COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2022 - 2023

TECHNICAL SHEET OF THE SUBJECT

Data of the subject	
Subject name	Chemical Engineering
Subject code	DIM-MII-523
Mainprogram	Official Master´s Degree in Industrial Engineering
Involved programs	Máster Universitario en Ingeniería Industrial [First year]
Level	Postgrado Oficial Master
Quarter	Semestral
Credits	4,5 ECTS
Type	Obligatoria
Department	Department of Mechanical Engineering
Coordinator	Eva Paz Jiménez

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SPECIFIC DATA OF THE SUBJECT

Contextualization of the subject

Contribution to the professional profile of the degree

This course aims to introduce a complementary aspect in the training of students through the study of some industrial chemical processes that are representative and pedagogical.
This course focuses on the purely chemical aspect of said Industry. At the end of the course, students will be able to analyze and understand Industrial Chemical processes, both the global strategy and the most important unit operations that occur in it.

Prerequisites

Chemistry, Thermodynamics, Fluid mechanics, Heat transmission.

Competencies - Objectives

Competences

GENERALES	
BA01	Haber adquirido conocimientos avanzados y demostrado, en un contexto de investigación científica y tecnológica o altamente especializado, una comprensión detallada y fundamentada de los aspectos teóricos y prácticos y de la metodología de trabajo en uno o más campos de estudio
BA07	Ser capaces de asumir la responsabilidad de su propio desarrollo profesional y de su especialización en uno o más campos de estudio.
CG01	Tener conocimientos adecuados de los aspectos científicos y tecnológicos de: métodos matemáticos, analíticos y numéricos en la ingeniería, ingeniería eléctrica, ingeniería energética, ingeniería química, ingeniería mecánica, mecánica de medios continuos, electrónica industrial, automática, fabricación, materiales, métodos cuantitativos de gestión, informática industrial, urbanismo, infraestructuras, etc.
CG02	Proyectar, calcular y diseñar productos, procesos, instalaciones y plantas
ESPECÍFICAS	
CMT04	Capacidad para el análisis y diseño de procesos químicos

Learning outcomes	
RA01	Conocer la historia y evolución de la industria química.
RA02	Entender el concepto de operación unitaria, conocer el fundamento de los diferentes tipos de operaciones unitarias.
RA03	Conocer los distintos fenómenos de transporte, así como la cinética que los rige. Saber emplear las ecuaciones de Newton, Fourier y Fick
RA04	Conocer los fundamentos y las aplicaciones industriales de los procesos de destilación, absorción, extracción líquido-líquido, adsorción e intercambio iónico
RA05	Comprender la diferencia entre reacciones químicas homogéneas y heterogéneas y saber emplear los modelos cinéticos en el estudio de la evolución de las reacciones.
RA06	Conocer el fundamento del uso de catalizadores, los tipos de catalizadores y su influencia sobre la velocidad de reacción.
RA07	Determinar las ecuaciones de velocidad de reacciones químicas y calcular las cantidades de producto obtenido.
RA08	Determinar las ecuaciones de velocidad de reacciones químicas y calcular las cantidades de producto obtenido.
RA09	Conocer y analizar la importancia de los procesos químicos involucrados en algunas de las industrias más importantes del mundo actual (refinerías, combustibles alternativos, papeleras, cementeras, etc).

THEMATIC BLOCKS AND CONTENTS

Contents - Thematic Blocks

Ingeniería Química

Topic 1: INTRODUCTION.

1.1. Scope and historical evolution of Chemical Engineering
1.2. Trends in Chemical Engineering.
1.3. Importance of chemical processes in industrial development.

Topic 2: STAGES OF INDUSTRIAL CHEMICAL PROCESSES.

2.1. Definition of operation and unit process.
2.2. Graphic representation of Industrial Chemical processes.

Topic 3: UNIT OPERATIONS

3.1. Continuous and discontinuous operations.
3.2. Fundamentals and classification of unit operations.
3.3. Flowcharts: representation and interpretation

Topic 4: CHEMICAL EQUILIBRIUM AND TRANSPORT KINETICS IN UNIT OPERATIONS

4.1. Equilibrium conditions between immiscible phases.
4.2. Molecular and turbulent transport.
4.3. Kinetic laws in molecular transport: Newton, Fourier and Fick's laws. Transport coefficients.

Topic 5: OPERATIONS OF SPECIAL INTEREST IN THE CHEMICAL INDUSTRY

5.1 Liquid-liquid extraction.
5.2 Distillation.
5.3 Adsorption-desorption processes.
5.4 Ion exchange.
5.5 Industrial applications.

Topic 6: MASS BALANCES

6.1. Introduction
6.2. Mass baance withouth chemical reactions
6.3. Mass baance with chemical reactions

Topic 7: CHEMICAL REACTIONS AND REACTORS

7.1 Classification of reactions and kinetic models.
7.2 Reaction rate. Catalysis and catalysts
7.3 Chemical Reactors. Homogeneous and heterogeneous reactors

Topic 8: APPLICATION OF CHEMICAL PROCESSES IN INDUSTRY

TEACHING METHODOLOGY

General methodological aspects of the subject

In-class Methodology: Activities

1. Master class and general presentations. Exposure by the teacher to the main concepts is sufficient to induce the student to deepen and delve into such knowledge exposed by the teacher, following his guidelines and relying on the proposed bibliography. It will include dynamic presentations, small practical examples and the regulated or spontaneous participation of the students. The material used in these classes will be available to students in computer support.
2. Resolution of practical problems in class. In these sessions, issues of a level similar to that found in the exams of each topic, previously proposed by the teacher and worked on by the student, will be explained, solved and analyzed.
3. Laboratory practices and Seminars. Students will be assigned to work groups that will have to carry out regulated laboratory practices and seminars on computer simulation of chemical processes.
4. Exhibition of Works. The different groups of students will present their work, which will be discussed and analyzed with the rest.
5. Tutorials. Whose purpose is to resolve doubts and guide students individually or in small groups so that the student does not advance the agenda of the subject, leaving parts that he does not understand or does not know how to focus on.

Non-Presential Methodology: Activities

1. Individual and personal study by the student of the concepts presented in the expository lessons. The material presented in transparencies and the subject's notes will be used for this.
2. Analysis of problems solved in class and whose doubts will be clarified in the tutorials.
3. Resolution of proposed problems and exams from previous courses. Doubts that arise will be dealt with in the tutorials.

4. Study and resolution of practical problems outside of class hours by the student. The student must use and internalize the knowledge provided in the subject. The correction to the class will be made by one of the students or the teacher, depending on the case. The individualized sentence of each exercise will be carried out by the student or another classmate, depending on the subject (exchange method).
5. Laboratory practices. Workgroups of 3 or 4 students will be made, who must carry out regulated laboratory practices. The laboratory practices will end with writing a laboratory report that the students of the group will prepare outside of class hours.
The main objective of the non-contact work is to understand and comprehend the theoretical concepts of the subject, as well as to be able to put this knowledge into practice to solve

SUMMARY STUDENT WORKING HOURS

CLASSROOM HOURS		
Clase magistral y presentaciones generales	Resolución grupal de problemas	Prácticas de laboratorio
23.00	14.00	8.00
NON-PRESENTIAL HOURS		
Estudio y resolución de problemas prácticos fuera del horario de clase por parte del alumno	Prácticas de laboratorio	
78.00	12.00	
ECTS CREDITS: 4,5 (135,00 hours)		

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
• Final Exam (50%) • Midterm Exam (20%)	• Understanding of concepts. • Application of concepts to the resolution of practical problems. • Analysis and interpretation of the results obtained in the resolution of problems. • Presentation and written communication.	70 %
• Laboratory (10%) • Simulation seminars (5%)	• Analysis and interpretation of the results obtained in the practical cases of the laboratory. • Presentation and discussion of the results obtained in the laboratory.	15 %
• Group work (15%)	• Carrying out group work and exposition and defense.	15 %

Ratings
CONVOCATORIA ORDINARIA

The qualification will be obtained by adding the following:

Theory mark (70%):

20% result of midterm exams, carried out throughout the semester (1 or 2 exams).
50% mark on the final exam, including all the course material, must be a 4.0 to pass the subject.

Requirements: The theory mark (average for the final and midterm exams) must be at least 5.0 to pass the course.

Laboratory and works (30%)

15% laboratory note.
15% note of the realization, presentation and defense of group work.

Requirements: Attendance at the laboratory is mandatory. You must earn a 5.0 grade on both the paper and the lab to pass.

CONVOCATORIA EXTRAORDINARIA

The qualification will be obtained by adding the following:

- 15% of the laboratory mark
- 15% the mark of the group work
- 70% of the mark of the exam of the extraordinary call. (The minimum grade for the exam will be 5.0).

Consideraciones generales de evaluación

- For a laboratory, exam or class absence to be considered justified, it is essential to notify and present the supporting document in advance.
- The use of programmable calculators, smartwatches or any other device that allows the connection or storage of data will not be allowed when taking the exams.
- Exams can only be attended by bringing a non-programmable calculator, ruler and writing material. The use of forms, notes, books, etc. is prohibited unless otherwise notified to
the students.
- The laboratory reports are mandatory and must be delivered the same day of the practice before leaving the laboratory.
- Without taking the laboratory, the seminars and doing the work, it is impossible to pass the subject either in the ordinary or the extraordinary call.
- Failure to attend more than 15% of the contact hours of this subject may result in the impossibility of taking the ordinary call.

BIBLIOGRAPHY AND RESOURCES

Basic Bibliography

- Introducción a la ingeniería química. Guillermo Calleja Pardo, Editorial Sintesis. 2010

Complementary Bibliography

- Basic Principles and Calculations in ChemicalEngineering. (8º edición). David H. Himmelblau. Pearson. Agosto 2012
- Warren L. McCabe, Julian C. Smittm. (7º edición). Mc Graw Hill. 207
- Francisco Garcia Herruzo. Introducción a la Ingeniería Química Guillermo Calleja Pardo (editor). 2008

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