VNIVERSITAT DE VALÈNCIA

Course Guide
34209 Chemical Engineering

COURSE DATA

Data Subject	
Code	34209
Name	Chemical Engineering
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Faculty of Chemistry	3	Second term

Subject-matter

Degree	Subject-matter	Character
1110 - Degree in Chemistry	11 - Chemical Industry	Obligatory

Coordination

Name	Department
PEÑA MARTINEZ, MARIA PILAR	245 - Chemical Engineering
RUANO GARCIA, MARIA VICTORIA	245 - Chemical Engineering
VERCHER MONTAÑANA, ERNESTO	245 - Chemical Engineering

SUMMARY

This subject provides students with the basic concepts of chemical engineering: material and energy balances, fundamentals of unit operations and principles of chemical reactors. Also, the aim of the course is to familiarise students with the most important chemical engineering processes. It is a compulsory subject taught in year 3 of the Degree in Chemistry and it is worth a total of 6 ETCS credits in the curriculum.

It is a very practical subject in which, after the introduction of concepts, students will carry out numerous practical exercises and conduct experiments in the laboratory.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

To successfully address the subject, students require some previous knowledge of mathematics and chemistry, which must have been acquired in the subjects studied in previous years. Such knowledge includes:

- Calculation of enthalpy and heat of reaction
- Reaction rate
- Calculation of logarithms and exponentials
- Solution of systems of linear equations
- Solution of nonlinear equations
- Solution of immediate integrals

OUTCOMES

1110 - Degree in Chemistry

- Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate.
- Demonstrate the ability to adapt to new situations.
- Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.
- Demonstrate knowledge of unit operations of chemical engineering.
- Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
- Solve qualitative and quantitative problems following previously developed models.
- Recognise and analyse new problems and plan strategies to solve them.
- Handle chemicals safely.
- Relate theory and experimentation.
- Recognise and evaluate chemical processes in daily life.
- Develop sustainable and environmentally friendly methods.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.

- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.
- Have basic skills in the use of information and communication technology and properly manage the information obtained.

LEARNING OUTCOMES

The previous section includes the competences contained in the document VERIFICA. This subject addresses part of the learning results of the subject Chemical Engineering grade that allow to acquire both specific knowledge of chemistry, cognitive skills and skills and general skills recommended by the EUROPEAN CHEMISTRY THEMATIC NETWORK (ECTN) by the Chemistry Eurobachelor® Label. The following table lists the learning outcomes acquired in the subject Chemical Engineering related to the competences of the degree in Chemistry.

COMPETENCIAS Y HABILIDADES RELACIONADAS CON LA PRÁCTICA DE LA QUÍMICA	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Chemical Engineering that contemplate the learning outcomes EUROBACHELOR®
Capacidades necesarias para realizar procedimientos de laboratorio estándar así como para utilizar instrumentación en trabajos sintéticos y analíticos, en ambos casos en relación con sistemas tanto orgánicos como inorgánicos.	**C1:** Carry out standard experimental procedures involved in synthetic and analytical work, in relation to organic and inorganic systems..(CE18). **C2:** Relate theory and experimentation..(CE22). **C3:** Understand the qualitative and quantitative aspects of chemical problems..(CE24).

Capacidad para interpretar datos derivados de las observaciones y medidas de laboratorio en términos de su relevancia, y relacionarlos con la teoría adecuada.	**C1:** Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them..(CE20). **C2:** Relate theory and experimentation..(CE22). **C3:** Recognise and evaluate chemical processes in daily life..(CE23). **C4:** Understand the qualitative and quantitative aspects of chemical problems..(CE24). **C5:** Relate chemistry with other disciplines.(CE26).
COMPETENCIAS GENERALES	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Chemical Engineering that contemplate the learning outcomes EUROBACHELOR®
Capacidad para aplicar conocimiento práctico para la resolución de problemas relacionados con información cualitativa y cuantitativa.	**C1:** Solve problems effectively..(CG4). **C2:** Solve qualitative and quantitative problems following previously developed models..(CE14). **C3:** Relate theory and experimentation..(CE22). **C4:** Recognise and evaluate chemical processes in daily life..(CE23). **C5:** Understand the qualitative and quantitative aspects of chemical problems..(CE24).

Capacidades de cálculo y aritméticas, incluyendo aspectos tales como error de análisis, estimaciones de órdenes de magnitud, y uso correcto de las unidades.	**C1:** Develop capacity for analysis, synthesis and critical thinking.. (CG1). **C2:** Show inductive and deductive reasoning ability..(CG2). **C3:** Solve problems effectively..CG4).
Habilidades interpersonales para interactuar con otras personas e implicarse en trabajos de equipo.	**C1:** Demonstrate ability to work in teams both in interdisciplinary teams and in an international context..(CG5). **C2:** Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate..(CG7). **C3:** Demonstrate the ability to adapt to new situations..(CG9).

Perform and interpret the flow chart of a process.

Define a chemical process and understand how the different chemical processes works.

Apply material and energy balances to any chemical process.

Identify and explain the physical meaning of each of the terms of the balance equations.

Know the most common unit operations, differing the type transport of property that takes place in them.

Interpret and draw information from the statement of a problem.

Ability to communicate ideas, problems and solutions.

Solve the problem using appropriate mathematical tools.

Ability to develop a problem in a systematic and organized order.

Ability to critically analyze the results of a problem as well as the laboratory results.

