECTS to the work done by the students consisting in preparing and presenting a work done in group, 0.5 ECTS of continuous evaluation and 0.5 to lab practices. The 2.5 credits of theory will be done in class where the main aspects of living tissues and the interaction with biointerfaces will be developed with the support of books and research papers. Students will do some lab practices for a total time of 6h. The subject presents a part of continuous evaluation that will involve the development of different works such as solving questions raised in class by the professor, discussion of relevant research papers, looking for information about a relevant issue related to the subject, etc. Students will be evaluated for the correct performance of the work as well as for their active participation in class.

**Learning objectives of the subject**

Tissue regeneration and reparation can be performed by using substitutive materials or biomaterials and involve some requirements related to the interactions between this biomaterials and the biological entities.

The general objective of this course is to introduce the students in the biological world and to get to know the biological entities (such as cells, proteins and tissues) that will get in contact with the biomaterials and implants. We will analyze all the tissue components, the surface properties and their role in the biological-material interactions when biomaterials devices are implanted. Also a revision on tissue composition and structure will be performed.

**Study load**

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

| The Cell | Learning time: 8h  
Theory classes: 8h |
|----------|---------------------|
| **Description:**  
**Specific objectives:**  
Introduction of basic concepts on cell biology. Get to know the composition, structure and cell behaviour with the surrounding environment and how they produce the extracellular matrix. |

| Tissues | Learning time: 11h  
Theory classes: 11h |
|---------|---------------------|
| **Description:**  
Extracelular matrix. Composition. Introduction to animal tissues. Tendons, ligaments, bone, cartilage, skin, etc  
**Related activities:**  
Oral group presentations on selected tissues.  
**Specific objectives:**  
To knw tissue composition, structure and function. |

| Surfaces | Learning time: 9h  
Theory classes: 9h |
|----------|---------------------|
| **Description:**  
Surfaces. Modification and functionalization. Surface characterization techniques: wettability, topography, electrical charge, chemical analysis, etc.  
**Related activities:**  
Individual work related to the subject.  
**Specific objectives:**  
To identify surface tipology and how to modify them and characterize. |

| Role of absorbev proteins on tissue reaction to biomaterials | Learning time: 3h  
Theory classes: 3h |
|---------------------------------------------------------------|---------------------|
| **Description:**  
Adhesion effect of the adsorbed proteins on the cells materials interactions.  
Conformational and biological changes of adsorbed proteins. Relation with surface properties.  
**Specific objectives:**  
To analyze surface interactions and biological environments. |
The final qualification will come from:

\[ N_{\text{final}} 1 = 0.45 \text{Nef} + 0.25 \text{Npp} + 0.35 \text{Ntc} \]

\[ N_{\text{final}} 2 = 0.65 \text{Nef} + 0.35 \text{Ntc} \]

\( \text{Nfinal} \): final mark
\( \text{Nef} \): final exam mark
\( \text{Npp} \): mark from partial marks
\( \text{Ntc} \): final work mark + continuous evaluation

There will be reevaluation.

**Bibliography**

**Tissue response to implants.**

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 6h</th>
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<table>
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<tr>
<th>Related activities:</th>
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<tbody>
<tr>
<td>Individual assessment on the subject.</td>
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<table>
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<tr>
<th>Specific objectives:</th>
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<tbody>
<tr>
<td>Revision of the implants knowledge.</td>
<td></td>
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<tr>
<td>Analysis of the body reaction processes to implants.</td>
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**Examples and applications on tissue engineering.**

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<tr>
<th>Description:</th>
<th>Learning time: 8h</th>
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<tr>
<td>Tissue engineering applications. Scaffold designs. Examples on tissue regeneration: skin, ligaments, bone, heart, central nervous system, etc.</td>
<td>Theory classes: 8h</td>
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<tr>
<th>Related activities:</th>
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<tr>
<td>Team work based on an oral presentation in class where the group will explain a tissue engineering based application.</td>
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<th>Specific objectives:</th>
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<tr>
<td>To Correlate the biocompatibility concept with the surface properties and the body's strategies to regenerate tissues.</td>
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