Course guide
820529 - OBA1 - Unit Operations I

Last modified: 02/10/2025

Unit in charge: Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: EULALIA PLANAS CUCHI

Others: Primer quadrimestre:
ALBA ÁGUEDA COSTAFREDA - Grup: M1
AURELIO CALVET TARRAGONA - Grup: M1
EULALIA PLANAS CUCHI - Grup: M1

PRIOR SKILLS

Knowledge on fluid mechanics and heat transfer

REQUIREMENTS

MECÀNICA DE FLUIDS - Corequisit
TERMODINÀMICA - Prerequisit

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEQUI-19. Understand mass and energy balances, biotechnology, mass transfer, separation operations, chemical reaction engineering, the design of reactors, and the recovery and processing of raw materials and energy resources.
CEQUI-27. Understand spatial vision and graphic representation techniques, whether using traditional metric and descriptive geometry methods or computer assisted design applications.

TEACHING METHODOLOGY

- Lectures on theory and problems by the professors.
- Problems solving by the students.
- Autonomous learning.

LEARNING OBJECTIVES OF THE SUBJECT

The subject intends to introduce the students into the concept of unit operation, at the same time that they are introduced to the foundations for the calculation of some of the operations that are based mainly on the transfer of heat and momentum.
At the end of the course students must be able to:
- Know the principles and methodologies of the studied unit operations.
- Design/calculate the equipments corresponding to the studied unit operations.
- Solve dertain projects in the field of chemical engineering.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	60,0	40.00

Total learning time: 150 h

CONTENTS

Unit Operations I

Description:
Block 1 (15 h)
1. Introduction (4 h). Chemical processes. Flow and P&I diagrams. Unit operations. Dimensional analysis. Freedom degrees.
2. Unitilities (5 h). Heating with steam. Steam generation: boilers. Balances. Use of steam: distribution, pressure reduction, condensation, purging, retourm of condensates. Heating with other fluids.
3. Heat transfer (6 h). Short review of transmission mechanisms: conduction, convection, radiation. Heat transger coefficients. Overal coefficient. Scaling.

Block 2 (21 h)
4. Heat exchangers (9 h). Double tube exchangers, shell and tube, plate. Condensers. Jacketed vessels; coil vessels.
5. Evaporation(7 h). Fundamentals. Types of evaporators. Simple effect operation. Energy saving: multiple efecte operation, vapor compression.
6. Cristallization (5 h). Fundamentals. Nucleation and growth. Equilibrium diagrams. Balances. Types of crystallizers. Calculation.

Block 3 (8 h)
7. Agitation (4 h). Stirred vessel. Vortex. Agitator types. Baffles and tubes. Dimensional analysis. Required power.
8. Pumping of liquids (4 h). Energy balance. Pump types. Cgaracteristic curves. Cavitation.

Block 4 (16 h)
9. Fluid-particle systems I (2 h). Particle characterization. Fluid-particle interaction. Packed beds: types, features, pressure drop.
10. Fluid-particle systems II (2 h). Sòlid-gas separation: settling chambers, cyclones, filters. Sòlid-líquid separation: settling, filtration.
11. Fluid-particle systems III. Fluïdization (5 h). Monimum fluidization velocity. Fluidized bed types. Fluidized bed calculation and design.
12. Drying od solids (7 h). Interaction air-water. Kinetics and drying velocity. Types of dryers.

Specific objectives:
Passing the course, the student should be able to:
- Knowing the principles and procedures of the studied unit operations.
- Designing/calculating the equipments associated to the studied unit operations.
- Solving certain projects in the field of chemical engineering.

Full-or-part-time: 60h
Theory classes: 60h

GRADING SYSTEM

FINAL RATE:
NF = 0,45·NEF + 0,25·NEP + 0,1·NPP + 0,2·NAC

Where,
NEF: Rate of the final exam
NEP: Rate of the partial exam
NPP: Rate of the partial test
NAC = Rate of continuous evaluation obtained as mean value of the scores obtained in the tasks

The course will have a reevaluation exam according to the calendar and rules of the EEBE, this exam will substitute the three scores of individual test, so will count 80%. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations.

EXAMINATION RULES.

Some examinations will take place with documentation available to the students, some without it (the students will be previously informed on this).

BIBLIOGRAPHY

Basic:
- Coulson, J. M.; Richardson, J. F.; Backhurst, J. R.; Harker, J. H. Ingeniería química : unidades SI. Vol. I. Barcelona: Reverté, 1979-1986. ISBN 8429171347.
- Coulson, J. M., Richardson, J. F., Backhurst, J. R., Harker, J. H. Ingeniería química : unidades SI. Vol. 2. Barcelona: Reverté, 1979-1986. ISBN 8429171347.
- McCabe, Warren L.; Smith, Julian C.; Harriott, Peter. Operaciones unitarias en ingeniería química. 7ª ed. Madrid [etc.]: McGraw-Hill, cop. 2007. ISBN 9789701061749.
- Sinnott, R. K.; Towler, Gavin. Chemical engineering design. 5th ed. Oxford [etc.]: Butterworth Heinemann, cop. 2009. ISBN 9780750685511.
- Perry, Robert H. (ed.). Manual del ingeniero químico [on line]. 7ª ed. Madrid: McGraw-Hill, cop. 2001 [Consultation: 08/06/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6572. ISBN 9788448612788.
- Felder, Richard M.. Principios elementales de los procesos químicos. 3ª ed. México: Limusa Wiley, cop. 2003. ISBN 9681861698.
- Aucejo, Antoni ... [et al.]. Introducció a l'enginyeria química. València: Universitat de València, 2013. ISBN 9788437091624.
- Izquierdo, José Felipe ... [et al.]. Introducción a la ingeniería química : problemas resueltos de balances de materia y energía. 2ª ed. Bancelona: Reverté, cop. 2015. ISBN 9788429171167.
- Levenspiel, Octave. Engineering flow and heat exchange. 3rd ed. New York: Springer US, 2014. ISBN 9781489974532.
- Bennett, C.O.; Myers, J. E. Transferencia de cantidad de movimiento, calor y materia. Barcelona, [etc.]: Reverté, DL 1979. ISBN 8429170472.
- Casal Fàbrega, Joaquim; Clotet, Ramon. Operacions unitàries de la indústria alimentària. Barcelona: Societat Catalana de Tecnologia, filial de l'Institut d'Estudis Catalans, 1995. ISBN 8472832805.

RESOURCES

Other resources:
Additional documentation (graphs, tables, power-point, etc.) given by professors.