240656 - Industrial Chemistry

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering
Academic year: 2017
Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits: 4,5  Teaching languages: Catalan

Teaching staff
Coordinator: Rosa Maria Darbra Roman
Others: Oriol Gibert

Opening hours
Timetable: To be agreed with the professor

Degree competences to which the subject contributes

Specific:
1. Capacity to understand and apply basic knowledge principles of general chemistry, organic and inorganic chemistry and their engineering applications.
2. Basic knowledge of industrial production systems.

Transversal:
3. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
4. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
5. 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.
6. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

Teaching methodology
Lectures
Practical classes
Seminars from invited speakers
Independent learning
Learning through projects, problems and case-studies (team project)

Learning objectives of the subject
The objective of this subject is to provide an overview of the chemical industry and also about its diversity of products. The main chemical processes are studied, including all the transformations from the raw materials to the final product. Special emphasis is made on the safety and environmental aspects related to these processes.
The specific objectives of this subject are:

1- Make the student aware of the diversity of products and industries related with the industrial chemistry.
2- Identify the raw materials and intermediate products used in the chemical production at large scale.
3- Understand the different physico-chemical processes that allow the transformation of these raw materials to a final product.
4- Describe relevant processes for the chemical industry.
5- Assess the safety and environmental aspects related to the chemical processes.
6- Value the importance of maintenance and other related services for the proper functioning of the chemical plants.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours medium group:</th>
<th>45h</th>
<th>40.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time: 112h 30m</td>
<td>Self study:</td>
<td>67h 30m</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
# Content

<table>
<thead>
<tr>
<th>Chapter 1. Introduction to Industrial Chemistry</th>
<th>Learning time: 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Self study : 4h</td>
</tr>
</tbody>
</table>

**Description:**
Chemical industry importance at Spanish level and at a global scale. Chemical process definition. Key aspects for its success. Environmental and safety aspects in the chemical industry.

**Related activities:**
- Lectures (4h)
- Practical exercises
- 1 home assigment
- 1 paper to read at home about the chemical engineer studies

**Specific objectives:**
Objectives 1 and 5.

<table>
<thead>
<tr>
<th>Chapter 2. Raw materials used by the chemical industry</th>
<th>Learning time: 18h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Self study : 10h</td>
</tr>
</tbody>
</table>

**Description:**
Main natural sources of raw materials for the chemical industry: litosphere, hydrosphere, atmosphere and biosphere.

**Related activities:**
- Lectures (4h)
- Practical exercises
- Practical classes on the waste water treatment (4h)
- Self study for the test on the waste water treatment

**Specific objectives:**
Objectives 2 and 5.
<table>
<thead>
<tr>
<th>Chapter 3. Petroleum industry</th>
<th>Learning time: 17h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 9h</td>
</tr>
<tr>
<td></td>
<td>Self study: 8h</td>
</tr>
</tbody>
</table>

**Description:**
Petroleum industry at global scale. Refining industry: Refining processes I (distillation and cracking) and Refining processes II (reforming and purification). Final products.

**Related activities:**
- Lectures (7h)
- Practical exercises
- 1 home assignment
- 2 papers to read at home
- Starting the team project preparation
- Seminar from an invited speaker (2h)

**Specific objectives:**
Objectives 3, 4 and 5.

<table>
<thead>
<tr>
<th>Chapter 4. Petrochemical industry</th>
<th>Learning time: 15h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 5h</td>
</tr>
<tr>
<td></td>
<td>Self study: 10h</td>
</tr>
</tbody>
</table>

**Description:**
Petrochemical industry introduction. Detailed explanation of the derivates from: ethane, ethylene, propylene and benzene among others. Uses and applications.

**Related activities:**
- Lectures (3h)
- Practical exercises
- 2 papers to read at home
- 1 chemical plant visit (2h)
- Self study for the mid-term exam

**Specific objectives:**
Objectives 2, 3 and 4.
| Chapter 5. Plastics industry | Learning time: 13h  
Theory classes: 5h  
Self study: 8h |
|----------------------------|-------------------|
| Related activities: | Lectures (3h)  
Practical exercises  
1 home assignment  
1 chemical plant visit (2h)  
Team project development |
| Specific objectives: | Objectives 3, 4, and 5. |

| Chapter 6. Detergents industry | Learning time: 13h  
Theory classes: 5h  
Self study: 8h |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Detergents industry introduction. Environmental aspects. Main characteristics and functioning. Soap and synthetic detergents production. Formulations.</td>
</tr>
</tbody>
</table>
| Related activities: | Lectures (3h)  
Practical exercises  
1 home assignment  
1 chemical plant visit (2h)  
Team project development |
| Specific objectives: | Objectives 2, 3, 4 and 5. |
### Chapter 7. Chlor-Alkali industry

**Description:**

**Related activities:**
- Lectures (3h)
- Practical exercises
- 1 paper to read at home
- Seminar from an invited speaker (2h)

**Specific objectives:**
Objectives 2, 3 and 4.

**Learning time:** 13h
- Theory classes: 5h
- Self study: 8h

### Chapter 8. Fertilizers industry

**Description:**
Fertilizers introduction. Sulphuric acid, Phosphoric acid and Nitric acid production. Environmental and safety aspects.

