295565 - 295EQ221 - Experimentation and Instrumentation

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2019). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: Elaine Armelin Diggroc
Others: Lourdes Franco García
Jordi Puiggalí Bellalta
Núria Saperas Plana
Irene López Pena

Opening hours

Timetable: It will be specified at the beginning of classes

Prior skills

It is a practical course, most of the classes are conducted in the chemical laboratory. Therefore, laboratory experience would be desirable.
The students should have general knowledge of chemical and physicochemical characterization of polymers. It is interesting to have studied topics related to polymers such as those taught in the following subjects: Polymers and Biopolymers, Polymer Physics and Chemistry of Polymerization.

Requirements

Mandatory aspects: The students must bring their own individual protection equipment (known as IPE) to work at chemical laboratory. Those are mainly: protection glasses, laboratory coat, protective mask against toxic gases. Protection gloves will be supplied in the laboratory. At web UPC shop, the students can order the most relevant IPE material: http://www.upc-shop.com/epages/1220514.sf/ca_ES/?ObjectPath=/Shops/1220514/Categories/Proteccio_individual_laboratoris

Degree competences to which the subject contributes

Generical:
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
CGMUEQ-04. To carry out the appropriate research, undertake the design and manage the development of engineering solutions, in new or little known environments, relating creativity, originality, innovation and technology transfer
CGMUEQ-06. Have the capacity to analyze and synthesize the continuous progress of products, processes, systems and services using safety, economic viability, quality and environmental management criteria

Transversal:
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
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.

**Teaching methodology**

Laboratory in polymer synthesis with a brief introduction at the beginning of the semester to explain the main polymerizations to be carried out during the course. Theory and practice are combined in the laboratory. Experiments are performed in small groups. Visits to private companies in the plastic sector (depending on company availability).

**Learning objectives of the subject**

.

**Study load**

<table>
<thead>
<tr>
<th>Study load</th>
<th>Total learning time: 150h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group:</td>
<td>2h</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>40h</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>6h</td>
</tr>
<tr>
<td>Self study:</td>
<td>102h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study load</th>
<th>Total learning time: 150h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group:</td>
<td>2h</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>40h</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>6h</td>
</tr>
<tr>
<td>Self study:</td>
<td>102h</td>
</tr>
</tbody>
</table>

| Hours large group:         | 2h                        |
| Hours small group:         | 40h                       |
| Guided activities:         | 6h                        |
| Self study:                | 102h                      |

<table>
<thead>
<tr>
<th>Percentage</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.33%</td>
<td>26.67%</td>
</tr>
<tr>
<td>4.00%</td>
<td>68.00%</td>
</tr>
</tbody>
</table>
### Topic 1. Syntheses of thermoplastic polymers, commodities (like polystyrene) and engineering (likenylons and polyurethanes)

**Learning time:** 22h 45m  
Theory classes: 2h  
Laboratory classes: 8h  
Self study: 12h 45m

**Description:**  
In this laboratory practice, the synthesis of polystyrene will be carried out by suspension polymerization, the synthesis of nylon 6.10 by interfacial polymerization and the synthesis of a thermoplastic polyurethane (TPU) by condensation polymerization. We will also work on polymer purification and plastics processing techniques.

### Topic 2. Synthesis of thermoset polymers

**Learning time:** 16h 45m  
Theory classes: 0h  
Laboratory classes: 4h  
Self study: 12h 45m

**Description:**  
Two types of thermosets will be prepared: a two component epoxy and a polyester resin. Their adhesive properties, after thermal curing treatments, will be evaluated.

### Topic 3. Preparation of elastomers

**Learning time:** 16h 45m  
Theory classes: 0h  
Laboratory classes: 4h  
Self study: 12h 45m

**Description:**  
The polymerization of the natural rubber is usually carried out in two steps, a pre-vulcanization stage and the complete vulcanization stage, the latter being the main one. In this practice, vulcanized rubber specimens will be fabricated and their degree of crosslinking will be determined using ASTM standards.

### Topic 4. Preparation of glass fiber reinforced plastics: composites

**Learning time:** 16h 45m  
Theory classes: 0h  
Laboratory classes: 4h  
Self study: 12h 45m

**Description:**  
A commercial polyester resin, with an initiator (peroxide), will be used to obtain a rigid polymer with incorporated glass fiber. Glass-reinforced plastic (GRP), also known as Glass-Fiber Reinforced Plastic (GRP), is a composite material with better mechanical properties than the pure homopolymer.
**Topic 5. Characterization of polymer structure with infrared spectroscopy and nuclear magnetic resonance**

**Description:**
In this practice we will work with the chemical identification of polymers using spectroscopic techniques: FTIR and NMR. The student will learn how to use an infrared spectrophotometer and how to process the graphs in order to analyze the main absorption bands of a given polymer. In the part of RMN, they will know the equipment and how to process and interpret the chemical shifts with the help of a computer program and standard tables, which contain the relation of the different organic functional groups and their theoretical displacements.

**Learning time:** 20h 45m
- Theory classes: 0h
- Laboratory classes: 8h
- Self study: 12h 45m

**Topic 6. Preparation of alginate-based hydrogel polymers: application as a biocatalyst**

**Description:**
In this practice the student will work with another class of polymers, the polysaccharides. The aim is to carry out the hydrolysis reaction of an alginate gel and to evaluate the D-glucose content obtained after the hydrolysis by spectroscopic methods (UV-visible). On the other hand, it is noteworthy that in this practice the student will come into contact with the preparation of a type of biohydrogel and the immobilization of enzymes.

**Learning time:** 16h 45m
- Theory classes: 0h
- Laboratory classes: 4h
- Self study: 12h 45m

**Topic 7. Determination of the presence of enzymes in a commercial detergent**

**Description:**
Detergents have, in addition to surfactants and bleaches, polycarboxylates and enzymes. Enzymes accelerate certain chemical reactions by acting as a biochemical catalyst. In this practice the student will evaluate the proteolytic activity of enzymes in a commercial detergent using the electrophoresis technique. Therefore, in this subject the student will have the opportunity to work with SYNTHETIC POLYMERS, NATURAL POLYMERS and BIOPOLYMERS.
### Topic 8 - Evaluation of mechanical properties of thermoplastic polymers

<table>
<thead>
<tr>
<th>Learning time: 16h 45m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 0h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Self study: 12h 45m</td>
</tr>
</tbody>
</table>

### Description:

The students will be able to manipulate and familiarize with the stress-strength machine and will know how calculate the Young's modulus, the maximum strength, the elongation at break, etc.

### Qualification system

Final mark = $0.10 \times E_{Pre} + 0.45 \times AP + 0.45 \times EF$

- $E_{Pre}$: Individual score for the preparation of the practices before laboratory.
- $AP$: Report of results obtained on the experimental work (one per group).
- $EF$: Final exam (individual)

In this subject there is not any other exam that replaces the latest ones (called "examen de revaluació").

### Regulations for carrying out activities

Practice reports drawn up by teams of three-four students, depending on the number of students enrolled. The written exam (final exam) will be held individually at the end of the semester. There are no partial exams in this course.

It has a minimum of 70% attendance at the practical classes, in order to be able to collect the qualification of practical reports.
295565 - 295EQ221 - Experimentation and Instrumentation

Bibliography

**Basic:**


**Complementary:**


**Others resources:**

Internship dossier available at photocopying service EEBE

Model for the writing of the experimental report