

Course guide

3200661 - EEQ1 - Experimentation on Chemical Engineering I

Last modified: 20/05/2025

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual 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: Fernando Carrillo Navarrete

Others: Carrasco Portero, Manuel
De Bruijn Berenguer, Frederic
Colom Fajula, Xavier

PRIOR SKILLS

It is recommended that the student attends parallel to this subject, some subject related with Unit Operations of fluid and heat transport in Chemical Engineering.

On the other hand, it is also recommended that the student knows the objectives of the first level of generic skills: independent learning, effective oral and written communication and teamwork.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

6. 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.

5. CHE: Ability to design and manage applied experimental procedures, in particular to determine thermodynamic and transport properties, and to model phenomena and systems related to chemical engineering: systems with fluid flow, heat transfer, mass-transfer operations, and reactor and reaction kinetics.

Transversal:

05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

TEACHING METHODOLOGY

Lecturers communicate with students via the UPC Virtual Campus, which is now open to both faculty and students.

Students are provided with educational materials that cover the theoretical foundations of the subject, experimental procedures and a bibliography for each experimental run.

This subject is planned to work and assess the competence of teamwork.

The following student's tasks will be developed during the laboratory course:

- Cooperative learning based on laboratory experiments (54 h): The students will carry out laboratory experiment through a cooperative learning methodology. Teams, under guidance of tutors, will be responsible for planning and designing the experiments.
- Homework (90): The students have to dedicate time to develop the programmed course activities and the pre and post-laboratory activities.
- Exams (6h): two written exams have been planned.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of this subject, students will be able to: design and manage chemical-engineering experimental procedures for determining thermodynamic and transport properties; and model chemical-engineering phenomena and systems, systems with fluid flow, heat transfer, mass transfer operations, chemical kinetics and reactors.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

TOPIC 1: MOMENTUM TRANSPORT: PHENOMENA AND BASIC OPERATIONS

Description:

- 1.P1. Measurement of compressible flow: diaphragm.
- 1.P2. Mass balance in non-stacionary regime.
- 1.P3. Mechanical energy balance: tank drainage.
- 1.P4. Fluid flow through packed columns.
- 1.P5. Batch sedimentation.
- 1.P6. Stirring and mixing of liquids.

Specific objectives:

On completing this topic, students will be able to:

- Understand the objectives, methodology and assessment methods of the subject.
- Analyse the behaviour of fluids circulating through pipelines.
- Formulate matter and energy balances and apply them to fluid flow mechanics.
- Apply and analyse the basic principles of internal fluid flow to determine energy loss due to friction.
- Handle basic fluid-transport elements (pipes, valves and fittings) and equipment (pumps and fans).
- Handle instruments and equipment commonly used to measure pressure, temperature and fluid flow.
- Determine the pressure loss that occurs in fluid flow through a porous bed.
- Experimentally analyse the operating conditions of the basic operation of sedimentation.
- Assess the degree of fit of the theoretical equations for modelling the basic phenomena and operations of fluid transport from laboratory data.
- Under guidance, document, plan and lead an open-result experiment while working in a team.
- Use computer-based techniques and tools for data computation, processing and interpretation and for the presentation of results.

Related activities:

- Under guidance, document, plan and lead an open-result experiment while working in a team.

Full-or-part-time: 75h

Laboratory classes: 30h

Self study : 45h

TOPIC 2: HEAT TRANSFER: PHENOMENA AND BASIC OPERATIONS

Description:

- 2.P1. Thermal conductivity of solids.
- 2.P2. Local heat-transfer coefficient: convection.
- 2.P3. Liquid-liquid heat transfer in a concentric tube heat exchanger.
- 2.P4. Specific heat of solids.
- 2.P5. Heat-transfer coefficients of a batch rising-film evaporator.
- 2.P6. Cooling tower.

Specific objectives:

On completing this topic, students will be able to:

- Identify the various mechanisms of heat transfer.
- Describe the basic phenomena of heat transfer between solids and fluids.
- Identify the mechanisms of heat transfer in a specific case study.
- Formulate and apply the balances and equations that describe heat-transfer phenomena.
- Apply basic heat-transfer principles to experimentally determine individual and overall heat-transfer coefficients.
- Handle instruments (for measuring temperature and fluid flow) and devices (boilers, heat exchangers, coils) related to heat-transfer equipment.
- Using a pilot plant, experimentally analyse the operating conditions of heat-transfer equipment: concentric tube heat exchanger, coil heat exchanger, evaporator, batch rising film evaporator, reactor cooling jacket.
- Assess the degree of fit of the theoretical equations for modelling the phenomena and basic operations of heat transfer from laboratory data.
- Under guidance, document, plan and lead an open-result experiment while working in a team.
- Use computer-based techniques and tools for data computation, processing and interpretation and for the presentation of results.

Related activities:

- Under guidance, document, plan and lead an open-result experiment while working in a team.

Full-or-part-time: 75h

Laboratory classes: 30h

Self study : 45h

GRADING SYSTEM

Tests on each of the topic 1: 25%

Tests on each of the topic 2: 25%

Student laboratory notebook 1: 17,5%

Student laboratory notebook 2: 17,5%

Written presentation of coordinated experiment: 15%

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.

If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

BIBLIOGRAPHY

Basic:

- Calleja, Guillermo. Introducción a la ingeniería química. Madrid: Síntesis, 1999. ISBN 8477386641.
- Aucejo, Antoni. Introducció a l'enginyeria química [on line]. València: Universitat de València, cop. 2013 [Consultation: 23/04/2025]. Available on: <https://research-ebSCO-com.recursos.biblioteca.upc.edu/plink/96f66798-ede8-350b-87bf-f13a3de43a23>. ISBN 9788437091624.
- McCabe, Warren L [et al.]. Operaciones unitarias en ingeniería química. 7a ed. Madrid: McGraw-Hill, 2007. ISBN 9789701061749.



Complementary:

- Coulson, J. M.; Richardson, J. F. Ingeniería química, vols. 1, 2, 4, 5. Barcelona: Reverté, 1979-1981. ISBN 9788429171341.
- Levenspiel, Octave. Flujo de fluidos e intercambio de calor [on line]. Barcelona: Reverté, 1993 [Consultation: 14/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8184. ISBN 8429179682.