UAB
Universitat Autònoma de Barcelona

Separation Processes II

Code: 106060
ECTS Credits: 6

2025/2026

Degree	Type	Year
Chemical Engineering	OT	4

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

It is recommended having reached the basic knowledge and fundamentals on: Computer applications, Heat transfer and Thermotechnics, Transport Phenomena, Separation processes I and Simulation of Chemical processes.

Objectives and Contextualisation

This subject deals with separation processes based on mass transfer, both equilibrium and rate-controlled. In particular: Humidification, Adsorption, Ion Exchange, Chromatography, and separations by Membranes. At all times is carried out a development of each block in a cumulative way regarding the separation operations that the student already knows, using the concepts of equilibrium, transfer rate, transport coefficients, countercurrent systems, cross flow, etc.., and making a synthesis of the common concepts among all of them. Finally, it is intended to know the basic concepts of these operations and the different methods and applications as a necessary basis on new separation technologies.

Competences

- Develop thinking habits.
- Objectively compare and select different technical options for chemical processes.

- Understand and apply the basic principles on which chemical engineering is founded, and more precisely: balances of matter, energy and thermodynamic momentum, phase equilibrium and kinetic chemical equilibrium of the physical processes of matter, energy and momentum transfer, and kinetics of chemical reactions

Learning Outcomes

1. Apply and identify basic concepts related with chemical engineering.
2. Apply the scientific and technological basics of balance and transfer of matter and separation operations.
3. Apply the scientific and technological basics of matter transfer to separation operations.
4. Choose between different options for defining separation processes.
5. Develop critical thinking and reasoning
6. Identify, analyse and resolve balances of energy in simple chemical processes.

Content

TOPIC 0.- INTRODUCTION

Separation processes based on mass transfer. Phase equilibria. Transfer rate. Configurations. Equilibrium-stage operations.

TOPIC 1.- HUMIDIFICATION

1.1. Introduction

1.2. Definitions and nomenclature

1.3. Phase Equilibria

1.4. Adiabatic-saturation Temperature (T_s)

1.5. Measurement of humidity and wet-bulb Temperature (T_w)

1.6. Psychometric or Humidity chart

1.7. Theory and calculation of cooling towers

1.7.1. Equations and balances for cooling towers

1.7.2. Estimation of the outlet gas temperature

TOPIC 2.- ADSORPTION

2.1. Introduction. Definition and types of adsorption processes

2.2. Adsorbents

2.3. Equilibria. Adsorption isotherms. Adsorption models.

2.4. Stage adsorption processes

2.4.1. Cross flow

2.4.2. Countercurrent

2.5. Continuous contact adsorption processes and equipment

2.5.1. Fixed bed

2.5.2. Moving bed

2.5.3. Fluidized bed

TOPIC 3.- IONIC EXCHANGE

3.1. Principles of ionic exchange

3.2. Ionic exchange resins

3.2.1. Physical structure

3.2.2. Chemical structure. Polymeric matrix

3.2.3. Functional groups

3.3. Ionic equilibria between S-L phases

3.4. Rate of Ionic exchange

3.5. Ionic exchange operations

3.5.1. Countercurrent

3.5.2. Fixed bed

3.6. Techniques and their uses

3.6.1. Water softening

3.6.2. Total demineralization. Deionization

3.6.3. Waste treatment and metal ions recovery

3.6.4. Chromatography

TOPIC 4.- MEMBRANES

4.1. Fundamentals and types of membrane separation processes

4.2. Microfiltration

4.3. Osmosis, Reverse Osmosis and Ultrafiltration

4.3.1. Reverse Osmosis

4.3.2. Ultrafiltration

4.3.3. Configuration of membrane systems

4.3.4. Concentration polarization

4.4. Dialysis

4.5. Electrodialysis

4.6. Membrane modules

4.7. Equipment and applications

4.7.1. Metal ions recovery. Electrodialysis

4.7.2. Recycling of degreasing baths

4.7.3. Separation of enzymes produced by fermentation

4.7.4. Desalinization

4.7.5. Hemodialysis

4.7.6. Algae harvesting and preparation as food

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classroom practices (Problem solving)	15	0.6	3, 2, 1, 5, 4, 6
Expository lectures (master class)	31	1.24	3, 2, 1, 5, 4, 6
Seminars	4	0.16	3, 2, 1, 5, 4, 6
Type: Supervised			
Further tutorials	5	0.2	3, 2, 1, 5, 4, 6
Theoretical work, problems and computer simulation	8	0.32	3, 2, 1, 5, 4, 6
Type: Autonomous			
Problem solving	34	1.36	3, 2, 1, 5, 4, 6
Study	42	1.68	3, 2, 1, 5, 4, 6
Tutorials with professor	2	0.08	3, 2, 1, 5, 4, 6

MD1 Presentation of content in class - Master class or conference
MD2 Participatory classes (joint problem solving, debates, case analysis, presentations of work done by students)
MD3 Tutorials
MD5 Evaluation activities (continuous evaluation with at least three milestones: Initial, follow-up and final)
MD6 Problem/use case/project based learning
MD7: Use of specific software for the design of separation operations through simulation

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Partial tests	30 %	3	0.12	3, 2, 1, 5, 4, 6
Problem solving and case studies, reports, works and their defense	20 %	0	0	3, 2, 1, 5, 4, 6
Synthesis test	50 %	6	0.24	3, 2, 1, 5, 4, 6

To consider the subject passed, it will be necessary to obtain a minimum overall mark of 50/100.

a) Evaluation process and programmed activities
The continuous evaluation will be made considering a series of activities:

- Problems, tasks, and exercises (PTE): 20 % of the final course mark.
- 1st partial test (PP1) (topic 1): 10 % of the final course mark.
- 2nd partial test (PP2) (topics 2 and 3): 10 % of the final course mark.
- 3rd partial test (PP3) (topic 4): 10 % of the final course mark.
- Synthesis test (PS) (topics 1 to 4): 50 % of the final course mark.

The problems, tasks, and exercises (PTE) will be done individually or in groups and may or may not be problems from the subject list, specific study cases and activities based on key theoretical concepts of the corresponding topics.The partial tests (PP1, PP2 and PP3) will be individual and will consist of a short problem and theoretical concepts of the corresponding topics (1h). The synthesis test (PS) will be individual and will include all the content of the subject and will consist of a theoretical part and another with three problems (5h). In the partial tests and the problems of the synthesis test, support material can be used: notes, books, forms, solved problems, computer, calculation tools, etc ... In the theory part of the synthesis test no type of additional material can be used unless indicated by the teacher.

b) Time-scheduling of evaluation activities
The time-schedule of the evaluation and delivery of work activities will be published in the corresponding virtual platform (Moodle) and may be subject to possible programming changes for reasons of adaptation to possible incidents. Always being informedin the corresponding virtual Platform about these changes, since it is understood that this is the usual platform for exchange of information between teachers and students.

Tests will not be held on dates, times, and places other than those scheduled and disseminated by the Degree Coordination/School of Engineering. No change may be introduced without the approval of the degree coordination. After 30 minutes of the scheduled time of the evaluation activity, if it has not started, it will be cancelled. Canceled activities will be rescheduled.

c) Recovery process
Students who have failed the continuous evaluation or want to raise the mark will be able to take the final recovery test (PR 100%). They must have been evaluated from a set of activities that represents a minimum of 2/3 parts of the total subject qualification. By taking this final recovery test, they waive all the marks of the continuous evaluation.

The final test will include all the content of the subject and will consist of a theoretical part and another with three problems (5h). In the problems of the final test, supporting material can be used: notes, books, forms, solved problems, computer, calculation tools, etc. In the theory part of the final test no type of additional material can be used unless indicated by the teacher. In case of not taking the final test, the final course mark for the subject will be the obtained from the continuous evaluation.

d) Revision of the qualifications
For each evaluation activity, a place, date, and time of review will be indicated at the corresponding virtual platform (Moodle) in which the student can review the activity with the teacher.

e) Special qualifications
Granting a qualification of "matrícula de honor" (MH), apart from the minimum mark that can give access (≥ 9.00), is the decision of the faculty responsible for the course that will takeinto account the proactivity towards the subject, the understanding of the fundamentals and their relationship with other subjects and the fluency, reliability, expression and rational thinking. Special attention will be paid to the theoretical part of the synthesis and final tests. The MH resulting from calculating the 5% or fraction of people enrolled may be granted. Students will be considered Not Evaluable (NA) if have not been evaluated from a set of activities that represents a minimum of 2/3 parts of the total subject qualification.

f) Irregularities from the student, copying and plagiarism
If the student performs any irregularity that may lead to a significant variation in the grade of an evaluation act, this evaluation act will be graded with a 0, regardless of the disciplinary process that may be instructed. This evaluation activity will not be recoverable. The professor responsible for the subject will have to report these cases to the coordination of the degree that will record the fact.

g) Second registration or more
From the second registration, the student could choose between new continuous evaluation or a synthesis test that will be the same test (equal date and time) as the synthesis test (PS) for the students of first registration. It is mandatory to be communicated by e-mail to the teacher within the first 15 days of the course. Thus, the qualification of the course will correspond either to the continuous evaluation or just the mark of this test (PS 100%), replacing the continuous evaluation for all purposes. They could also do a final recovery test (PR 100%), according to requirements and conditions for the modality selected, and will be the same test (equal date and time) than the recovery test (PR 100%) for the students of first registration.

h) Single evaluation
This subject does not provide for a single evaluation system.

i) Uso de AI
The use of AI is allowed in the realization of assignments, although the student must declare its use and the purpose for which it has been used.

Bibliography

- Coulson, J.M., Richardson, J.F. ChemicalEngineering. Vol 2. Particle Technology andSeparation Processes. 5th ed. Butterworth-HeinemannLtd. UK. (2002).

  Geankoplis, C. J., Hersel, A.A., Lepek, D.H. Transport Processes andSeparation Process Principles. 5th ed. Prentice Hall PTR. USA (2018).

  McCabe, W. Unit operations of chemicalengineering. 7th ed. McGraw-Hill Education. UK. (2005).

  Perry'sChemicalEngineers' Handbook. 8th ed. McGraw-Hill Education. USA. (2008).

  Wankat, P. C. Ingeniería de procesos de separación (2a. ed.). PearsonEducación. (2008).

Software

- Pal, Nirupam & Siletti, Charles & Petrides, Demetri. (2008). Superpro Designer: An Interactive Software Tool for Designing and Evaluating Integrated Chemical, Biochemical, and Environmental Processes.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	211	Catalan	first semester	morning-mixed
(SEM) Seminars	211	Catalan	first semester	morning-mixed
(TE) Theory	21	Catalan	first semester	morning-mixed