

<b>Centre</b>	<b>University College of Engineering of Vitoria-Gasteiz</b>
<b>Name of subject</b>	<b>26094 – Unit Operations</b>
<b>Qualification</b>	<b>Degree in Industrial Chemical Engineering</b>
<b>Type</b>	<b>Compulsory</b>
<b>Credits</b>	<b>12 ECTS</b>
<b>Year</b>	<b>3</b>
<b>Term(s)</b>	<b>Full Year</b>
<b>Department</b>	<b>Chemical and Environmental Engineering</b>
<b>Language</b>	<b>Spanish</b>

## Outcomes / Objectives

### OUTCOMES.

1. Have knowledge of, understand and apply the principles of mass and energy balances, fluid mechanics, heat transfer and mass transfer that underpin the design and operation of vapour-liquid and liquid-liquid separation equipment and solid-fluid separation equipment. TEQI1
2. Relate process/operation criteria, requirements and specifications to the choice of working variables to consider, working ranges, efficiency, dimensioning, shape, construction materials, solvents where applicable and ancillary elements of the equipment for said operation. TEQI8
3. Relate equipment investment and operating costs to working ranges, efficiency, dimensioning, shape, construction materials, solvents where applicable and auxiliary elements of the equipment for said operation. TEQI8
4. Carry out a preliminary interpretation of deviations in equipment operation from the design intend in terms of efficiency, costs and process parameters. TEQI8
5. Specify the required characteristics of new equipment where a need/concrete situation arises during the process. TEQI11
6. Use specific vocabulary and terminology and the appropriate means to effectively communicate knowledge, procedures, results, skills and aspects of the field of Industrial Engineering in their speciality. TEQI9

### BRIEF DESCRIPTION.

Mass and energy balances. Fluid flow. Heat transfer. Separation operations.

### OBJECTIVES.

1. Carry out an introduction to chemical engineering and the main unit operations for industrial use
2. Have knowledge of and apply the fundamentals of mass and energy balances
3. Have knowledge of the basic transport phenomena that constitute the fundamentals of unit operations
4. Have knowledge of the fundamentals and applications of the main mass transfer-based unit operations
5. Have knowledge of the fundamentals and applications of the main momentum transfer-based unit operations

## Syllabus

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### Thematic unit I: INTRODUCTION TO CHEMICAL ENGINEERING AND UNIT OPERATIONS

Unit 1.-Introduction to chemical engineering.

Unit 2.-Physico-mathematical instruments

Unit 3.-Mass balances, and

Unit 4.-Energy balances.

Unit 5.-Introduction to transport phenomena:

Unit 6.-Momentum transfer.

Unit 7.-Mass transfer.

Unit 8.-Heat transfer.

### Thematic unit II: MOMENTUM TRANSFER-BASED UNIT OPERATIONS

Unit 9.-Fluid transport

Unit 10.-Filtration

Unit 11.-Sedimentation

Unit 12.-Flotation

### Thematic unit III: MASS TRANSFER-BASED UNIT OPERATIONS

Unit 13.-Diffusion.

Unit 14.-Distillation.

Unit 15.-Rectification in multistage systems.

Unit 16.-Special distillation techniques.

Unit 17.-Absorption in packed columns.

Unit 18.-Liquid-liquid extraction.

Unit 19.-Lixiviation.

### Thematic unit IV: HEAT TRANSFER-BASED UNIT OPERATIONS:

Unit 20.-Drying

Unit 21.-Heat exchangers

## Methodology

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### Teaching Method

#### Face-to-Face Teaching Hours

Lectures	Seminars	Classroom practice	Lab. practice	Computer sessions	Clinical practice	Workshops	Industrial workshops	Field practice
84		36						

#### Student Hours of Non Face-To-Face Activities

Lectures	Seminars	Classroom practice	Lab. practice	Computer sessions	Clinical practice	Workshops	Industrial workshops	Field practice
126		54						

# Assessment System

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## General criteria

- Written essay exam
- Practical tasks (exercises, case studies or problems)
- Group assignments
- Presentation of assignments, reading...

## Clarification regarding assessment

Explanation (SPANISH)

The final grade is the weighted average of the following scores:

- Written exam score: 70%

Written exams will consist of theory and practical exercises. In order to pass, students must pass either the midterm exams or the final exam on the assigned dates. In order to calculate the average of the two midterm exams, a minimum score of 4 out of 10 must be obtained in each midterm exam.

- Case studies: 20%

Students will be assessed on the solution and oral presentation of the case studies proposed by the lecturer.

- Workshops: 10%

During the workshops students will carry out practical activities related to the topic covered in the first term. They will be assessed on the task books where the results of the practical activities will be entered. The passing grade for the subject is 5 out of 10.

## Bibliography

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### Basic Bibliography

- CALLEJA PARDO, G Introducción a la ingeniería química. Ed Síntesis
- COSTA NOVELLA, E Ingeniería química Ed. Alambra
- COSTA LOPEZ, J Curso de química técnica. Ed Reverté
- FELDER, R.M.; ROUSSEAU, R.W. Principios elementales de los procesos químicos.
- Mc. CABE W.L. Operaciones Básicas de Ingeniería Química. Ed. Mc. Graw Hill
- COULSON J.M. Ingeniería Química. Ed. Aguilar
- OCON J. Y TOJO G. Problemas de Ingeniería Química. Ed. Aguilar
- AURELIO HERNANDEZ Depuración de aguas residuales Ed. Servicio de publicaciones de la escuela de Ingenieros de caminos
- DEGREMONT Manual técnico del agua Ed. Degremont

### In-depth Bibliography

- KREITH F. Y BOHN Principios de transferencia de calor. Ed. Thomson
- TREYBAL R.E. Operaciones de Transferencia de masa. Ed. Mc. Graw Hill
- R.DESJARDINS Le traitement des eaux Ed. Ecole polytechnique de Montreal
- RH PERRY Manual del ingeniero químico ed McGraw-Hill
- RB BIRD Fenómenos de transporte Ed. Reverté
- CJ KING Procesos de separación Ed Reverté P. J. MARTINEZ DE LA CUESTA Operaciones de separación en Ingeniería Química)

### Magazines

- Chemical Engineering
- Química e Industria.
- Ingeniería química
- Water research
- Environmental Science and Technology

### Websites

- <http://moodle.ehu.es>