Ability to argue from rational and logical criteria.

Know specialized bibliographic sources.

- # Ability to work independently.
- # Ability to integrate and actively participate in group tasks.

Use different equipments and devices of industrial application.

Make measurements with accuracy and precision.

Write clearly and organized reports from the work developed in the laboratory.

Know and understand the concept of industrial sustainability and circular economy

Know the role of chemical engineers in environmental issues

Know strategies to minimize energy consumption and raw materials in the industrial process.

DESCRIPTION OF CONTENTS

1. INTRODUCCTION

Definition of chemical engineering. Chemical process. Forms of operation in the chemical industry. Basic operations.

2. MATERIAL BALANCES

Introduction. Total mass balance. Mass balance applied to a component. Non-reacting systems in steady state. Reacting systems in steady state. Non-reacting systems in unsteady state.

3. ENERGY BALANCES

Total energy balance. Balance of heat energy. Application to non-reacting systems in steady state. Application to reacting systems in steady state. Application to non-reacting systems in unsteady state. Mechanical energy balance.

4. INTRODUCTION TO DESIGN OF REACTORS

Classification. Batch or semi-batch reactors. Continuous flow reactors. Continuous tubular reactor (Plug flow reactor).

5. FUNDAMENTALS OF UNIT OPERATIONS

Transport mechanisms. Molecular transport: transport equations. Conduction heat transfer. Turbulent transport: transport equations. Heat exchanger analysis and design.

6. PRACTICAL LABORATORY

The objective of these laboratory sessions is to show students the experimental methods used in chemical engineering in order for them to learn how to use different equipment and devices for industrial applications, to take measurements with accuracy and precision, to carry out calculations methodically and to write clear reports of the experiments carried out.
Practical sessions:

- Mass balance applied to a component in unsteady state
- Energy balance in unsteady state
- Hydrolysis of ethyl acetate on a batch reactor

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	41,00	100
Laboratory practices	12,00	100
Tutorials	7,00	100
Development of group work	15,00	0
Development of individual work	10,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	13,00	0
Preparation of practical classes and problem	35,00	0
Resolution of online questionnaires	2,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The development of the subject is structured around theoretical and problem-based lessons, laboratory practices and projects.

Theory lectures will serve to present and/or explain the main contents of each unit from which the lecturer will highlight the key aspects.

Practical problem-based lessons will be delivered following two models. In some of the classes, the lecturer will solve a series of sample problems in order to teach students to identify the essential elements in the statement and in the solution of problems. In other practical lessons, students, either individually or in teams, will have to solve similar problems under the supervision of the lecturer.

For laboratory practice sessions, students will have scripts. Experimental sessions will be carried out entirely by them under the supervision of the lecturer.

The work proposed to students will be divided into two types:

a) complete problems with similar complexity to those in exams, aimed at reviewing the most important concepts of each unit

b) self-correcting tests, completed on the Virtual Classroom.

Throughout the course students will receive the corrected materials so that they can work on unfamiliar concepts.

EVALUATION

The subject consists of a theoretical part (85 %) and other part from experimental practices (15 %).

The evaluation of experimental practices will be obtained from the reports of results presented of three practices realized (minimum mark of each memory 3.0 and mean mark equal to or greater than 5.0) and the corresponding practice exam. The mark for the exam has to be equal to or greater than 3.0.

The assessment of theoretical part will be obtained as the greater one of:

Mode A : by assessing the activities of students (20 %) and the note of the exam performed (65 %). The mark for the exam has to be equal to or greater than 4.5

Mode B: from the note of the exam (85 %).

The mark for the theoretical part and the mark for the part from experimental practices must be equal to or greater than 5.0

An examination advance to finish the Grade studies will be able to be requested only if the laboratory associated with the subject is approved.

The laboratory sessions are a non-recoverable and obligatory activity for the course to be passed.

Anyhow, the evaluation system will be based on the guides stated in the “Reglament d’Avaluació i Qualificació de la Universitat de València per a Graus i Màsters” (https://goo.gl/UdDYS2).

Final warning

Copying or plagiarism of any assignment that is part of the evaluation will make it impossible to pass the course, and the student will be subject to the appropriate disciplinary procedures.

Please note that, according to Article 13 d) of the University Student Statute (RD 1791/2010, December 30), "*it is the duty of a student to refrain from using or cooperating in fraudulent procedures in evaluation tests, in the work performed or in official University documents*".

REFERENCES

Basic

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- FELDER, R.M.; ROUSSEAU. R.W Principios Elementales de los Procesos Químicos, Wilmington: Editorial Addison-Wesley Iberoamericana (2ª Edición),1991. 729 p. ISBN: 0201629526
- CALLEJA, G. et al., Introducción a la ingenieria química, Madrid: Síntesis, 1999. 523 p. ISBN: 8477386641

Additional

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- REKLAITIS, G. V., Introduction to material and energy balances, New York: Wiley, 1983. 683 p. ISBN: 0471041319
- COSTA LÓPEZ, J. et al., Curso de química técnica: introducción a los procesos, las operaciones unitarias y los fenómenos de transporte en la ingeniería, Barcelona: Reverté, 1985. 440 p. ISBN: 8429171266
- LEVENSPIEL O. Ingeniería de las Reacciones Químicas, Barcelona: Ed. Reverté, 1990. 638 p. ISBN: 8429173250