Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 702 - CMEM - Department of Materials Science and Metallurgy
713 - EQ - Department of Chemical Engineering

Academic year: 2018
Degree:
ECTS credits: 6
Teaching languages: Catalan, Spanish, English

Teaching staff
Coordinator: Elaine Armelin Diggroc
Others: Elaine Armelin Diggroc
Maria Lluïsa Maspoch
Orlando Santana
Jonathan Cailloux

Opening hours
Timetable: To be specified according to the professors' availabilities.

Prior skills
Fundamental knowledge on chemical structure of polymers, classification, polymerization methods and polymer physics.

Requirements
Previous knowledge on other subjects related to polymer science (chemical of polymerization, polymer physics, properties).

Degree competences to which the subject contributes

Generical:
CGMUEQ-01. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the matter undergoes changes in its composition, state or energy content, characteristic of the chemical industry and other related sectors among which are the pharmaceutical, biotechnological, materials, energy, food or environmental
CGMUEQ-02. To conceive, project, calculate and design processes, equipment, industrial facilities and services, in the field of chemical engineering and related industrial sectors, in terms of quality, safety, economy, rational and efficient use of natural resources and environment conservation

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.

Learning objectives of the subject

b.
## Study load

<table>
<thead>
<tr>
<th></th>
<th>Hours Large Group:</th>
<th>28h</th>
<th>18.67%</th>
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</thead>
<tbody>
<tr>
<td>Hours Medium Group:</td>
<td>0h</td>
<td></td>
<td>0.00%</td>
</tr>
<tr>
<td>Hours Small Group:</td>
<td>14h</td>
<td></td>
<td>9.33%</td>
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<tr>
<td>Guided Activities:</td>
<td>6h</td>
<td></td>
<td>4.00%</td>
</tr>
<tr>
<td>Self Study:</td>
<td>102h</td>
<td></td>
<td>68.00%</td>
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</tbody>
</table>
# Content

## Topic 1: Plastics for general purpose (commodity plastics)

**Learning time:** 18h  
Theory classes: 3h 30m  
Laboratory classes: 1h 45m  
Self study: 12h 45m

**Description:**  
1. Knowledge on plastics for general purpose: Polyethylene (PE), Polipropylene (PP), Polyvinyl chloride (PVC) and Polystyrene (PS).  
2. Chemical structures, properties, processing and recycling methods  
3. Main applications and processing techniques  

**Related activities:**  
Work in the exercises proposed at classroom related to the plastic properties and polymer characterization.

## Topic 2: Engineering plastics

**Learning time:** 18h  
Theory classes: 3h 30m  
Laboratory classes: 1h 45m  
Self study: 12h 45m

**Description:**  
1. Knowledge in main family of engineering plastics:  
   - Polycarbonates (PC)  
   - Polysters: Polyethylenetereftalate (PET), Polybutylentereftalate (PBT).  
   - Polyamides: Nylon 6, Nylon 6,6  
   - Styrene copolymers: Acrylonitrile-butadiene-styrene (ABS), Styrene-acrylonitrile (SAN)  
   - Acrylic plastics: Polymethacrylate (PMMA)  
   - Polysters: Polyoxymethylene (POM)  
2. Chemical structure, properties, recycling processes.  
3. Main applications

**Related activities:**  
Work in the exercises proposed at classroom related to the plastic properties and polymer characterization.

## Topic 3: Termosets and elastomers

**Learning time:** 18h  
Theory classes: 3h 30m  
Laboratory classes: 1h 45m  
Self study: 12h 45m

**Description:**  
1. Knowledge on termoset materials: epoxy resins, polyuretanes (PUR), unsaturated polyesters, silicones; and elastomers: natural rubber (latex) and synthetic rubber (SBR, NBR, Neoprene, among others).  
2. Chemical structure, properties, processing and recycling.  
3. Main applications
### Topic 4: High performance polymers

**Description:**
1. Knowledge on main family of high performance plastics: Polyimides (PI), Polyaryletercetones (PAEK), polytetrafluoroetilene (PTFE), polyesters aromatics (APE, PCT, PEN), polysulfones and polysiloxanes.
2. Estructuras, propiedades físico-químicas, procesado y reciclado.
3. Principales aplicaciones

**Related activities:**
Work in the exercises proposed at classroom related to the plastic properties and polymer characterization.

**Learning time:** 18h
- Theory classes: 3h 30m
- Laboratory classes: 1h 45m
- Self study: 12h 45m

### Topic 5: Polymer rheology

**Description:**
Knowledge on the fundamental of polymer rheology and the main assays carried out for viscosity measurements. Introduction to the fundamentals of plastic transformation.

**Related activities:**
Laboratory for practice on the measurement of melt flow index. Exercises and real case of study on experimental data related to the melt flow index.

**Learning time:** 18h
- Theory classes: 3h 30m
- Laboratory classes: 1h 45m
- Self study: 12h 45m

### Topic 6: Extrusion

**Description:**
Main equipments and spindles used for the extrusion of plastics. Extrusion nozzles for the manufacture of different profiles as well as the corresponding calibrators. Analysis of the process and the influence of the different variables on the quality of the pieces. Knowledge on the techniques related to extrusion (Coextrusion, multilayer extrusion, extrusion blow, among others)

**Related activities:**
Extrusion practices at the facilities of the Center Català del Plàstic (Terrassa), using both single-screw extruders and double-screw extruders. Extrusion process by blowing.

**Learning time:** 18h
- Theory classes: 3h 30m
- Laboratory classes: 1h 45m
- Self study: 12h 45m
# 295566 - 295EQ222 - Polymer Transformation Processes

<table>
<thead>
<tr>
<th><strong>Topic 7: Injection</strong></th>
<th><strong>Learning time:</strong> 18h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>Knowledge of thermoplastic injection machines. Analysis of the process and the influence of the different variables on the quality of the pieces. Introduction to the design of molds, parts of a mold. Analysis of defects of injected parts, we will work with real pieces in class, and the causes and possible solutions to these defects will be analyzed. Injection by blowing.</td>
<td>Theory classes: 3h 30m</td>
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<tr>
<td><strong>Related activities:</strong></td>
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<tr>
<td>Injection practices at the facilities of the Center Català del Plàstic (Terrassa). Obtaining pieces using different process configurations and analyzing the quality of the pieces obtained.</td>
<td>Laboratory classes: 1h 45m</td>
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<td>Self study : 12h 45m</td>
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<tr>
<th><strong>Topic 8: Other transformation techniques used in plastic processing</strong></th>
<th><strong>Learning time:</strong> 18h</th>
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<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>Description: Description of the process of thermoforming and rotational molding. Advanced processing techniques: bicomponent injection, coinjection, gas assisted injection and water injection. Foaming and micro-foaming processes.</td>
<td>Theory classes: 3h 30m</td>
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<tr>
<td><strong>Related activities:</strong></td>
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<tr>
<td>Practices for obtaining foams and characterizing them in the facilities of the Center Català del Plàstic (Terrassa).</td>
<td>Laboratory classes: 1h 45m</td>
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<td>Self study : 12h 45m</td>
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## Qualification system

Final marks from formative evaluations:
- Non-presencial and presencial activities (EV1) = 30%
- Reports on laboratory practices (EV2) = 20%
- Final exam (EV3) = 50%

Final marks (Nf): 0.3 EV1 + 0.2 EV2 + 0.5 EV3

## Regulations for carrying out activities

Evaluation on activities, reports and final exam
**Bibliography**

**Basic:**


**Complementary:**


**Others resources:**

Material to follow the theoretical and experimental classes will be available in Atenea digital platform.