

Course guide

320067 - OB - Basic Operations

Last modified: 16/07/2026

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: **Academic year:** 2026 **ECTS Credits:** 12.0
Languages: Catalan

LECTURER

Coordinating lecturer: Josep Maria Guadayol Cunill

Others:

PRIOR SKILLS

Knowledge of technical English.

REQUIREMENTS

Students will be expected to have passed the subjects on physical chemistry, fluid transport and heat transfer. Students lacking knowledge of these topics should not take this subject.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. CHE: Knowledge of material and energy balances, biotechnology, the transfer of materials, separation operations, chemical reaction engineering, the design of reactors, and the reuse and transformation of raw materials and energy resources.

TEACHING METHODOLOGY

- Face-to-face lecture sessions.
- Face-to-face practical work sessions.
- Independent learning and exercises.

In the face-to-face lecture sessions, the lecturer will introduce the basic theory, concepts, methods and results for the subject and use examples to facilitate students' understanding.

Practical class work will be covered in three types of sessions:

- a) Sessions in which the lecturer will provide students with guidelines to analyse data for solving problems by applying methods, concepts and theoretical results (85%).
- d) Sessions in which students give presentations of group work (9%).
- d) Examination sessions (6%).

Students will be expected to study in their own time so that they are familiar with concepts and are able to solve the exercises set, whether manually or with the help of a computer.

Group work will consist of longer, more complex exercises that require the application of the concepts covered in class. All group members (maximum three students) will be expected to work together to complete the exercises, especially in applications that require knowledge of many different concepts.

Students may come to office hours to resolve any doubts that may arise from the theoretical or applied content presented in class.

LEARNING OBJECTIVES OF THE SUBJECT

In this subject, students will learn the fundamentals of the unit operations of chemical engineering. After a general overview, we will delve into the particulars of each operation. We will adapt, for the purposes of chemical engineering, operations that are not strictly chemical in nature but are applied in chemistry, and whose fundamentals are well understood (for example, dimensional analysis, heat transfer and fluid transport).

In addition, we will develop applications that provide a practical overview of the subject's theoretical content—a fundamental objective for any chemical engineer.

Groups of students will work on both theoretical and applied content.

STUDY LOAD

Type	Hours	Percentage
Hours large group	60,0	20.00
Self study	180,0	60.00
Hours medium group	60,0	20.00

Total learning time: 300 h

CONTENTS

TOPIC 1: INTRODUCTION TO UNIT OPERATIONS

Description:

- Continuous and batch operations.
- Systems of units.
- Dimensional analysis.

Specific objectives:

- Mastery of the basic concepts used throughout the subject.
- Mastery of the SI system of units and knowledge of commonly used English units.
- An understanding of and ability to apply the principles of dimensional analysis, which is necessary in order to work with the dimensionless quantities that occur in laboratory data related to fluid-transport phenomena and unit operations.
- The ability to document, plan and conduct an open-ended experiment in a group under supervision.
- The ability to use techniques and computer tools to calculate, process and interpret data and present results.

Full-or-part-time: 10h

Theory classes: 2h

Practical classes: 2h

Self study : 6h

TOPIC 2: FLUID MECHANICS

Description:

- Calculation and design of operations controlled by momentum transport and mechanical energy.
- Transport of incompressible fluids in chemical engineering.
- Transport of compressible fluids in chemical engineering.
- Fluid flow around submerged bodies:
- Flow through beds of solids.
- Movement of particles through fluids.
- Fluidisation.
- Agitation and mixing of liquids.

Specific objectives:

Continuing with the content introduced in Fluid Mechanics (third semester), we use examples from chemical engineering to review the concepts necessary to follow the subject:

- Application of the concepts of incompressible fluid mechanics to fluid statics and transport in chemical engineering.
- Application of the concepts of compressible fluid mechanics to fluid transport in chemical engineering.

In addition, the following new content will be presented:

- General concepts of fluid flow around solid bodies.
- Concepts and application of fluid flow through beds of solids.
- Concepts and application of movement of particles through fluidised beds.
- Concepts and application of fluidisation.
- Concepts and calculation of stirred tanks and agitation systems.
- Calculation of agitator power.
- Mixing operations.

Full-or-part-time: 40h

Theory classes: 8h

Practical classes: 8h

Self study : 24h

TOPIC 3: HEAT TRANSFER

Description:

- Fundamental considerations. Steady and transient states.
- Heat transfer by means of conduction, convection and radiation.
- Correlation for the calculation of convective heat transfer coefficients with and without phase change.
- Overall heat transfer coefficient.
- Introduction to heat exchangers.
- Shell-and-tube heat exchangers.
- Heat exchanger design (Kern method).
- Design combustion power-generation equipment (furnaces and boilers).
- Evaporation
- Energy saving in industrial processes.

