240EQ021 - Catalysis and Advanced Reactor Design

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering
Academic year: 2017
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: 4,5
Teaching languages: Spanish

Teaching staff
Coordinator: JORGE BOU SERRA
Others: FRANCISCO-JAVIER RECASENS BAXARIAS
         - JORDI LLORCA PIQUE

Opening hours
Timetable: Please see attendant hours on department board

Prior skills
Basic knowledge of chemical engineering, chemical reactors and calculus

Requirements
Have completed courses related to previous cited capacities

Degree competences to which the subject contributes

Specific:
1. Adapting to structural changes in society motivated by phenomena such factors or economic, energy or natural to solve the problems and to provide technological solutions with a high commitment to sustainability.
2. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.
3. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.
4. Direct and supervise all types of facilities, processes, systems and services in different industrial areas related to chemical engineering.
5. Design, build and implement methods, processes and equipment for the supply and management of waste solids, liquids and gases in industries, capable of assessing their impacts and risks.
6. Designing products, processes, systems and services for the chemical industry as well as the optimization of other already developed technology based on various areas of chemical engineering, understanding of processes and transport phenomena, separation operations and engineering chemical reactions, nuclear, electrochemical and biochemical.
7. Manage the Research, Development and Technological Innovation, based on the transfer of technology and property rights and patents.
8. Ability to solve problems that are unfamiliar, incompletely defined, and have competing specifications, considering the possible methods of solution, including the most innovative, selecting the most appropriate, and to correct implementation, evaluating the different solutions Design.

Generic:
9. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve
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complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.

10. Communicate and discuss proposals and conclusions in forums multilingual, skilled and unskilled, in a clear and unambiguous.

11. Conceive, design, calculate, and design processes, equipment, manufacturing and service facilities in the field of chemical engineering and related industrial sectors in terms of quality, safety, economy, rational and efficient use of natural resources and conservation environment.

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

13. Conduct proper research, undertake design and lead the development of engineering solutions in new or unfamiliar environments, linking creativity, originality, innovation and technology transfer.

14. Know how to establish and develop mathematical models using appropriate informatics, scientific and technological basis for the design of new products, processes, systems and services, and for other already developed optimization.

15. Ability to analyze and synthesize to the continued progress of products, processes, systems and services using criteria of safety, affordability, quality and environmental management.

Teaching methodology

MD.2: Teacher's lecture
MD.3 Scheduled independent learning
MD.5: Project-based learning, problems and cases discussion

Learning objectives of the subject

i) To develop technical criteria to define a reactor system of an industrial process from chemical data, biological, catalysis, mass and heat transfer and flow of matter and energy.

ii) To provide training to analyze scientifically and technologically any kind of chemical or biological reactor and to express the basis for its optimization and/or modification.

iii) To identify the problems and shortcomings of chemical facilities based on reactors and being able to offer engineering solutions.

iv) To get scientific spirit to investigate new developments in the field of reactors.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 112h 30m</th>
<th>Hours large group: 27h 24.00%</th>
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<tbody>
<tr>
<td>Hours medium group: 0h 0.00%</td>
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<tr>
<td>Hours small group: 13h 30m 12.00%</td>
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</tr>
<tr>
<td>Guided activities: 0h 0.00%</td>
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<tr>
<td>Self study: 72h 64.00%</td>
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## Catalysis

**Learning time:** 25h 30m  
- Theory classes: 5h  
- Practical classes: 4h  
- Laboratory classes: 2h  
- Self study: 14h 30m

**Description:**  

**Related activities:**  
Nº 1: Design of heterogeneous catalysts

**Specific objectives:**  
To get scientific bases from catalysis

## Catalytic reactors

**Learning time:** 18h  
- Theory classes: 3h  
- Practical classes: 3h  
- Self study: 12h

**Description:**  

**Related activities:**  
Nº 1: Design of heterogeneous catalysts

**Specific objectives:**  
To get knowledge of chemical reactors which work containing solid catalysts and to be able to design them
## Multiphase reactors

**Learning time:** 33h  
- Theory classes: 7h  
- Practical classes: 4h  
- Laboratory classes: 2h  
- Self study: 20h

**Description:**  

**Related activities:**  
Nº 2: Reactors analyses

**Specific objectives:**  
To get theoretical and numerical concepts of reactors working in several phases. Acquiring the ability to extrapolate the basis of mass transfer to other chemical engineering systems.

## Enzymatic reactors

**Learning time:** 21h  
- Theory classes: 3h  
- Practical classes: 3h  
- Laboratory classes: 2h  
- Self study: 13h

**Description:**  

**Related activities:**  
Nº 3: Analysis of productive system from enzymatic or fermentation processes

**Specific objectives:**  
To get basic and mathematic concepts of enzymatic bioreactors and their applications.
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**Fermenters**

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>15h</th>
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<tbody>
<tr>
<td>Theory classes:</td>
<td>4h</td>
</tr>
<tr>
<td>Practical classes:</td>
<td>3h</td>
</tr>
<tr>
<td>Self study:</td>
<td>8h</td>
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**Description:**
- Fermentation Bioreactors: Discontinued stirred tank. Continuous reactors, washing process and dilution rate. Immobilized cell systems. Transfer O2 (OUR) and agitation. Air-lift reactors and bubble size. Scaling

**Related activities:**
- No 3: Analysis of productive system from enzymatic or fermentation processes

**Specific objectives:**
- To get theoretical and practical knowledge of fermentations and their applications

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**Qualification system**

IE.1: Written examination, midterm (NEP), final (NEF) and re-evaluation (NER)

IE.4: Reports (NAC)

Final cumulative grade: \( NF = 0.2 \times \text{NEP} + 0.5 \times \text{NEF} + 0.3 \times \text{NAC} \) or

\[ NF = 0.2 \times \text{NEP} + 0.5 \times \text{NER} + 0.3 \times \text{NAC} \]

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**Regulations for carrying out activities**

- Individually written exam by hand
- Duration: depending on time availability
- Documentation, as books or notes, can be brought. Calculator (accepted by teacher) can be used
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Bibliography

Basic:


Complementary:


Others resources:

Teacher notes, problems collection and documents attached at digital campus.