Course guide
220210 - 220210 - Analysis and Design of Chemical Processes

Last modified: 19/04/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 717 - DEGD - Department of Engineering Graphics and Design.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Cusola Aumedes, Oriol
Roncero Vivero, Maria Blanca
Valls Vidal, Cristina

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Capacity for analysis and design of chemical processes.
2. Knowledge and skills to perform verification and control facilities, processes and products.

TEACHING METHODOLOGY

- Lectures presenting the subject content.
- Sessions of applied work.
- Independent learning and exercises solving by the students.

In lectures teachers introduce fundamentals of the subject, concepts and methods, illustrated with suitable examples to facilitate their understanding.

The practical sessions involve the following activities: experimental practices in laboratory and the use of a process simulator.

LEARNING OBJECTIVES OF THE SUBJECT

The purpose of this course is to provide an introduction to the analysis and design of chemical processes applied to industrial engineering. The fundamentals of the unit operations involved in the industrial sector are provided, allowing students to perform basic engineering and design of industrial processes.
The main goal is to provide students with:
- Knowledge and skills to analyze, plan and design chemical processes.
- Knowledge and skills to perform verification and control facilities of chemical processes.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	12.00
Hours large group	30,0	24.00
Self study	80,0	64.00

Total learning time: 125 h

CONTENTS

1. Introduction to processes and unit operations

Description:
Introduction. Fundamentals and classification of unit operations. Physical unit operations controlled by momentum transfer. Physical unit operations controlled by energy transfer. Physical unit operations controlled by mass transfer.

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

2. Coagulation and flocculation

Description:
Classification of solid particles in water. Colloidal structure. Fundamentals of colloidal destabilization. Chemicals used in the flocculation and coagulation. Flocculation technology. Application to water treatment and facilities design.

Related activities:
Laboratory work about coagulation wastewater: Destabilization by adsorption and charge neutralization. Zeta potential determination of colloidal particles. Destabilization by precipitation with metal coagulants; destabilization by adsorption and bridge formation between particles with different types of flocculants.

Full-or-part-time: 20h
Theory classes: 4h
Laboratory classes: 2h
Self study : 14h

3. Sedimentation

Description:
Sedimentation fundamentals. Gravity sedimentation. Sedimentation technology. Basic skills for facilities design: Application to water treatment.

Full-or-part-time: 12h
Theory classes: 4h
Self study : 8h

4. Flotation

Description:
Fundamentals and types of flotation. Global flotation. Dissolved air flotation. Froth flotation. Application to water treatments. Application of froth flotation to substances with different hydrophobicity (mining industry and paper industry). Calculation of facilities.

Related activities:
Laboratory work about selective flotation I: Application to deinking of printed paper by using a laboratory flotation cell.

Laboratory work about selective flotation II: Deinking process evaluation by optical spectrophotometric technique.

Full-or-part-time: 19h
Theory classes: 4h
Laboratory classes: 4h
Self study : 11h

5. Filtration and Membrane separation processes

Description:
Filtration fundamentals. Filtration technology. Applications to industrial processes. Gas filtration.

Fundamentals of membrane separation processes. Membrane types. Reverse Osmosis. Nanofiltration, Ultrafiltration. Microfiltration Applications to industrial processes.

Full-or-part-time: 15h
Theory classes: 4h
Self study : 11h

6. Simultaneous transmission of energy and matter

Description:
Fundamentals of simultaneous transmission of matter and energy: application to humidification, dehumidification and cooling. Cooling towers. Physical properties of moist air. Psychrometry. Determining characteristics of moist air. Mass and energy balances. Applications to industrial processes.

Full-or-part-time: 12h
Theory classes: 4h
Self study : 8h

7. Chemical Reactors

Description:
Chemical reaction. Reactor types. Fundamentals characteristics and application. Batch reactors. Stirring and mixing. Dynamic behavior of tanks and reactors. . Modeling and simulation. Application to chemical delignification of cellulosic material. Application to wastewater treatment.

Related activities:
Laboratory work about chemical reaction: Application to the delignification of cellulosic material.

Application in a CADSIM process simulator: Learning to use the simulator and case studies.

Full-or-part-time: 39h
Theory classes: 6h
Laboratory classes: 9h
Self study : 24h

GRADING SYSTEM

The final grade depends on the following evaluative acts:
- Activity 1 (Delivery of solved exercises and questionnaires): 5%
- Activity 2 (attendance to the practical sessions, delivery of the experimental practical reports, and one evaluative session of the knowledge acquired with the process simulator): 15%
- Activity 3 (midterm exam): 40%
- Activity 4 (final exam): 40%

Only the students assigned to a specific session will be able to attend that session. Students from other groups will not be able to attend. Students will be allowed to change group if they agree and exchange with a student from another group. In this case, the change must be notified via e-mail to the teachers before the practical session. Group exchanges will not be allowed on the same day of the laboratory session. The practical sessions will be held exclusively on the days established by the School without any possibility to do recover in another day.

The unsatisfactory result in the midterm exam (Activity 3) may be redirected by a written test on the day set for the final exam (Activity 4). Students who didn't assist at the midterm exam (Activity 3) or with a grade lower than 5.0 in the midterm exam (Activity 3) can access this test. The grade obtained in the redirected test will replace the initial grade as long as it is higher, until a maximum of 5.0.

BIBLIOGRAPHY

Basic:
- Professors de l'assignatura. Presentacions de classe a ATENEA.

Complementary:
- Baker, Richard W. Membrane Technology and Applications. 3rd ed. Chichester, West Sussex: John Wiley, 2012. ISBN 9780 470743720.
- Costa López, José [et al.]. Curso de química técnica: introducción a los procesos, las operaciones unitarias y los fenómenos de transporte en la ingeniería química. Barcelona: Reverté, 1984. ISBN 8429171266.
- McCabe, W.L.; Smith, J.C.; Harriott, P. Operaciones unitarias en ingeniería química. 7ª ed. Madrid: McGraw-Hill, 2007. ISBN 9789701061749.
- Tchobanoglous, George; Burton, Franklin L. Ingeniería de aguas residuales: tratamiento, vertido y reutilización. 3ª ed. Madrid: McGraw-Hill, 1995. ISBN 8448116070.
- Felder, Richard M; Rousseau, Ronald W. Principios elementales de los procesos químicos. 3ª ed. México: Limusa Wiley, 2003. ISBN 9681861698.
- Peinemann, K.V.; Nunes, Suzana Pereira. Membranes for water treatment. Weinheim: Wiley-VCH, cop. 2010. ISBN 9783527314836.
- Weber, Walter J. Control de la calidad del agua: procesos fisicoquímicos. Barcelona [etc.]: Reverté, cop. 1979. ISBN 8429175229.