Specific objectives:

Continuing with the content introduced in Applied Thermodynamics and Heat Transfer (third semester), we use examples from chemical engineering to review the concepts necessary to follow the subject:

- Understand and differentiate between the concepts of steady-state and transient processes.
- Understand and differentiate between the concepts of conduction, convection and radiation.

In addition, the following new content will be presented:

- Convective heat transfer coefficients and identification of the applicable coefficient for a given situation.
- Calculation of the overall heat transfer coefficient in any situation.
- Selection and calculation of heat exchangers, taking into account the requirements of each situation.
- Design of heat exchangers using the Kern method.
- Calculation of single- and multiple-effect evaporators.
- Calculation, design and selection of heat-transfer equipment and installations.
- Design of combustion power-generation equipment.
- Energy saving and efficiency applied to industrial processes.

Full-or-part-time: 75h

Theory classes: 15h

Practical classes: 15h

Self study : 45h

TOPIC 4: MASS TRANSFER OPERATIONS

Description:

- Introduction to mass transfer.
- Absorption of gases.
- Humidification.
- Operations with stepwise equilibrium.
- Distillation:
 - Flash distillation.
 - Continuous distillation with reflux.
 - Tray column design.
 - Packed columns.
 - Batch distillation.
 - Multicomponent distillation.
- Liquid-liquid extraction.
- Leaching.

Specific objectives:

- Familiarity with the theoretical basis of the calculation, design and selection of separation equipment.
- A general understanding of the phenomenon of diffusion.
- An understanding of the basics of mass transfer.
- An understanding of gas absorption and how it is calculated.
- An understanding of humidification and how it is calculated.
- The ability to calculate cooling towers.
- An understanding of the concept of operations with stepwise equilibrium.
- An understanding of flash distillation and how it is calculated.
- An understanding of continuous distillation with reflux and how it is calculated, using the McCabe-Thiele and Ponchon-Savarit methods.
- The ability to design a sieve tray column.
- The ability to calculate packed columns.
- An understanding of batch distillation and how it is calculated.
- An understanding of multicomponent distillation.

Full-or-part-time: 150h

Theory classes: 30h

Practical classes: 30h

Self study : 90h

TOPIC 5: OPERATIONS WITH SOLID PARTICLES

Description:

- Characterisation of solid particles.
- Solid mixtures.
- Size reduction.
- Mechanical separation techniques:
 - Sifting.
 - Filtration.
 - Sedimentation.

Specific objectives:

- An understanding of the characteristics of solid particles.
- An understanding of solid mixtures and how they are calculated.
- An understanding of solid particle size reduction and how it is calculated.
- An understanding of the mechanical separation of solids and how such operations are calculated.

Full-or-part-time: 25h

Theory classes: 5h

Practical classes: 5h

Self study : 15h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the [Action Framework for Academic Integrity in Assessment at the UPC](#).

- First examination: 25%
- Second examination: 25%
- Third examination: 25%
- Fourth examination: 25%

EXAMINATION RULES.

It is essential that students have knowledge of technical English, as it enables them to access a broader range of information on this subject. Therefore, the notes, PowerPoint slides and examinations for this subject will be in English. This will also enable students to be evaluated in this generic competency.

BIBLIOGRAPHY

Basic:

- Coulson, J. M.; Richardson, J. F. Ingeniería química, vols. 1, 2, 3, 4. Barcelona: Reverté, 1979-1984.. ISBN 8429171347.
- Martínez de la Cuesta, Pedro J.; Rus Martínez, Eloísa. Operaciones de separación en ingeniería química : métodos de cálculo. Madrid: Prentice Hall, 2004. ISBN 8420542504.
- McCabe, W. L.; Smith, J. C.; Harriott, P. Operaciones unitarias en ingeniería química. 7a ed. Madrid: McGraw-Hill, 2007. ISBN 9789701061749.

Complementary:

- Costa Novella, E. Ingeniería química, vols. 3, 4, 5. Madrid: Alhambra, 1983. ISBN 8420509892.
- Costa López, J. Curso de química técnica : introducción a los procesos, las operaciones unitarias y los fenómenos de transporte en la ingeniería química. Barcelona: Reverté, 1984. ISBN 8429171266.
- Vian, A.; Ocón, J. Elementos de ingeniería química: operaciones básicas. 5a ed. Madrid: Aguilar, 1967. ISBN 8403201532.
- Ocón García, Joaquín. Problemas de ingeniería química: operaciones básicas, vols. 1, 2. Madrid: Aguilar, 1963-1970. ISBN



8403209975.

- Levenspiel, Octave. Flujo de fluidos e intercambio de calor. Barcelona: Reverté, 1993. ISBN 8429179682.