

**COURSE DATA****Data Subject**

<b>Code</b>	44436
<b>Name</b>	Process design and product engineering
<b>Cycle</b>	Master's degree
<b>ECTS Credits</b>	4.5
<b>Academic year</b>	2020 - 2021

**Study (s)**

<b>Degree</b>	<b>Center</b>	<b>Acad. year</b>	<b>Period</b>
2209 - M.D. in Chemical Engineering	School of Engineering	1	First term

**Subject-matter**

<b>Degree</b>	<b>Subject-matter</b>	<b>Character</b>
2209 - M.D. in Chemical Engineering	9 - Process design and product engineering	Obligatory

**Coordination**

<b>Name</b>	<b>Department</b>
SAN VALERO TORNERO, PAU	245 - Chemical Engineering
SOLSONA ESPRIU, BENJAMIN EDUARDO	245 - Chemical Engineering

**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 because 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.

## 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.

## OUTCOMES

### 2209 - M.D. in Chemical Engineering

- 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.
- Lead and define multidisciplinary teams which can make technical changes and address managerial needs in both national and international contexts.
- 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.
- 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.
- Conceive, plan, calculate and design processes, equipment, industrial facilities and services in the field of chemical engineering and other related industrial sectors in terms of quality, safety, economics, rational and efficient use of natural resources and environmental conservation.



- Know how to establish and develop mathematical models by using appropriate software in order to provide the scientific and technological basis for the design of new products, processes, systems and services and for the optimisation of others already developed.
- 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.
- 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.
- Communicate and discuss proposals and conclusions in specialised and non-specialised multilingual forums, in a clear and unambiguous manner.
- Adapt to changes and be able to apply new and advanced technologies and other relevant developments with initiative and entrepreneurship.
- Have skills for independent learning in order to maintain and enhance the specific competences of chemical engineering which enable continuous professional development.
- Be able to access information tools in different areas of knowledge and use them properly.
- 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 take responsibility for their own professional development and specialisation in one or more fields of study.
- 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.
- 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.
- Conceptualize engineering models; apply innovative methods in problema solving and applications suitable for the design, simulation, optimization and control of processes and systems.
- 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.
- Direct and supervise all types of facilities, processes, systems and services in different industrial areas related to chemical engineering.
- 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.



- Manage and perform verification and control of facilities, processes and products, as well as certifications, audits, inspections, tests and reports.

## LEARNING OUTCOMES

The student should be able to :

- 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.

## 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.

**WORKLOAD**

ACTIVITY	Hours	% To be attended
Theory classes	26,00	100
Classroom practices	14,00	100
Seminars	5,00	100
Development of group work	15,00	0
Study and independent work	37,50	0
Readings supplementary material	5,00	0
Resolution of case studies	10,00	0
<b>TOTAL</b>	<b>112,50</b>	

**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 classroom.*
- *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 Shreves 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 Design, J. Macketta, William A. Cunningham. (editores), Ed. Marcel Dekker, 1977-...
- Ullmanns Encyclopedia of Industrial Chemistry. CD-ROM. 6th. Edition 1999. Electronic Release. Wiley-VCH.

#### **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**

*The contents initially collected in the teaching guide are maintained.*



### ***Volume of work and temporary planning of teaching***

*Regarding the workload:*

*The different activities described in the Teaching Guide are maintained with the planned dedication.*

*Regarding the temporary planning of teaching*

*The material for the follow-up of the classroom theory / practical classes allows to continue with the teaching planned (in both days and hours, and also if the teaching is classroom-based or not).*

### ***Teaching methodology***

*In the classroom theory and practical classes, there will be the maximum possible attendance, whenever the sanitary restrictions that limit the capacity of the classrooms to 50% of their usual occupation are accomplished. If the number of students enrolled exceeds the classroom capacity limit, it may be necessary to distribute the students in two groups in certain sessions that necessarily require attendance. If this situation arises, each group will attend classroom theory and practical sessions with physical presence in the classroom by rotating shifts, thus ensuring compliance with the criteria for occupying spaces. The rotation system will be established once the actual enrollment data is known, guaranteeing, in any case, that the attendance percentage of all the students enrolled in the subject is the same. For classroom sessions and theory sessions that are not face-to-face, there will be a preferably synchronous online teaching model, as long as compatibility with other scheduled activities is allowed. Online teaching will be carried out by synchronous videoconference respecting the schedule, or, if not possible, asynchronous.*

*The visit to the industrial facilities is subject to the possible restrictions of the collaborating entities. If this activity cannot be carried out, it will be replaced by an equivalent complementary.*





*Once the actual enrollment data is confirmed and the availability of spaces is known, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaptation to each subject. Specific teaching conditions will be fixed for each subject.*

*If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes of the subject, these will be replaced by non-contact sessions following the established schedules.*

### **Evaluation**

*The evaluation system described in the Teaching Guide of the subject in which the different 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 that affect 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 on-line mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade for the course will remain unchanged, as established in this guide.*

### **References**

*The references recommended in the Teaching Guide is kept as it is fully accessible.*