COURSE DATA

DATA SUBJECT

Code: 46558
Name: Process design and product engineering
Cycle: Master's Degree
ECTS Credits: 4.5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
2261 - Master's Degree in Chemical Engineering	Escola Tècnica Superior d'Enginyeria	1	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2261 - Master's Degree in Chemical Engineering	Process design and product engineering	COMPULSORY

COORDINATION

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SUMMARY

Process Design and Product Engineering is a compulsory module of the Master in Chemical Engineering, consisting of 4.5 ECTS credits, taught in Spanish. This module extends and complements the knowledge acquired in the Degree in subjects such as engineering processes and products.

It is a key module in the curriculum of the Chemical Engineers beause of the great importance that the knowledge of industrial chemical processes and the main techniques for the design of products have. This subject will be oriented towards the description and analysis of some of the most representative processes in the chemical industry, especially focusing on aspects such as the best available techniques, energy saving, environment and raw materials.

A student who passes this module should be able to propose alternatives, compare them and select the most appropriate techniques for a particular product, to interpret flowcharts and know the most representative processes of the chemical industry. The student will have to be able to analyse , projects, integrate chemical units and know the main auxiliary services in a chemical plant. Students also will have to

know the key aspects of product engineering and understand the importance of the design of new products. Some seminars are taught by industrial collaborators.

LEARNING OUTCOMES (RD 1393/2007): List and explain the main techniques for the design of products. Cite and explain representative marketing methods. Understand the main processes of Chemical Industry. Analyze the most representative processes of the chemical industry. Design and integrate industrial chemical processes . Understand the importance of auxiliary services in a chemical plant. Design auxiliary services.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

Students who enroll in this course should have basic knowledge of Physics, Chemistry and Chemical Engineering . It is also highly recommended in order to follow the module to be familiar with most of the common chemical processes in the chemical industry. Students have also to possess an intermediate level of English reading.

COMPETENCES / LEARNING OUTCOMES

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Adapt to changes and be able to apply new and advanced technologies and other relevant developments with initiative and entrepreneurship.

Adapt to structural changes in society caused by economic, energy or natural factors or phenomena in order to solve resulting problems and provide technological solutions with a high commitment to sustainability.

Apply critical reasoning to their knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience and practice, in order to establish economically viable solutions to technical problems.

Be able to access information tools in different areas of knowledge and use them properly.

Be able to analyse and synthesise for the continued progress of products, processes, systems and services while applying criteria of safety, affordability, quality and environmental management.

Be able to apply the scientific method and the principles of engineering and economics to formulate and solve complex problems in processes, equipment, facilities and services in which matter changes its composition, state or energy content, these changes being characteristic of the chemical industry and of other related sectors such as pharmacology, biotechnology, materials science, energy, food or the environment.

Be able to assess the need to complete their technical, scientific, language, computer, literary, ethical,

social and human education, and to organise their own learning with a high degree of autonomy.

Be able to defend criteria with rigor and arguments and to present them properly and accurately.

Be able to solve unfamiliar and ill-defined problems that have specifications in competition by considering all possible methods of solution, including the most innovative ones, and selecting the most appropriate, and correct implementation by evaluating the different design solutions.

Communicate and discuss proposals and conclusions in specialised and non-specialised multilingual forums, in a clear and unambiguous manner.

Design, build and implement methods, processes and equipment for the comprehensive management of supplies and waste - solids, liquids and gases - in industries and be able to assess their impacts and risks.

Design products, processes, systems and services for the chemical industry and optimise others already developed, on the basis of the technologies of various areas of chemical engineering including transport processes and phenomena, separation operations and engineering of chemical, nuclear, electrochemical and biochemical reactions.

Direct and supervise all types of facilities, processes, systems and services in different industrial areas related to chemical engineering.

Have skills for independent learning in order to maintain and enhance the specific competences of chemical engineering which enable continuous professional development.

Integrate knowledge and handle the complexity of formulating judgments and decisions, based on incomplete or limited information, which take account of the social and ethical responsibilities of professional practice.

Lead and define multidisciplinary teams which can make technical changes and address managerial needs in both national and international contexts.

Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.

Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.

Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.

Students should demonstrate self-directed learning skills for continued academic growth.

Students should possess and understand foundational knowledge that enables original thinking and research in the field.

DESCRIPTION OF CONTENTS

1. Conception, design and marketing of products

In this lesson the product is defined from different points of view. The different stages from product design to manufacturing will be also described. Finally several product marketing techniques will be shown.

2. New techniques in the Oil industry and Biorefinery

En este tema inicialmente se describirá el funcionamiento de una refinería tipo. This part will describe the operation of a typical refinery. Then, a series of innovative processes that are either recently developed or their future implementation is in sight will be discussed. Later, the design and integration of the different processes that take place in the refinery will be studied. Afterwards, the auxiliary services necessary for the proper work of a refinery will be shown. Finally, the concept of biorefinery will be introduced and the latest trends in the use of biomass as a raw material to obtain usable chemical compounds and biofuels will be shown.

