# COURSE DATA

## DATA SUBJECT

**Code:** 34766
**Name:** Unit operations of chemical engineering I
**Cycle:** Undergraduate Studies
**ECTS Credits:** 6
**Academic year:** 2026-27

## STUDY (S)

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1401 - Degree in Chemical Engineering | Escola Tècnica Superior d'Enginyeria | 3 | First quarter |
| 1934 - Double Degree Program in Chemistry-Chemical Engineering | Facultat de Química | 3 | First 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 | Tercer curso | COMPULSORY |

## COORDINATION

LLADOSA LOPEZ ESTELA

LORAS GIMENEZ SONIA

# SUMMARY

The course is a compulsory course taught in the third year of the degree in Chemical Engineering in the first (autumn) semester. In the curriculum of the University of Valencia has a total of 6 ECTS.

The theory classes will be taught in Spanish and practical classes as stated in the course information available on the website of the degree.

The course Unit Operations of Chemical Engineering I is part of the subject Unit Operations of Chemical Engineering whose overall objective is to enable the student to the design and performance analysis of different types of unit operations in the chemical industry. Courses Unit Operations of Chemical Engineering I and III are focused on the most important mass transfer unit operations used in practice. They are intended to give students the ability to design and manage the operation of the equipment needed to perform these operations. Specifically the subject Unit Operations of Chemical Engineering I is focused

on the study of two very important operations in the chemical industry: distillation and absorption of gases. Being the first course of Unit Operations, the first part is a general introduction and review of some thermodynamic concepts applied to mass transfer.

The contents of the course are: Unit Operations of mass transfer: mechanisms and basic design equations. Separation in stages and continuously. Thermodynamic equilibrium. Design and analysis of mass transfer equipment.

## 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 for the student to dispose of the following knowledge:
Mass and energy balances
Property transport rate equations. Transport coefficients.
Basic concepts of chemistry and chemical thermodynamics

## COMPETENCES / LEARNING OUTCOMES

### 1401 - Degree in Chemical Engineering

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.

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. Mass Transfer Unit Operations

Unit Operations in Chemical Engineering. General Introduction.- Separation Processes. Generalities.- Some basic concepts about separation processes.- Characteristics, classification and selection of separation processes.

### 2. Basic Thermodynamics of Phase Equilibria

Phase diagram in binary systems. Thermodynamic treatment of equilibrium: Gibbs free energy, chemical potential, law of Raoult, non ideality. Bubble temperature and pressure, and dew temperature and pressure. Relative volatility. Vapor-liquid equilibrium ratio (K values).

### 3. Distillation

Differential simple distillation: binary and multicomponent mixtures. Continuous simple distillation. Flash distillation: isotherm and adiabatic. Partial condensation.

### 4. Continuous rectification of binary mixtures in trayed columns

Deduction of fundamental equations. - Optimal position of feed-stage. - Calculation of number of equilibrium stages: rigorous method, approximate methods. - Limiting conditions of operation. - Study of different alternatives of operation. - Calculation of the number of actual stages: efficiencies. - Calculation of the diameter

### 5. Continuous rectification of binary mixtures in packed columns

Types of packing. - Design methods. - Calculation of the diameter of the column. ¿ Packed columns versus trayed columns.

## 6. Batch rectification

Design: operation at constant distillate composition, operation at constant reflux ratio. - Performance: operation at constant distillate composition, operation at constant reflux ratio.

## 7. Rectification of multicomponent mixtures

Previous decisions: operating pressure, type of condenser, key components; approximate compositions of distillate and residue, reflux ratio, etc. - Methods of calculation: rigorous method, approximate methods. - Special Distillations

## 8. Absorption

Solubility of gases in liquids. Gas-liquid equilibrium. Henry's Law. - Design of absorption towers. Absorption of a single component. ¿ Trayed towers. Calculation of the diameter and number of stages. ¿ Packed towers. Calculation of the diameter and packing height. Absorption tower design. multicomponent absorption

# 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 | 35,00 |
| Independent study and work | 0,00 |
| Preparation of lessons | 35,00 |
| Preparation for assessment activities | 20,00 |
| Resolution of case studies | 0,00 |
| **Total hours** | **90,00** |

# TEACHING METHODOLOGY

The development of the course is structured in lectures on the theory together with the resolution of related problems, and carrying out works.

In the lectures, master classes will be the basic methodology. The professor will present by means of presentation and/or explanation of the contents highlighting those key aspects for understands them.

Practical sessions of problems will be developed following two models. Some of the classes will be the professor who solves a series of sample problems in order to help the students to identify the essential elements of the way the problem is set out and its solution. In other practical sessions will be the students, individually or in team, who should solve similar problems under the supervision of the professor. After the work, the problems will be collected, analyzed and corrected by the professor.

The proposed work to the student will be divided into two types: complete Problems, with a similar complexity to the problem exams, and Tests, designed to prepare the most important concepts of each unit. Part of these activities will be made during the lectures, and the rest of them will be optional deliveries for a proper preparation of the course by the students. After its correction, the students will be informed of their results and a summary of the most consolidated and frequent failures.

## EVALUATION

The assessment of student learning will be carried out using two models:

**Model A**: The assessment with this model is based on a continuous assessment taking account the works (tests and proposed problems) and two partial objective exams according to two parts (Part I: units 1 to 4 and Part II: units 5 to 9). The partial exam of Part I will be when these contents finish, and the exam of Part II will be on the official date for first vocation.

The final mark will be calculated as the greater one of:

- the weighting between the average mark of the tests (20%), delivered problems (10%) and the grade of the two partial objective exams (70%),or
- the grade of the two partial objective exams plus a 5% of the average mark of the works (tests and proposed problems)

If a minimum mark of 4 (out of 10) is not gotten in the average score of the partial tests, the final mark will be the average of the two partial objectives tests.

**Model B**: The assessment of the course with this model will be realized through an exam of all contents of the course in the official date. The activities carried out throughout the course will also be valued, although they have a lower percentage weight in the final grade than in Model A.

The final mark with this model will be obtained as the greater one of:

- the weighting between the average mark of activities (20%) and the mark of the exam (80%), or
- the mark of the exam

If a minimum mark of 4 (out of 10) is not gotten in the exam, the final mark will be the grade obtained in the exam.

In the first call, the student will accept one of the two evaluation models, in such a way that if the student presents himself/herself to the first partial objective test, he/she will be evaluated according to Model A. The student will not be able to renounce the A modality of evaluation after taking the partial exam.

On the second call the evaluation will be conducted by Model B.

The qualification of *Not presented* will be obtained only when the student does not take any of the partial objective tests (in Model A) or the final exam (in Model B), even if he/she has partially or completely carried out the proposed continuous evaluation activities (questionnaires and deliverable problems).

The exams will have theoretical and practical questions and problems.

The subject will be passed when the average final mark is equal or greater than 5 (out of 10).

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).

Anyhow, the evaluation system will be based on the guides stated in the "Reglament d'Avaluació i Qualificació de la Universitat de València per a Graus i Màsters" (ACGUV 108/2017).

## REFERENCES

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