Course guide
320070 - EPQB - Chemical and Biotechnological Process Engineering

Last modified: 19/04/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Fernando Carrillo Navarrete

Others:

PRIOR SKILLS

It is recommended that students have passed the objectives of the courses:
Unit Operations, Chemical Reaction Engineering and Chemical Process Control.
It is also recommended that students have previously achieved a level of basic knowledge in chemical process simulation, similar to the course of Chemical Process Control.
It is also important that the student has achieved the objectives of the second level of transversal competences: independent learning, effective oral and written communication and teamwork.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
5. CHE: Knowledge of material and energy balances, biotechnology, the transfer of materials, separation operations, chemical reaction engineering, the design of reactors, and the reuse and transformation of raw materials and energy resources.

4. CHE: ability to analyse, design, simulate and optimise processes and products.

TEACHING METHODOLOGY

Communication with students for the dissemination of information is carried out through the Virtual Campus of the UPC, which is currently at the service of professors and students.

Didactic material is provided to the student (digital presentations, list of activities, instructions and delivery preparation templates) to facilitate their follow-up.

The subject has been planned so that the student works autonomously third level transversal skills: autonomous learning, effective oral and written communication and teamwork.

In order for the student to achieve the objectives and the programmed competences, the subject is structured in three types of sessions:

- Theoretical sessions (30 h): the professor explains the theoretical basis of the material, concepts, and methods and illustrates them with examples to facilitate understanding.

-Application Sessions (15h): The professor will guide students in applying theoretical concepts to solve chemical process engineering problems.

- Cooperative learning based on a Plant Design Project: Analysis, Sinthesis and preliminary design of a chemical process, prioritizing teamwork.
Work will be performed in cooperation with other teams to get a proper process design. The assessment of the design project is made through the delivery of written and oral individual and team activities.

- Homework (90): The students have to dedicate time to develop the course activities programmed.

- Exams (6h): 2 exams have been planned.

The students will receive feedback assessments of their learning progress from teacher in order that, if necessary, the student can reorient their work.

LEARNING OBJECTIVES OF THE SUBJECT

Applying chemical engineering principles to the analysis and design of chemical processes and industrial biotechnology that aims the processing of raw materials and energy resources in desired products.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours medium group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Topic 1. The design and engineering processes

Description:
1.1 Introduction
1.2 Nature Design
1.3 The design process .
1.4 Engineering Project
- Organization of a chemical engineering project
- Design Bases
- Codes and Standards
- Design Factors
- Project Documentation
1.5 Ethical Considerations
1.6 Activities

Full-or-part-time: 4h
Practical classes: 2h
Self study : 2h

Topic 2. Preliminary Synthesis of Chemical Processes

Description:
2.1 Introduction
2.2 Process Creation
- Design and process definition
- Evaluation and selection of alternatives
- Preliminary Synthesis : tree alternatives.
2.3 Heuristics for Process Synthesis
2.4 Activities

Full-or-part-time: 12h
Practical classes: 6h
Self study : 6h

Topic 3. Flowcharts and process integration

Description:
3.1 Flowchart overview.
3.2 Integration of basic operations.
3.3 Integration of processes: heat exchange networks.
3.4 The P & I diagram

Full-or-part-time: 24h
Practical classes: 12h
Self study : 12h

Topic 4. Health, Safety and Environment

Description:
4.1 Introduction
- Safety Legislation
- The layered pyramid plant safety
4.2 Dangers of hazardous materials and proces
4.3. HAZOP
- Examples of accidents ¿
4.3 Security analysis
- Safety Indices
- Hazard and operability studies
4.4 Environmental Considerations

Full-or-part-time: 12h
Practical classes: 6h
Self study : 6h

Topic 5. Economic Analysis

Description:
5.1 Estimated capital investment
5.2 Estimated manufacturing cost
5.3 Profitability Analysis
5.4 Economic optimization

Full-or-part-time: 8h
Practical classes: 4h
Self study : 4h

Tema 7. Examples of relevant industrial processes

Description:
7.1. Petrochemical Processes.
7.2. Production of base chemicals.
7.3. Production of bulk chemicals.
7.4. Polimerization processes.
7.5. Biotechnological processes.

Full-or-part-time: 90h
Theory classes: 30h
Self study : 30h
Self study : 30h

GRADING SYSTEM

- 1st Exam: 25%
- 2nd Exam: 25%
- Deliverables: 25%
- Design Project: 25%

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

BIBLIOGRAPHY

Basic:
- Richard Turton [et al.]. Analysis, synthesis, and design of chemical processes. 5th ed. Boston: Prentice Hall, 2018. ISBN 9780134177403.
- Moulijn, J. A.; Makkee, M.; Diepen, A. van. Chemical process technology [on line]. 2nd ed. Chichester: Wiley, 2013 [Consultation: 14/06/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=1163226. ISBN 9781444320251.
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Complementary:
- "Introducción al diseño de procesos químicos". Puigjaner Luis [et al.]. Estrategias de modelado, simulación y optimización de procesos químicos. Madrid: Síntesis, 2006. p. 16-26.
- Seider W.D.; Seader J.D.; Lewin D.R. Process design principles: synthesis, analysis and evaluation. New York: Wiley, 1999. ISBN 0471243124.
- Perry R. H.; Green D. W.; Maloney J. O. Manual del ingeniero químico [on line]. 4ª ed. Madrid: McGraw-Hill, 2001 [Consultation: 20/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6572. ISBN 8448130081.
- Peters M.; Timmerhaus K. Plant design and economics for chemical engineers. 5th ed. New York: McGraw-Hill, 2003. ISBN 9780071240444.
- Rase H. F.; Barrow M.H. Ingeniería de proyecto: para plantas de proceso. México: CECSA, 1973.
- Couper, James R. Chemical process equipment: selection and design. 3rd ed. Waltham, MA: Elsevier/Butterworths-Heinemann, 2012. ISBN 9780123969590.
- Woods, Donald R. Data for process design and engineering practice. Prentice Hall, 1995. ISBN 9780133181494.
- Ludwig, Ernest E. Applied process design for chemical and petrochemical plants. 3rd ed. Houston: Gulf Pub. Co., Book Division, 1995-2001.
- CRC: handbook of chemistry and physics. Cleveland, Ohio: CRC Press, 1977-.