240EM023 - Plastics Technology

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 Compulsory)
- MASTER’S DEGREE IN MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Teaching unit Compulsory)
- 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)
- ERASMUS MUNDUS MASTER’S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Teaching unit Optional)

ECTS credits: 4,5
Teaching languages: Spanish

Teaching staff
Coordinator: MARIA LLUÏSA MASPOCH RULBUA
Others: Santana Perez, Orlando
Cailloux, Jonathan
García Masabet, Violeta Del Valle

Opening hours
Timetable: The teaching staff will establish and communicate the attention hours at the beginning of semester.

Prior skills
Knowledge about structure and properties of polymeric materials, transport phenomena.

Requirements
240EM013-Structure and properties of Polymers.

Degree competences to which the subject contributes

Specific:
- CEMCEM-02. (ENG) Dissenyar i desenvolupar productes, processos, sistemes i serveis, així com l'optimització d’altres ja desenvolupats, atenent a la selecció de materials per a aplicacions específiques
- 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:
- 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.
- 02 SCS N2. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.
- 06 URI N2. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for
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- To deepen in the rheological behavior of polymers and their relation with the molecular structure.
- To study the techniques of characterization of the rheological behavior of polymeric materials.
- Know the main families of thermoplastic materials and their relevant characteristics: processing and final properties.
- To Study the techniques of processing plastic materials by analyzing the production lines and the relationship between the process parameters and the quality of the piece obtained.

Teaching methodology

Depending on the number of students enrolled:

Masterful expository classes (and participatory with material available on digital campus)
Self-paced learning
Cooperative learning
Project-based learning, problems and case studies.

Learning objectives of the subject

- To deepen in the rheological behavior of polymers and their relation with the molecular structure.
- To study the techniques of characterization of the rheological behavior of polymeric materials.
- Know the main families of thermoplastic materials and their relevant characteristics: processing and final properties.
- To Study the techniques of processing plastic materials by analyzing the production lines and the relationship between the process parameters and the quality of the piece obtained.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 112h 30m</th>
<th>Hours large group: 31h 30m</th>
<th>28.00%</th>
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<tbody>
<tr>
<td>Hours medium group: 0h</td>
<td>0.00%</td>
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<tr>
<td>Hours small group: 9h</td>
<td>8.00%</td>
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<tr>
<td>Guided activities: 0h</td>
<td>0.00%</td>
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<tr>
<td>Self study: 72h</td>
<td>64.00%</td>
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### Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Learning time</th>
<th>Theory classes</th>
<th>Laboratory classes</th>
<th>Self study</th>
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</thead>
</table>
| 1.- Description and additives of thermoplastics | **Description:**
Description of the main families of thermoplastic materials attending to properties, considerations for their processing and additivation:
- Polyolefins
- Styrene base polymers.
- Acrylic Polymers
- Thermoplastic polyesters: aliphatic and aromatic.
- Polyamides
- Halogenated polymers.
- Bioplastics. | **12h** | 4h 30m | | 7h 30m |
| 2.- Flow of polymeric systems | **Description:**
Rheological behavior of polymers.
Techniques of rheological characterization.
Factors that determine rheological behavior.
Elastic effects on the fluid | **13h 30m** | 4h 30m | 1h 30m | 7h 30m |
| 3.-Technology of mixing and compounding | **Description:**
- Mixing considerations: a) Polymer + rigid charges and b) Polymer + polymer
- Rheological criteria for mixing polymer systems.
- Morphology induced by mixing.
- Discontinuous mixing techniques.
- Continuous mixing techniques (Double screw extrusion). | **11h 30m** | 4h 30m | | 7h |
4.- Extrusion and main lines of production

**Description:**
- The extrusion process
- Description of the machine
- Operation curves: parameters and effects
- Main production lines and typical defects:
  - Production of Multicapas: Coextrusion, lamination and coating.
  - Sheet production
  - Fiber production
  - Production of pipes
  - Film production (calendering and blowing)
  - Production of hollow bodies (blown extension)

**Learning time:** 20h

- Theory classes: 6h
- Laboratory classes: 1h 30m
- Self study: 12h 30m

5.- Thermoforming

**Description:**
- Process description.
- Types of thermoforming.
- Material requirements.
- Typical defects and solutions.

**Learning time:** 4h

- Theory classes: 1h 30m
- Self study: 2h 30m

6.- Rotational Molding

**Description:**
- Descripción del Proceso.
- Requerimientos del material.
- Defectos típicos y soluciones.

**Learning time:** 4h

- Practical classes: 1h 30m
- Self study: 2h 30m
7.- Injection molding

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<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>- Machines and parameters of the process</td>
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<tr>
<td>- Description of the mold and functionalities</td>
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<tr>
<td>- Defects and solutions in injected parts</td>
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</tbody>
</table>

**Learning time:** 20h
- Theory classes: 6h
- Laboratory classes: 1h 30m
- Self study: 12h 30m

8.- Advanced Processing Techniques

<table>
<thead>
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<th>Description:</th>
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<tbody>
<tr>
<td>Over-injection</td>
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<tr>
<td>Co-Injection</td>
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<tr>
<td>Fluid Assisted Injection</td>
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<tr>
<td>Injection + Microfoam</td>
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<tr>
<td>Additive Manufacturing: FDM</td>
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**Learning time:** 12h
- Theory classes: 3h
- Laboratory classes: 1h 30m
- Self study: 7h 30m

Qualification system

- Group Activities Evaluation Note (NEAG)
- Note practice report or scripts report (L)
- Partial Note 1 (P1)
- Partial Note 2 (P2)
- Final Exam (EF)

The Group Activity Assessment Note (NEAG) will be calculated as the average of the group activities that are proposed: laboratory report, analysis work. Communiqué at the beginning of the semester based on the number of registered students. The minimum number of group activities per term will be 2, reaching a maximum of 3. In this way:

The final grade (NF) will be calculated as:

Final Note (NF): $0.3 \text{NEAG} + 0.70 \text{NT} = (0.1 L1 + 0.1 L2 + 0.1 L3) + 0.7 \text{NT}$

$\text{NT (theory note)} = 0.5 P1 + 0.5 P2$ (if P1 and P2 > 4)

$\text{NT (theory note)} = 0.25 P1 + 0.25 P2 + 0.5 \text{EF}$ (if P1 and / or P2 4)

Since there are more than 4 tests to evaluate during the semester, no re-evaluation exam is contemplated in the subject.
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Regulations for carrying out activities

All evaluation items will be evaluated in the scale of 10, and are mandatory to be able to approve the subject.

Partial examinations P1 and P2:
Two written tests, with a maximum duration of 1.5h. No use of support material. The topics to be evaluated in each of them will be communicated during the course.
The minimum assessment in each of them must be 4/10. Otherwise a final exam (EF) must be done.

Final exam:
Maximum duration 2h. All the topics covered in the course will be evaluated. Students who have not obtained a minimum grade of 4/10 in any of the partial tests will be presented compulsory.

Reports of practical activities:
They will be presented according to a model that will be published in the digital campus of the subject. The groups or work teams will be established at the beginning of the quarter by the students themselves. The maximum number of participants in each group will be between 3 and 4 students.

Bibliography

Basic:

Others resources:

Hyperlink

Videos
Selected videos of youtube processes.

Audiovisual material

Nom recurs

Resource