240EM112 - Organic Matrix Composites

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)
ERASMUS MUNDUS MASTER’S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (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: Spanish

Teaching staff
Coordinator: M Lluisa Maspoch
Others: Jonathan Cailloux
Violeta García

Opening hours
Timetable: It will be communicated by each teacher at the beginning of the course.

Prior skills
To have knowledge about plastic materials at the level of the subjects Fundamentals of Polymers and Plastics materials and composites (Degree in Materials Engineering.)

Requirements
To have knowledge about plastic materials at the level of the subjects Fundamentals of Polymers and Plastics materials and composites (Degree in Materials Engineering.)

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
Transversal:
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.
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Learning objectives of the subject

1. Know the main types of organic matrices, of second phases.
2. Know the properties of the interface and how it can be modified.
3. Know the main processing processes of composite materials with fibers.
4. Learn how to design a laminated composite material in order to optimize its useful life in real service conditions.

Study load

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

Expositive class with visual support material available on the digital campus.
Activity resolution class based on cooperative work.
Laboratory work and delivery of the respective report.
Oral presentation of a guided work.
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## Content

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<tr>
<th>Subject 1. Introduction</th>
<th>Learning time: 6h</th>
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<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 3h</td>
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<tr>
<td>Definition</td>
<td>Self study: 3h</td>
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<tr>
<td>Classification</td>
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<tr>
<td>Examples of applications</td>
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<tr>
<td>Natural compounds</td>
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<tr>
<td>The wood</td>
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<tr>
<td><strong>Related activities:</strong></td>
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<td>Laboratory work</td>
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<tr>
<th>Subject 2. Composites with fibers.</th>
<th>Learning time: 19h 30m</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>Types of fibers.</td>
<td>Guided activities: 1h 30m</td>
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<tr>
<td>Types of polymeric matrix.</td>
<td>Self study: 12h</td>
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<td>Matrix fiber interfaces.</td>
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<tr>
<td>Key factors that determine the properties of a compound.</td>
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<tr>
<td><strong>Related activities:</strong></td>
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<tr>
<td>Laboratory work.</td>
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<tr>
<th>Subject 3. Compounds with particles.</th>
<th>Learning time: 16h 30m</th>
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<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>Rigid particles: types of particles, function of each type of particle, effects on mechanical properties and on fracture behavior and crack propagation. Incorporation.</td>
<td>Self study: 10h 30m</td>
</tr>
<tr>
<td>Elastomeric particles: preparation of these composites, examples and applications. Effect on mechanical properties and on tenacity</td>
<td></td>
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</tbody>
</table>
### Tema 4. Foams

**Description:**
- Definitions by cell type and size.
- Preparation methods.
- Examples and applications.
- Properties and function of the size of the cells.

**Learning time:** 9h
- Theory classes: 1h 30m
- Guided activities: 1h 30m
- Self study: 6h

### Subject 5. Nanocomposites.

**Description:**
- Classification and types of nanofillers in polymer matrix.
- Methods of preparation of organic matrix nanocomposites.
- Relationship structure and properties.
- Examples of applications.

**Learning time:** 3h
- Theory classes: 1h 30m
- Self study: 1h 30m

### Subject 6. Processing of composites

**Description:**
- Manual and projection molding.
- SMC and BMC.
- Compression molding.
- Vacuum bag, infusion and RTM.
- Autoclave.
- Pultrusion and winding of filaments.
- RIM, RRIM and SRIM

**Related activities:**
- Guided work.

**Learning time:** 9h
- Theory classes: 1h 30m
- Guided activities: 1h 30m
- Self study: 6h
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### Subject 7. Micro and macromechanics of composite materials with long fibers

**Description:**
Unidirectional mechanical properties of composite materials with long fibers from known properties of fiber and matrix.
Mechanical properties in laminates: estimation of elastic constants in the medium plane.
Mechanical design of laminates.

**Related activities:**
Group activities

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### Subject 9. Failure analysis in laminates.

**Description:**
Failure models.
The "Ply discount" model.
Prediction of useful life of laminates.

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### Qualification system

The final score (Nf) will be calculated according to the following expression:

- Practical laboratory score (P) = 5%
- Guided activities score (A) = 40%
- Guided work score (TD) = 10%
- Theory note (NT) = 45%

Final note (NF): \(0.05 \times P + 0.40 \times A + 0.1 \times TD + 0.45 \times NT\)
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Regulations for carrying out activities

The type of evaluation is continuous.

Evaluation of guided activities (face-to-face or non-face-to-face):
Delivery of the solution of proposed problems (A)
Delivery of practice reports (P).

Final exam (NT): (individual)
It will consist of questions related to theoretical knowledge or to the resolution of problems of the syllabus of the subject and aimed at assessing the learning objectives achieved by the student.

Guided work (TD): (in group)
Oral presentation of a topic relating to the subject previously selected from a list proposed by the professor.

Bibliography

Basic:

Complementary: