295703 - MACE - Ceramic Materials

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 702 - CMEM - Department of Materials Science and Metallurgy
Academic year: 2018
Degree: BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Spanish

Degree competences to which the subject contributes

Specific:
- CEI-09. Understand the fundamentals of materials science, technology and chemistry. Understand the relationship between the microstructure, synthesis or processing and the properties of materials.
- CEMT-19. Knowledge of the structure of different types of materials, as well as material characterisation and analysis techniques.
- CEMT-22. Knowledge and application of materials technology in the production, transformation, processing, selection, control, maintenance, recycling and storage of all types of materials.

Transversal:
- 04 COE N3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

Teaching methodology

Theoretical class in conjunction with Laboratory: sessions and autonomous learning exercises will be done. Two exams, a presentation and small exercises will be part of the grade.

Learning objectives of the subject

The objective of this subject is that the student will acquire the introductory knowledge and skills over structure, properties, processing, design and in-service response of traditional and advanced ceramic materials.
At the end of the course the student should be able to:
- Identify the main crystallographic structures and microstructures of ceramic materials
- Identify the main defects in ceramics, as well as formulate the main reactions between them
- Select the optimal processing route of ceramic components
- Design to optimize the structural integrity and reliability of ceramic devices.
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### Study load

<table>
<thead>
<tr>
<th><strong>Total learning time:</strong> 150h</th>
<th>Hours large group: 45h</th>
<th>30.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
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<tr>
<td></td>
<td>Hours small group: 15h</td>
<td>10.00%</td>
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<td></td>
<td>Guided activities: 90h</td>
<td>60.00%</td>
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# Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time: 15h</th>
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<tbody>
<tr>
<td>Introduction to ceramic materials</td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 1h</td>
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<tr>
<td></td>
<td>Laboratory classes: 2h</td>
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<tr>
<td></td>
<td>Guided activities: 0h</td>
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<tr>
<td></td>
<td>Self study : 6h</td>
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**Description:**
- History of ceramic technology.
- Classification of ceramic materials.
- Crystallography of ceramics.
- Silicates and Aluminosilicates.
- Glass.

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<thead>
<tr>
<th>Topic</th>
<th>Learning time: 13h</th>
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<tbody>
<tr>
<td>Crystallographic defects in ceramics</td>
<td>Theory classes: 4h</td>
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<tr>
<td></td>
<td>Practical classes: 1h</td>
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<tr>
<td></td>
<td>Laboratory classes: 0h</td>
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<td>Guided activities: 0h</td>
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<td>Self study : 8h</td>
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**Description:**
- Point defects.
- Kröger-Vink notation.
- Dislocations.
- Pores.
- Grain Boundaries.

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<thead>
<tr>
<th>Topic</th>
<th>Learning time: 10h</th>
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<tbody>
<tr>
<td>Microstructure and Phase Equilibrium</td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Practical classes: 2h</td>
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<tr>
<td></td>
<td>Laboratory classes: 0h</td>
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<td>Guided activities: 0h</td>
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<tr>
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<td>Self study : 6h</td>
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**Description:**
- Ceramic phase diagrams.
- Phases out of equilibrium.
- TTT curves and glass formation.
- Ceramic Microstructures.

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<thead>
<tr>
<th>Topic</th>
<th>Learning time: 34h</th>
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<tbody>
<tr>
<td>Processing Technology</td>
<td>Theory classes: 8h</td>
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<tr>
<td></td>
<td>Practical classes: 1h</td>
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<tr>
<td></td>
<td>Laboratory classes: 6h</td>
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<tr>
<td></td>
<td>Guided activities: 0h</td>
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<td>Self study : 19h</td>
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**Description:**
- Overview of ceramic processing routes.
- Raw materials.
- Solid state sintering.
- Densification.
- Forming.
- Additives.
- Glass.
- Single crystals.
### Design, mechanical properties and reliability

**Learning time:** 21h  
- Theory classes: 5h  
- Practical classes: 1h  
- Laboratory classes: 2h  
- Guided activities: 0h  
- Self study: 13h

**Description:**  

### Thermo-mechanical behaviour

**Learning time:** 8h 30m  
- Theory classes: 1h  
- Practical classes: 1h  
- Laboratory classes: 2h  
- Guided activities: 0h  
- Self study: 4h 30m

**Description:**  
Thermal properties. Thermo-mechanics: thermal shock and creep.

### Engineering applications

**Learning time:** 11h  
- Theory classes: 0h  
- Practical classes: 1h  
- Laboratory classes: 0h  
- Guided activities: 0h  
- Self study: 10h

**Description:**  
Engineering applications

### Qualification system

50% Final Exam + 20% Mid-term exam + 10% laboratory (Activity 1) + 10% quiz (Activity 2) + 10% presentation (Activity 3)


Bibliography

Basic:


Complementary: