295023 - ECMA - Materials Structure and Characterization

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 6  
Teaching languages: Catalan, Spanish

Degree competences to which the subject contributes

Specific:
1. Knowledge of science, technology and materials' chemistry fundaments. Understanding the relation between microstructure, synthesis or processing and materials' properties.

Transversal:
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Teaching methodology

Sessions will be taught in a theory, problems and laboratory practices format in which the subject's specific competencies will be introduced. Present directed activities to work on spoken and written communication and team work will take place. Autonomous learning and the solvent use of information resources by means of non-presence directed activities will also be encouraged.

Learning objectives of the subject

The subject's objective is that students acquire knowledge on the fundaments of material families, their structure and defects. In addition, students will have to know the different microstructural characterisation techniques as well as knowing to interpret results obtained by means of 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><strong>Total learning time:</strong></td>
<td>150h</td>
<td>45h</td>
<td>0h</td>
<td>0h</td>
<td>90h</td>
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<tr>
<td><strong>% of total learning time:</strong></td>
<td></td>
<td>30.00%</td>
<td>0.00%</td>
<td>10.00%</td>
<td>60.00%</td>
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</table>
# Content

<table>
<thead>
<tr>
<th>TOPIC I. Engineering materials</th>
<th>Learning time: 15h</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study : 10h</td>
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**Description:**
- Material's science and engineering.
- Types of materials: metals, ceramics and glasses, polymers, composite materials, semiconductors.
- From structure to properties.

<table>
<thead>
<tr>
<th>TOPIC II: The chemical bond</th>
<th>Learning time: 2h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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</tbody>
</table>

**Description:**
- Primary bonds: ionic, covalent, metallic, mixed
- Secondary bonds
- Force and bonding energy, relationship with properties of materials
- Band theory

<table>
<thead>
<tr>
<th>TOPIC III: Polymers' structure and characterisation</th>
<th>Learning time: 20h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 1h</td>
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<tr>
<td></td>
<td>Self study : 15h</td>
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**Description:**
- Obtaining polymers (polymerisation reactions). Average molecular mass and techniques to determine it.
- Architecture molecular (linear, ramified and reticulated) and polymer classification into thermoplastics, Thermostables and elastomers.
- Polymers' structure (amorphous and semicrystalline). Techniques to determine vitreous transmission temperature.
- Aggregation states.
- Copolymers.
### TOPIC IV: Crystalline structure

**Description:**
- Unit cell.
- Crystal systems.
- Primary crystal structures (BCC, FCC, HCP)
- Crystallographic directions and planes. Miller indices.
- Octahedral and tetrahedral interstices
- Solid metal solutions: interstitial and substitute
- Rules of Hume-Rothery
- Ceramic solid solutions

**Learning time:** 35h
- Theory classes: 9h
- Practical classes: 6h
- Self study: 20h

### TOPIC IV: Crystalline defects

**Description:**
- Defects in crystalline materials (point defects, linear defects, planar defects, volumetric defects)
- Dislocations (Geometry of dislocations and Burgers vector)
- Movement of dislocations (dislocation glide)

**Learning time:** 35h
- Theory classes: 9h
- Laboratory classes: 6h
- Self study: 20h

### TOPIC VI: Experimental techniques to identify microstructures and defects

**Description:**
- Optical metalography. Preparing samples. Grain size according to ASTM and determining the grain's diameter.
- Transmission electronic microscopy (TEM).

**Learning time:** 25h
- Theory classes: 7h
- Laboratory classes: 3h
- Self study: 15h
### Topic V: Analysis of Crystal Structures

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning Time: 20h</th>
</tr>
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<tbody>
<tr>
<td>- Diffraction techniques: X-Ray Diffraction</td>
<td>Theory classes: 7h</td>
</tr>
<tr>
<td>(properties and X-ray sources, formulation</td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td>Bragg powder diffractometer)</td>
<td>Self study: 10h</td>
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<tr>
<td>- Spectroscopic techniques: Infrared Spectroscopy</td>
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<tr>
<td>- Identification and analysis of crystalline</td>
<td></td>
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<tr>
<td>phases</td>
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### Qualification System

A student's grade will be:

Final Mark = 0.4*Final Exam + 0.3*Midterm Exam + 0.15*Lab Practices * 0.15*Works

Finally, as detailed in the academic normative of the EEBE, a reevaluation exam will take place (midterm+final contents). To be able to do the reevaluation exam, the student has to fail and has to attend to all the evaluation exams of the subject and its mark, N, for the part which can be reevaluated has to be such that N > 3.0


Final Mark = 0.7*Reassessment Exam + 0.15* Lab Practices * 0.15*Works

### Bibliography

#### Basic:


#### Complementary:


#### Others Resources:

Teaching material available in Atenea