3. Industries with high energy consumption: cement, ceramics and glass

In this lesson the main manufacturing processes of three industries with high energy consumption will be studied. It will be highlighted the best available techniques and a comparison between the different strategies used to optimize energy consumption in each of these three industries will be conducted. The design and integration of the plants as well as the main auxiliary services required will be considered.

4. Processes for fertilizers production

In this lesson the main processes for the manufacturing of compounds related to the fertilizers industry will be described: sulfuric acid, phosphoric acid and phosphates, and nitric acid. The best available techniques of this industry and its connection with other industrial processes will be highlighted. Finally, the design and integration of the different operation units as well as the main auxiliary services of this industry will be also studied.

5. Polymers and resins. Study of manufacturing processes of elastomers and paints.

In this lesson several processes related to the manufacturing of polymers will be described. As examples, the manufacturing of elastomers, paints and varnishes will be specifically studied. The best available techniques of this industry will be highlighted. Finally, the design and integration of the different operation units as well as the main auxiliary services of this industry will be also studied.

In this part of the subject, qualified professionals who are developing their work in different fields of chemical engineering will give a series of seminars. In these classes, different processes of the chemical

6. Seminars imparted by professionals

industry will be shown as well as the way of working in a real company in order to bring the student closer to the companies.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	21,00
Seminar	12,00
Classroom practices	12,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	15,00
Independent study and work	42,00
Preparation of lessons	0,00
Preparation for assessment activities	0,00
Resolution of case studies	10,00
Total hours	**67,00**

TEACHING METHODOLOGY

Theoretical activities (MD1)

In the theoretical classes the topics will be developed providing a global and integrating vision, analyzing in greater detail the key aspects and those of greater complexity, promoting, in all cases, the student participation. The theory class method will be based mainly on the master class model. The teacher will present the contents of each topic through a presentation, focusing on the key aspects. Professionals in the field of Chemical Engineering will also participate in these activities, in which they will show different processes paying special attention to the actual operation and their differences with the theoretical study.

Practical activities (MD2)

In the practical classes the theoretical activities will be complemented with the aim of applying the basic concepts and expanding them

- Problems solving exercises in the clasroom.

- Oral presentations.

- Discussion sessions previously worked by the students.

Transversal competences (MD3)

Visit to an industrial facility: a visit (or two) to an industry previously explained will take place. The student must carefully study and analyze the industrial process.

EVALUATION

The assessment of student learning will take place as follows. The student will have to do a final exam on the date of the first and / or second call. The final mark will be calculated according to the following criteria:

65 % Mark of the final exam

30 % Marks of the planned activities

5 % Participation

To pass the course, two requirements are needed:

- the mark in the final exam must be equal to or greater than 5

the final mark must be equal to or greater than 5 .

REFERENCES

Basic:

- Introducción a la química industrial (2a. ed.), Vian Ortuño, Ángel. España: Editorial Reverté, 2012. ProQuest ebrary. Web. (libro electrónico).
- Manual de Procesos Químicos en la Industria, Austin, G.T., G.T., Ed. MacGraw-Hill, 1992, traducción de Shreve¿s Chemical Process Industries (5ª Edición), Ed. MacGraw-Hill, 1984.

- Riegel's Handbook of Industrial Chemistry (8ª Edición), Kent, J.A., Ed. Van Nostrand Reinhold Company, 1983.
- Handbook of Chemical Production Processes, Meyers, R.A., Ed. MacGraw-Hill, 1986. Survey of Industrial Chemistry, Chenier, P.J., Ed. Wiley Interscience, 1986.
- Refino de Petróleo, Gary, J.H. y Handwerk, G.E., Ed. Reverté, 1980.
- Dirección y gestión de la producción, Rodrigo, C. y Molí, J., Ed. Sanz y Torres, 2011.
- Guía de Mejores Técnicas Disponibles en España del sector refino de petróleo. Documento BREF. Ministerio de Medio Ambiente, 2004.
- Guía de Mejores Técnicas Disponibles en España de fabricación de cemento. Ministerio de Medio Ambiente, 2003
- Documento de referencia de Mejores Técnicas Disponibles en la industria de fabricación de vidrio. Documento BREF. Ministerio de Medio Ambiente, 2004.
- Mejores Técnicas Disponibles de referencia europea: Producción de polímeros. Documento BREF. Ministerio de Medio Ambiente y Medio Rural y Marino. Traducción del original, 2009.

Additional:

- Kirk-Othmer Encyclopedia of Chemical Technology. 3ª Ed., Raymond Eller Kirk, Donald F. Othmer (editores), Ed. Wiley&Sons, 1978-1984. 4ª Ed., Jacqueline I. Kroschwitz (editor ejecutivo); Mary Howe-Grant ; Kirk-Othmer (editores) , Ed. Wiley&Sons, 1991- ¿
- Encyclopedia of Chemical Processing and Dessign, J. Macketta, William A. Cunningham. (editores), Ed. Marcel Dekker, 1977-...
- Ullmann's Encyclopedia of Industrial Chemistry. CD-ROM. 6th. Edition 1999. Electronic Release. Wiley-VCH.