Last update: 22-07-2019

220210 - Analysis and Design of Chemical Processes

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 717 - EGE - Department of Engineering Presentation
Academic year: 2019
Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Teaching unit Compulsory)
ECTS credits: 5 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Cusola Aumedes, Oriol
Roncero Vivero, Maria Blanca

Others: Galea Martinez, Silvia
CUSOLA AUMEDES, ORIOL
VALLS VIDAL, CRISTINA

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.

Last update: 22-07-2019

220210 - Analysis and Design of Chemical Processes

Study load

Total learning time: 125h	Hours large group:	30h	24.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	12.00%
	Guided activities:	0h	0.00%
	Self study:	80h	64.00%

Last update: 22-07-2019

220210 - Analysis and Design of Chemical Processes

Content

1. Introduction to processes and unit operations

Learning time: 8h

Theory classes: 4h
Self study : 4h

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.

2. Coagulation and flocculation

Learning time: 20h

Theory classes: 4h
Laboratory classes: 2h
Self study : 14h

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.

3. Sedimentation

Learning time: 12h

Theory classes: 4h
Self study : 8h

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

220210 - Analysis and Design of Chemical Processes

4. Flotation

Learning time: 19h

Theory classes: 4h
Laboratory classes: 4h
Self study : 11h

Description:
Fundamentals and types of flotation. Selective flotation. Selective flotation applied to substances with different hydrophobic behaviour. Non-selective flotation. Application to water treatment. Dissolved air flotation (DAF). Facilities design.

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.

5. Filtration and Membrane separation processes

Learning time: 15h

Theory classes: 4h
Self study : 11h

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.

6. Simultaneous transmission of energy and matter

Learning time: 12h

Theory classes: 4h
Self study : 8h

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.

Last update: 22-07-2019

220210 - Analysis and Design of Chemical Processes

7. Chemical Reactors	Learning time: 39h Theory classes: 6h Laboratory classes: 9h Self study : 24h

Description:
Chemical reaction. Reactor types. Fundamentals characteristics and application. Batch reactors. Plug flow reactor (PFR). Mixed reactors. Fluidized bed reactor. 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.

Qualification system

The final grade depends on the following evaluative acts:
- Activity 1 (attendance to the practical sessions, delivery of the experimental practical reports, and one evaluative session of the knowledge acquired with the process simulator): 30%
- Activity 2 (midterm exam): 35%
- Activity 3 (final exam): 35%

The practical sessions will be done exclusively on the days established by the School without any possibility to do them in another day.

The unsatisfactory result in the midterm exam (Activity 2) may be redirected by a written test on the day set for the final exam (Activity 3). Students who didn't assist at the midterm exam (Activity 2) or with a grade lower than 5.0 in the midterm exam (Activity 2) can access this test. The grade obtained in the redirected test will replace the initial grade as long as it is higher.

220210 - Analysis and Design of Chemical Processes

Bibliography

Basic:

Professors de l'assignatura. Presentacions de classe a ATENEA.

Complementary:

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McCabe, W.L.; Smith, J.C.; Harriott, P. Operaciones unitarias en ingeniería química. 7ª ed. Madrid: McGraw-Hill, 2007. ISBN 9789701061749.

Weber, Walter J. Control de la calidad del agua: procesos fisicoquímicos. Barcelona [etc.]: Reverté, cop. 1979. ISBN 8429175229.

Tchobanoglous, George; Burton, Franklin L. Ingeniería de aguas residuales: tratamiento, vertido y reutilización. 3ª ed. Madrid: McGraw-Hill, 1995. ISBN 8448116070.

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Baker, Richard W. Membrane Technology and Applications. 3rd ed. Chichester, West Sussex: John Wiley, 2012. ISBN 9780 470743720.