Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering
Academic year: 2018
Degree: MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2012). (Teaching unit Compulsory)
MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2012). (Teaching unit Compulsory)
ECTS credits: 6  Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: JOSE LUIS CORTINA PALLAS

Requirements
In order to carry out this course is necessary that the students have passed the course Transport Phenomena

Degree competences to which the subject contributes

Generical:
1. Possess independent learning skills to maintain and enhance the competencies of chemical engineering to enable the continued development of their profession.

Transversal:
2. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Teaching methodology
MD.2. Master lesson
M.D.3. Autonomous learning
M.D.4. Cooperative learning
M.D.5. Learning based on projects, problems and cases

Learning objectives of the subject
By the end of the course the student will have to be able to:
1. Apply the scientific method in the resolution of advanced separation processes in the field of chemical engineering
2. Understanding of the theory concepts of the equipment, applications and the effects which the advanced separation processes produce on the quality of the products and its environmental impact.
3. Be able to evaluate current problems, applying the scientific method to solve practical problems
4. Propose and select the mathematical models describing the results, which allow to predict and simulate them
5. Ability to analyse in a critical way some of the current problems which have not yet been resolved in the field of chemical Engineering
### Study load

<table>
<thead>
<tr>
<th></th>
<th>Hours large group:</th>
<th>54h</th>
<th>36.00%</th>
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<tbody>
<tr>
<td>Total learning time:</td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
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<td>Hours small group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>96h</td>
<td>64.00%</td>
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### Content

| 1. Process of membranes separation | Learning time: 25h  
Theory classes: 10h  
Practical classes: 4h  
Self study: 11h |
|------------------------------------|-----------------------------------|
| **Description:**   
Transport mechanism. Parameter process. Classification of separation processes with membranes. Facts which limit the permeate flow: polarization of the concentration, contamination. Applications: inverse osmosis, ultrafiltration, pervaporation, electrodialysis  
**Related activities:**   
Resolution of problems  
**Specific objectives:**   
Learn the basis of the operations with membranes, as well as the calculation methods and the design of the corresponding equipment |

| 2. Extraction of solid-solid | Learning time: 17h  
Theory classes: 4h  
Practical classes: 3h  
Self study: 10h |
|-----------------------------|-----------------------------------|
| **Description:**   
Definition. Applications in the industry. Stages of the process. Extraction speed and characteristics of the solvent.  
Facts which affect the speed extraction. Ways of operating. Calculation of solid-liquid extraction. Equipment  
**Related activities:**   
Resolution of problems  
**Specific objectives:**   
Learn the basis of the operation, as well as the calculation methods and the design of the corresponding equipment |
### 3. Extraction liquid-solid

<table>
<thead>
<tr>
<th>Learning time: 17h</th>
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<tbody>
<tr>
<td>Theory classes: 5h</td>
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<tr>
<td>Practical classes: 3h</td>
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<tr>
<td>Self study: 9h</td>
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</tbody>
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**Description:**

**Related activities:**
Resolution of problems

**Specific objectives:**
Learn the basis of the operation, as well as the methods of calculation and the design of the corresponding equipment.

### 4. Extraction of supercritical fluids

<table>
<thead>
<tr>
<th>Learning time: 14h 10m</th>
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<tbody>
<tr>
<td>Theory classes: 4h</td>
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<tr>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td>Self study: 8h 10m</td>
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</tbody>
</table>

**Description:**

**Related activities:**
Resolution of problems

**Specific objectives:**
Learn the basis of the operation, as well as the methods of calculation and the design of the corresponding equipment.
## 5. Adsorption


**Related activities:**
Resolution of problems

**Specific objectives:**
Learn the basis of the adsorption operation, as well as the calculation methods and the design of the corresponding equipment

**Learning time:** 14h 10m
- Theory classes: 4h
- Practical classes: 2h
- Self study: 8h 10m

## 6. Ionic exchange

**Basis:** analogies and differences between the adsorption processes. Applications in the industry. Ion exchange resins: capacity of the resin. Balance between phases. Calculation in extractions of ion exchange by stages and differentials. Equipment

**Related activities:**
Resolution of problems

**Specific objectives:**
Learn the basis of the ion exchange, as well as the calculation methods and the design of the corresponding equipment

**Learning time:** 10h
- Theory classes: 4h
- Practical classes: 2h
- Self study: 4h
### Crystallization

**Learning time:** 9h  
- Theory classes: 2h  
- Practical classes: 2h  
- Self study: 5h  

**Description:**  
Equipment

**Related activities:**  
Resolution of the problems

**Specific objectives:**  
Learn the basis of the crystallisation operation, as well as the calculation methods and the design of the corresponding equipment.

### Hybrid Processes

**Learning time:** 50h  
- Theory classes: 7h  
- Practical classes: 0h  
- Self study: 43h  

**Description:**  
Definition of the hybrid process. Ways of operation. Hybrid process with membranes: reactors with membranes, distillation with pervaporation and other applications. Hybrid processes with modified absorbers. Other hybrid processes. Study of the viability of the process

**Related activities:**  
Two monitoring sessions during the semester

**Specific objectives:**  
Planning of the project. Resolution of the doubts with the professors

### Qualification system

IE 1. Written exam 50%  
IE 3. Questions, tests, problems, small reports 15%  
IE 4. Formal reports 25%  
IE 5. Oral expositions 10%
240EQ022 - Advanced Separation Operations

Bibliography

Basic:


Complementary:
