COURSE DATA

Data Subject	
Code	34209
Name	Chemical Engineering
Cycle	Grade
ECTS Credits	6.0
Academic year	2021 - 2022

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
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

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

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 (RD 1393/2007) // NO CONTENT (RD 822/2021)

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	**C1:** Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that

de su relevancia, y relacionarlos con la teoría adecuada.	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,	**C1:** Develop capacity for analysis, synthesis and critical thinking.. (CG1).

estimaciones de órdenes de magnitud, y uso correcto de las unidades.	**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).

Draw and interpret a process flowchart.

Define a chemical process and understand how different chemical processes work.

Apply material and energy balances to any chemical process.

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

Know the most common unit operations and the different types of transport of property that take place in them.

Interpret and draw information from the statement of a problem.

Be able to communicate ideas, problems and solutions.

Solve problems using appropriate mathematical tools.

Be able to develop a problem in a systematic and organised manner.

Be able to critically analyse the results of a problem as well as the laboratory results.

Be able to argue from rational and logical criteria.

Know specialised bibliographic sources.

- # Be able to work independently.
- # Be able to integrate into groups and participate actively in group tasks.

Use different equipment and devices for industrial applications.

Make measurements with accuracy and precision.

Write clear and organised reports from the work developed in the laboratory.

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 another part of experimental practices (15%).

The assessment of experimental practices will be based on the reports submitted for three practicals conducted (average mark ≥ 5.0) and on the practical exam (minimum mark ≥ 3.0).

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

- Mode A : based on students' coursework (20 %) and on the final written exam (65%). The mark for the exam must be equal to or greater than 4.5.
- Mode B: based on the final written exam (85 %).

The marks achieved in the theoretical part and in the experimental practices must be ≥ 5.0.

Students entitled to move their exam to an earlier date to finish their degree studies can only request to do so if they have passed the experimental practice section.

The laboratory sessions is 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).

REFERENCES

Basic

- AUCEJO PEREZ A. et al. Introducció a lEnginyeria Química, Barcelona: Biblioteca Universitaria, 2010. 688 p. ISBN: 978-84-7306-556-6
- 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

- COSTA NOVELLA, E. Ingeniería química. Vol. 1, Conceptos generales / Enrique Costa Novella ; con la colaboración de J.L. Sotelo Sancho ... [et al.] . - [1a. ed.] Madrid : Alhambra, 1983. 257 p. ISBN: 8420509906
- 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

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contents

1.- The contents initially indicated in the teaching guide are maintained.

Workload and temporary teaching planning

Regarding the workload:

1.- The different activities described in the Teaching Guide are maintained with the intended dedication.

Regarding the temporary teaching planning:

2.- The material to follow the theory/tutoring/classroom-seminar classes allows to continue the temporary teaching planning both in days and schedule, whether the teaching is face-to-face in the classroom or not, although in some of the activities the student has the freedom to follow the non-face-to-face sessions according to his own planning. Teaching

Methodology

Theory subjects:

Situation of minimal attendance: In theory classes and tutorials the occupation will be, at most, 30% of their usual occupation. Teaching will be online. Students who have a laboratory session before or after theory classes, and the time to travel is longer than the time established in the schedules, will be able to follow the class in person in the classroom assigned in the schedules. When there are students in this situation, classes will be taught by synchronous videoconference in the group classroom.

Maximum face-to-face situation: In theory classes and tutorials, the occupation will respect the sanitary restrictions that limit the capacity of the classrooms. Depending on the capacity of the classroom and the number of students enrolled, it may be necessary that part of the students have to follow the classes synchronously. If this situation arises, the students will attend the group classroom in weekly rotating shifts (preferably in alphabetical order), so as to ensure that the percentage of attendance of all the students enrolled in the subject is the same.

Confinement situation: If for health reasons it is not possible to continue with hybrid teaching, totally or partially affecting the classes of the subject, these will be replaced by synchronous non-face-to-face sessions following the established schedules and using the virtual classroom tools.

Laboratory subjects:

Regarding the laboratory classes, there will be a trend towards maximum attendance, respecting the rules of distance and occupation of spaces set by the academic authorities. In this sense, the "L" type teaching will have 100% attendance and the "U" type teaching will be non-face-to-face and will be taught using the tools offered by the virtual classroom.

In the case of students confined to home due to COVID, to the extent possible, the experimental sessions will be recovered.

In all subjects

If there is a closure of the facilities for health reasons that totally or partially affects the classes of the course, they will be replaced by non-face-to-face sessions following the established schedules and using the tools of the virtual classroom. In the case of students confined to home due to COVID, they will be ensured on-line teaching through Teams or BBC.

Evaluation

2. The evaluation system described in the Teaching Guide of the subject in which the various evaluable activities have been specified as well as their contribution to the final grade of the subject is maintained. If there is a closure of the facilities for health reasons affecting the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade of the subject will remain unchanged, as set out in this guide.

References

2.- The literature recommended in the Teaching Guide is maintained since it is accessible, and it is complemented by notes, slides and problems uploaded to the Virtual Classroom as material of the course.