**Related activities:**
- Lectures (3h)
- Practical exercise
- 1 chemical plant visit (2h)
- Team project development

**Specific objectives:**
Objectives 3, 4 and 5.

**Learning time:** 13h
- Theory classes: 5h
- Self study: 8h
### Chapter 9. Cement industry

**Learning time:** 15h  
- Theory classes: 3h  
- Self study: 12h

**Description:**  

**Related activities:**  
- Lectures (3h)  
- Practical exercises at class  
- 1 paper to read at home  
- Final redaction of the team project report

**Specific objectives:**  
Objectives 2, 3, 4 and 5.

### Chapter 10. Paper industry

**Learning time:** 17h  
- Theory classes: 7h  
- Self study: 10h

**Description:**  

**Related activities:**  
- Lectures (3h)  
- 1 home assignment  
- Preparation of the team project presentations  
- Team project presentations at class (4h)  
- Self study

**Specific objectives:**  
Objectives 2, 3, 4 and 5
## Chapter 11. Maintenance and other auxiliary services

**Learning time:** 8h  
Theory classes: 4h  
Self study: 4h

### Description:
Maintenance importance for the chemical industry. Maintenance types and function. Introduction to other practical aspects of the industry (e.g. subcontracting, communication, management).

### Related activities:
- Lectures (4h)
- Practical exercise
- Self study

### Specific objectives:
Objective 6
## Planning of activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LECTURES</strong></td>
<td>92h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>Explain the contents of this subject.</td>
<td></td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td></td>
</tr>
<tr>
<td>Slides, exercises and papers. All the material is available on-line (atenea).</td>
<td></td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td></td>
</tr>
<tr>
<td>Home assignments. Mid-term exam and Final exam.</td>
<td></td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>To comply with those set in this subject.</td>
<td></td>
</tr>
<tr>
<td><strong>VISITS</strong></td>
<td>14h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>The visits to chemical plants will allow the students to have a first-hand view of the chemical processes at a large scale.</td>
<td></td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td></td>
</tr>
<tr>
<td>The one provided by the company.</td>
<td></td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>Objectives from 1 to 6.</td>
<td></td>
</tr>
<tr>
<td><strong>PRACTICAL CLASSES</strong></td>
<td>10h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>The practical classes about waste water treatment are very interesting, since the chemical industry produces great amounts of waste water in its processes.</td>
<td></td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td></td>
</tr>
<tr>
<td>Slides on-line (atenea)</td>
<td></td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td></td>
</tr>
<tr>
<td>Final test</td>
<td></td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>Objective 5</td>
<td></td>
</tr>
<tr>
<td><strong>TEAM PROJECT</strong></td>
<td>34h</td>
</tr>
<tr>
<td><strong>Hours:</strong></td>
<td>34h</td>
</tr>
<tr>
<td>Theory classes:</td>
<td>4h</td>
</tr>
<tr>
<td>Self study:</td>
<td>30h</td>
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</tbody>
</table>
Description:
The students will focus on a different chemical product used in the everyday life. The students will learn its production process from the raw material to the final product. They will explain this to the rest of the class.

Support materials:
Bibliographic research, chemical plant visits, professors inquiries, etc.

Descriptions of the assignments due and their relation to the assessment:
Final report and presentation delivery at the end of the term.

Specific objectives:
The students will face a new challenge: the production of a product that is unknown. They will have to find the way to understand and explain this process to the rest of the class.

Qualification system
First-term exam: 42.5% of the final qualification
Second-term exam: 42.5% of the final qualification
Team project: 10% of the final qualification
Practical classes: 5% of the final qualification

Regulations for carrying out activities
- Each exam is independent. The first-one assesses the topics explained up to mid-term and the final exam, the rest of topics until the end of the course.

- The second term exam will be done the day of the final exam.

- The reevaluation exam will only substitute the qualifications obtained in the mid-term and second-term exams. The final work and the practical classes are not reevaluated. The student have to do at least one evaluation event to obtain a final qualification.

- The visits to chemical plants are not compulsory, but they are another class. Therefore, their content can be asked in the exams.
# Bibliography

## Basic:


## Complementary: