COURSE DATA

DATA SUBJECT

Code: 34768
Name: Unit Operations of chemical engineering III
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	Escola Tècnica Superior d'Enginyeria	3	Second quarter
1934 - Double Degree Program in Chemistry-Chemical Engineering	Facultat de Química	4	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	Basic operations of chemical engineering	COMPULSORY
1934 - Double Degree Program in Chemistry-Chemical Engineering	Cuarto curso	COMPULSORY

COORDINATION

VERCHER MONTAÑANA ERNESTO

DEJOZ GARCIA ANA MARIA

SUMMARY

The subject Unit Operations of Chemical Engineering III (OB III) is a mandatory subject that is taught in the third year of the Degree in Chemical Engineering during the second (Spring) semester. In the curriculum of the University of Valencia has a total of 6.0 ECTS credits.

The OB III subject is part of the matter Basic Operations of Chemical Engineering whose overall objective is to train for the design and operation analysis of unit operations in the chemical industry. The subjects Unit Operations of Chemical Engineering I (OB I) and OB III are focused on the study of the most important unit operations used in practice based on mass transfer, being OB III the logical continuation of OB I.

In OB III the following operations will be studied in detail: Solvent Extraction, both Liquid-Liquid Extraction and Solid-Liquid Extraction; Adsorption and Ion Exchange; Air-Water Interaction Operations (water cooling by evaporation and air conditioning); Drying of wet solids; and Crystallization. Finally, some mechanical

separation operations based on fluid flow, such as Sedimentation and Filtration, will be treated in a necessarily very summary manner, and separation operations with membranes will be introduced.

In short, the objective of this subject is to apply the basic principles of chemical engineering to the design and operation analysis of the different types of process industry unit operations, according to standards and specifications, with the following contents:

- Unit operations based on mass transfer: mechanisms and basic design equations.

- Separation by stages and continuous. Thermodynamic equilibrium.

- Design and analysis of mass transfer equipment and other separation unit operations.

This is a subject with a large practical component in which, after the explanations of key concepts, numerous practical exercises will be carried out.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

It would be advisable to dispose of the following knowledge:
Mass and energy balances.
Basic concepts of chemistry and chemical thermodynamics.
Property transport rate equations. Transport coefficients.
Have taken the subject: Unit Operations of Chemical Engineering I.

COMPETENCES / LEARNING OUTCOMES

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Ability to handle specifications, regulations and standards of compliance.

Acquire knowledge of basic and technological subjects to facilitate the learning of new methods and theories, and develop the versatility to adapt to new situations.

Act autonomously in learning, make informed decisions in different contexts, issue judgements based on experimentation and analysis and transfer knowledge to new situations.

Analyse, design, simulate and optimise processes and products.

Be able to understand and apply the legislation required for the practice of the profession of technical industrial engineer.

Knowledge for carrying out measurements, calculations, valuations, appraisals, expert opinions, studies, reports, work plans and other similar work.

Propose creative and innovative solutions to complex situations or problems, typical of the area of ¿¿¿¿connection, to donate responses to the various professional and social needs

Solve problems with initiative, make decisions, think creatively and critically, and communicate and convey knowledge, skills and competences in the field of industrial engineering.

Understand material and energy balances, biotechnology, mass transfer, separation operations, chemical reaction engineering, reactor design, and the valorisation and transformation of raw materials and energy resources.

Work in a multilingual and multidisciplinary environment.

DESCRIPTION OF CONTENTS

1. Liquid-liquid Extraction

Introduction. - Equilibrium in liquid-liquid systems. - Immiscible and partially miscible systems. Triangular diagrams. Binodal curve and tie lines. - Mass balances. Lever rule. - Calculation of number of ideal stages in immiscible systems. Operating line. - Calculation of number of ideal stages in partially miscible systems. Operating pole. Classification and selection of L-L extraction units.

2. Solid-liquid extraction

Introduction. - Equilibrium in SLE. Retention by the solid solution. - Modes of operation in SLE. - Design of extractors. Calculation of number of ideal stages. - Industrial equipment for SLE.

3. Adsorption and Ion Exchange

Introduction. - Adsorbents and ion exchangers. - Equilibrium in adsorption. Adsorption isotherms. - Kinetics of adsorption. - Design of equipment. Moving bed and fixed bed. Breakthrough curve and adsorption wave. - Industrial equipment. - Advanced Adsorption Process. - Equilibrium in ion exchange. - The ion exchange capacity. - Kinetics of the exchange.

4. Operations based on air-water interaction

Air-Water Interaction. Introduction. - Properties of moist air. Mollier diagram. - Adiabatic and non adiabatic humidification. - Wet air temperature. - Design of equipments. Fundamental equations. - Water cooling towers. Enthalpy method. - Industrial equipment cooling water. - Humidification and dehumidification of air.

5. Drying wet solids

Introduction. - Properties of wet solids.-Equilibrium in drying. - Mechanism and kinetics of drying. Drying periods. - Design and calculation of dryers. - Determination of drying time: Batch Dryers. - Continuous dryers. Adiabatic operation. - Classification and selection of dryers.

6. Crystallization in solutions

Introduction. - Characteristics of crystalline solids. - Equilibrium of crystallization. - Diagrams of equilibrium: molten mixtures, solutions, binary systems, ternary systems. - Supersaturation. - Yields. - Kinetics of crystallization. - Design of crystallizers.

7. Other separation operations

Operations based on external fluid flow. Membrane separation processes. Description of the most important operations and their industrial application.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	20,00
Classroom practices	40,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	0,00
Preparation of lessons	30,00
Preparation for assessment activities	60,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

The development of the subject is structured around lectures on the theory and problem classes.

In the lectures the master classes model will be used. The professor will present the contents of each topic through presentation and/or explanation, focusing on those key aspects for understanding it.

The practical classes on numerical problems and questions will be developed following two models. In some of the classes, the professor will solve a series of problems and standard questions to instruct in the identification of the essential elements of problem setting out and problems solving. To improve learning, in other classes the students, individually or in groups, will have to solve problems of similar complexity to those of the exams, under the supervision of the professor. Once the work will be completed, the problems will be analysed and corrected in the same classroom.

EVALUATION

The learning evaluation in the **first call** will be based on the results of two Objective Tests (OT1 and OT2) carried out throughout the semester.

The first Objective Test will include the contents of topics 1 and 2 of the program and will be carried out on the date programmed in the subject schedule. The second Objective Test will include the contents of topics 3 to 7 and will be carried out on the official date of the first call exam. Both tests will consist of a theory part and a part of numerical questions and/or problems.

The Final Grade for the subject will be obtained as:

Final Grade = 0.35·OT1 + 0.65·OT2

To pass the subject in the first call, the Final Grade must be equal to or greater than 5.0 out of 10. Failure to attend either of the two Objective Tests (OT1 and OT2) will result in the grade of "No Show (NP)".

The evaluation of learning in the **second call** will be carried out based on the grade of a single Exam of all the contents of the subject (EX) that will be carried out on the official date of the second call. The Final Grade of the subject will be the exam grade.

To pass the subject in the second call, the Final Grade must be equal to or greater than 5.0 out of 10. Failure to attend the exam in the second call will result in the grade of "No Show (NP)".

Copying or plagiarism of any activity that is part of the evaluation will result in the impossibility of passing the course, and the student will then be subject to the appropriate disciplinary procedures indicated in the ACTION PROTOCOL FOR FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA (ACGUV 123/2020).

In any case, the evaluation system will be governed by that established in the Reglament d'Avaluació i Qualificació de la Universitat de València per a Títols de Grau i Màster (ACGUV 108/2017).

REFERENCES

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