240EM131 - Micromechanical Design, Nanomechanical and Coatings

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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ECTS credits: 4.5
Teaching languages: English

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ECTS credits: 4.5
Teaching languages: English

Teaching staff

Coordinator: Roa Rovira, Joan Josep
Others: Llanes Pitarch, Luis Miguel
Alcala Cabrelles, Jorge

Opening hours

Timetable: Monday: 17:00-18:00 h
Wednesday: 17:30-18:30 h
Outside of these hours, the student must specify and fix the consultation time with the teacher

Prior skills
No one previous capacity

Requirements
No prerequisite

Degree competences to which the subject contributes

Specific:
CEMCEM-03. (ENG) Aplicar mètodes innovadors en la resolució de problemes i aplicacions informàtiques adequades, pel disseny, simulació, optimització i control de processos de producció i transformació de materials
CEMCEM-07. (ENG) Dissenyar, calcular i modelar aspectes relacionats amb els materials per a components mecànics, estructures i equips

Transversal:
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.
The objective of this subject is that the student will acquire the introductory knowledge and skills over mechanical characterization, microstructure as well as the main deformation mechanisms induced under complex stress fields for bulk and coating systems.

At the end of the course the student should be able to correlate the microstructure/properties at the micro- and nanometric length scale.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 112h 30m</th>
<th>Hours large group: 27h (24.00%)</th>
<th>Hours medium group: 0h (0.00%)</th>
<th>Hours small group: 13h 30m (12.00%)</th>
<th>Guided activities: 0h (0.00%)</th>
<th>Self study: 72h (64.00%)</th>
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</thead>
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The course will be divided in four different modules. The teaching methodology for each module will be: Theoretical class and autonomous learning exercises will be done in each module. Different presentations (e.g. oral presentations, movies and conceptual maps) and small exercises will be presented and delivered as a part of the final mark.
## Content

### Module 1: Length scale issues and size effects on the mechanical response of materials: deformation, fracture and fatigue

**Description:**
Relation between microstructure and mechanical properties

**Specific objectives:**
Discussion and presentation of a scientific paper

**Learning time:** 27h
- Theory classes: 9h
- Self study: 18h

### Module 2: Experimental techniques as applied to nanomechanics: nanoindentation, AFM and FIB

**Description:**
- Basic principles of nanoindentation
- Atomic force microscopy
- Focused ion beam

**Related activities:**
- Deliverable activities
- Poster

**Learning time:** 27h
- Theory classes: 9h
- Self study: 18h

### Modul 3: Micromechanical Description of Crystal Plasticity

**Description:**
Description of the main plastic deformation mechanisms

**Related activities:**
- Presentation and discussion of a scientific paper

**Learning time:** 27h
- Theory classes: 9h
- Self study: 18h
## Modul 4: MEMs and Coatings

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>Fracture and Fatigue of Materials for Microsystems</td>
</tr>
<tr>
<td>Surface Modification Technology / Thin Films</td>
</tr>
<tr>
<td>Tribomechanical Response of Hard Coatings</td>
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</table>

<table>
<thead>
<tr>
<th>Related activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual map</td>
</tr>
<tr>
<td>Movie (scientific journal)</td>
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</table>

<table>
<thead>
<tr>
<th>Learning time: 31h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 9h</td>
</tr>
<tr>
<td>Self study : 22h 30m</td>
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</tbody>
</table>

### Qualification system

25% each module (25% module 1 + 25% module 2 + 25% module 3 + 25% module 4)

### Bibliography

**Basic:**