SUBJECT TEACHING GUIDE

G781 - Separation Processes

Degree in Chemical Engineering

Academic year 2019-2020

1. IDENTIFYING DATA					
Degree	Degree in Chemical Engineering			Type and Year	Compulsory. Year 3
Faculty	School of Industrial Engineering and Telecommunications				
Discipline	Subject Area: Balances, Biotechnology, Separation, Chemical Reaction Engineering, Reactor Design, Assessment and Transformation of Resources Module: Compusory Training Industrial Chemistry				
Course unit title and code	G781 - Separation Processes				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. INGENIERIAS QUIMICA Y BIOMOLECULAR
Name of lecturer	MANUEL ALVAREZ GUERRA
E-mail	manuel.alvarezg@unican.es
Office	E.T.S. de Ingenieros Industriales y de Telecomunicación. Planta: - 5. DESPACHO (S5005)
Other lecturers	MARIA FRESNEDO SAN ROMAN SAN EMETERIO

3.1 LEARNING OUTCOMES
- To know the main types of separation processes , to understand their fundamentals and to be able to choose the most suitable process according to the characteristics and properties of the mixture to be separated.
- To identify the main characteristics of the equipment used in different separation processes of interest in Chemical Engineering.
- To be able to use the appropriate sources of information to obtain the essential bibliographic information of physico-chemical properties of compounds and of phase equilibria for solving problems on separation processes.
- To be able to solve problems of separation processes of industrial interest using properly graphical methods , analytical methods and/or process-simulation advanced software.

4. OBJECTIVES
To acquire a global vision of separation processes.
To understand the fundamentals of different separation processes of interest in Chemical Engineering.
To learn and apply methods of analysis and design of separation processes based on equilibrium stages and on mass transfer models.
To appropriately use the mathematical tools required for calculation and design of separation processes and for solving problems of industrial interest.

6. COURSE ORGANIZATION	
CONTENTS	
1	Unit 1: Introduction to separation processes. Presentation, course development and bibliography. Separation mechanisms. Modes of operation. Separation factor. Selection of separation processes.
2	SEPARATION BY PHASE CREATION Unit 2: Fundamentals of processes of equilibrium stages. Terminology and basic concepts of a single equilibrium stage. Phase equilibria. Examples. Unit 3: Continuous rectification. Definition. Introduction. Continuous binary rectification: McCabe-Thiele method. Continuous multicomponent rectification: Fenske-Underwood-Gilliland method, rigorous resolution using process simulators. Equipment and design considerations. Unit 4: Distillation. Definition. Types of distillation. Flash distillation. Differential distillation.
3	SEPARATION BY PHASE ADDITION Unit 5: Absorption. Definition. Equipment. Design of an absorption column. Methods for determination of the no. of stages: McCabe-Thiele method. Kremser method for multicomponent absorption and desorption. Unit 6: Liquid-Liquid Extraction. Definition. Equipment. General design considerations. Extraction in one stage. Extraction in systems of multiple stages: methods to calculate the no. of stages.
4	Unit 7: Separations that involve a solid phase. Leaching or solid-liquid extraction. Crystallization. Drying of solids.
5	Unit 8. Operation in packed columns using mass transfer models. Introduction. Application to absorption/stripping. Application to distillation.
6	CASE STUDY (I): SEPARATION BY CONTINUOUS RECTIFICATION Task 1: Vapour-Liquid Equilibrium (VLE) data. Obtaining vapour-liquid equilibrium data: simulated and experimental. Task 2: Resolution by means of McCabe-Thiele graphical method. Task 3: Resolution by means of process simulator. Resolution using ChemSep. Study of the influence of variables. Task 4: Improvement of the separation: obtaining a distillate product of higher purity.
7	CASE STUDY (II and III): SEPARATION BY PHASE ADDITION Case study (II): CO2 absorption Task 5: Resolution by means of graphical methods. Task 6: Resolution by means of process simulator. Resolution using ChemSep. Study of the influence of variables. Case study (III): Liquid-Liquid Extraction Task 7: Liquid-liquid equilibrium data and single stage extraction of acetic acid. Task 8: Extraction of acetic acid in countercurrent, multiple stages.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Resolution of Cases of Study of Separation Processes (I)	Work	No	Yes	10,00
Test 1	Written exam	No	Yes	40,00
Resolution of Cases of Study of Separation Processes (II)	Work	No	Yes	10,00
Test 2	Written exam	No	Yes	40,00
TOTAL				100,00

Observations

The continuous assessment is based on doing tests 1 and 2 (weeks 8 and 15 of the four-month period) and doing the cases of study proposed.
The students that do not pass the course by continuous assessment will have the option of doing the final exam in the date established by the Centre.
Each exam will have a part of Theory (5 points) and a part of Practice (5 points). To pass each exam, it will be necessary to obtain a minimum mark of 2,5 points out of 5 points in each part.

Observations for part-time students

Article 15 of the Regulation of Assessment Processes in the University of Cantabria will be applied.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

SEADER, J.D., HENLEY., E.J., ROPER, D. K. (2016). “Separation Process Principles: with applications using process simulators". 4th edition. Ed. Wiley, Hoboken, New Jersey.

Mc CABE, W.L., SMITH, J.C., HARRIOTT, P. (2007) “Operaciones Unitarias en Ingeniería Química, 7ª edición”. Ed. McGraw-Hill, Madrid.

MARTÍNEZ DE LA CUESTA, P.J., RUS MARTÍNEZ, E. (2004) “Operaciones de separación en ingeniería química: métodos de cálculo”. Ed. Pearson Educación, Madrid.

MARCILLA GOMIS, A. (1998) "Introducción a las Operaciones de Separación: cálculo por etapas de equilibrio". Publicaciones Universidad de Alicante, Alicante.