Introduction to the knowledge of basic concepts of polymers and eventually of biotechnology, by laboratory experimentation and instrumental analysis.

Learning objectives of the subject

Introduction to the knowledge of basic concepts of polymers and eventually of biotechnology, by laboratory experimentation and instrumental analysis.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 112h</th>
<th>Hours medium group:</th>
<th>27h</th>
<th>24.11%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours small group:</td>
<td>13h</td>
<td>11.61%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>72h</td>
<td>64.29%</td>
</tr>
</tbody>
</table>

Prior skills

Bachelor of Science or Engineering with knowledge of chemistry

Requirements

Preferably have enrolled in subjects related with the specialization in chemistry (MUEI)

Teaching methodology

1) Theoretical classes will be taught about the introduction to the different practical classes.
2) Laboratory practices about synthesis and characterization of polymers and biopolymers will be carried out.
3) If student group is large (> 10 students) a visit to a company in the polymers industry sector will be performed.
4) Self study: Implementation and reporting laboratory practices.
## Content

<table>
<thead>
<tr>
<th>Description</th>
<th>Learning time: 3h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymerization reactions. Molecular weights. Viscometry. GPC.</td>
<td>Laboratory classes: 3h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Learning time: 3h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal properties of polymers. Differential scanning calorimetry (DSC). Thermogravimetry (TGA). Mechanical properties.</td>
<td>Laboratory classes: 3h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Learning time: 3h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synthesis of a polyamide by interfacial polycondensation and bulk polymerization.</td>
<td>Laboratory classes: 3h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Learning time: 3h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synthesis of a polyester by polycondensation reaction in bulk</td>
<td>Laboratory classes: 3h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Learning time: 3h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verification of the effect of several plasticizers on virgin and commercial PVC.</td>
<td>Laboratory classes: 3h</td>
</tr>
</tbody>
</table>
### Polymer characterization 1. FTIR.

**Description:**
Introduction to FTIR. Polymer applications. Practice session with commercial polymers

**Learning time:** 3h  
Theory classes: 1h  
Laboratory classes: 2h

### Polymer characterization 2. NMR. Session 1.

**Description:**
Introduction to Nuclear Magnetic Resonance. Polymer applications. Practical sessions in a 300 MHz NMR equipment.

**Learning time:** 3h  
Theory classes: 1h 30m  
Laboratory classes: 1h 30m

### Characterization of polymers 2. NMR. Session 2.

**Description:**
Characterization of polymers by NMR. Session 2. Simulation.

**Learning time:** 3h  
Laboratory classes: 3h

### Determination of thermal properties. DSC and TGA.

**Description:**
Thermal analysis of commercial polymers by differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA).

**Learning time:** 3h  
Laboratory classes: 3h

### Molecular weight determination. Viscometry and GPC.

**Description:**
Determination of the number, weight and viscosimetric average molecular weights by viscometry and GPC.

**Learning time:** 3h  
Laboratory classes: 3h
## Qualification system

1) Evaluation of practices and practical reports (NP)
2) Final exam (EF)

Final note: 0.6 NP + 0.4 EF

<table>
<thead>
<tr>
<th>Activity</th>
<th>Learning time:</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determination of mechanical properties.</td>
<td>3h</td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td><strong>Description:</strong> Determination of mechanical properties of polymers by stress-strain tests.</td>
<td></td>
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</tr>
<tr>
<td>Biotechnology 1. Immobilized enzymes.</td>
<td>3h</td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td><strong>Description:</strong> Practice of biotechnology with immobilized enzymes in polymer supports.</td>
<td></td>
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</tr>
<tr>
<td>Biotechnology 2. Structure of proteins.</td>
<td>3h</td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td><strong>Description:</strong> Determination of protein structure by molecular simulation programs.</td>
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</tr>
<tr>
<td>Visiting a company.</td>
<td>4h</td>
<td>Theory classes: 1h</td>
</tr>
<tr>
<td><strong>Description:</strong> Visit a company of polymers</td>
<td></td>
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</tr>
<tr>
<td>Final exam</td>
<td>2h</td>
<td>Self study: 2h</td>
</tr>
<tr>
<td><strong>Description:</strong> Final exam of the subject</td>
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</tbody>
</table>
Bibliography

Basic:


Others resources:

Synthesis laboratory fully equipped. Instrumentation: DSC (Perkin Elmer), TGA (Mettler), NMR (Bruker), GPC (Waters), Universal Testing Machine (Zwick).