Teaching Project Chemical Engineering Products.

Course/ Asignatura	Chemical Engineering Products / Ingeniería Química de Productos.		
Unit / Materia	Process & Product Engineering / Ingeniería de Procesos y Producto		
Module / Módulo	Process & Product Engineering / Ingeniería de Procesos y Producto		
Degree / Titulación	Master in Chemical Engineering/ Máster en Ingeniería Química		
Plan Code / Plan	542	**Couse code/** Código	53746
Period/ Periodo de impartición	2nd Semester / 2º CUATRIMESTRE	**Type /** Tipo/Carácter	COMPULSORY / OBLIGATORIA
Level/Cycle / Nivel/Ciclo	MÁSTER	**Year** / Curso	1º
ECTS credits / Créditos ECTS	4.5 ECTS		
Language / Lengua en que se imparte	SPANISH/ENGLISH		
Staff / Profesor/es responsable/s	María José Cocero Alonso		
Contact / Datos de contacto (E-mail, teléfono…)	mjcocero@iq.uva.es, 983 423174		
Tutoring Schedule / Horario de tutorías	www.uva.es → Centros → Campus de Valladolid → Escuela Ingenierias Industriales → Tutorias		
Department / Departamento	Ingeniería Química y Tecnología del Medio Ambiente		

1. Situation / concept of the subject

1.1 Contextualization

This course is a compulsory topic, that is taught in the second semester of the first year of the Master in Chemical Engineering. It is a subject of marked practical character, where students learn to develop products supported in his chemical engineering background, from the idea to the commercialization.

1.2 Relationship with other subjects

The subject is related to the "sustainability and excellence", focused on promoting students' entrepreneurship, in the opportunity to develop innovative products that can be commercialized.

1.3 Prerequisites

Knowledge of balances of matter and energy, and separation and reaction processes

2. Learning outcomes

2.1 Basic

CG02. Devise, project, calculate, and design processes, equipment, industrial facilities and services in the field of chemical engineering and related industrial sectors in terms of quality, safety, economy, rational and efficient use of natural resources, and environment preservation.

CG03. To lead and manage in a technical and economical way projects, facilities, plants, companies and technology centres in the field of chemical engineering and related industrial sectors.

CG04. Perform appropriate research, design and lead the development of engineering solutions, in new or uncertain environments, relating creativity, originality, innovation and technology transfer.

CG06. To be able to analyse and synthesize the continuous progress of products, processes, systems and services using criteria of safety, economic viability, quality and environmental management.

CG07. Integrate knowledge and face the complexity of making judgments and decision making, based on incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

CG08. To lead and define multidisciplinary teams, capable of solving technical changes and management needs in national and international contexts.

CG09. Communicate and discuss proposals and conclusions in multilingual, specialized and non-specialized forums, in a clear and unambiguous way.

CG10. Adapt to changes, being able to apply new and advanced technologies and other relevant developments, with initiative and entrepreneurial spirit.

CG11. To possess the abilities of the autonomous learning to maintain and to improve the own competences of the chemical engineering that allow the continuous development of the profession.

2.2 Specific

CEP01. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, with critical reasoning to establish economically viable solutions to technical problems.

CEP02 Design products, processes, systems and services of the chemical industry, as well as the optimization of others already developed, taking as technological base the chemical engineering bases, processes, transport phenomena, separation operations and engineering reactions chemical, nuclear, electrochemical and biochemical

.CEP04. Ability to solve problems that are unfamiliar, incompletely defined, and have competing specifications, considering possible methods of solution, including the most innovative, selecting the most appropriate, and being able to correct the implementation, evaluating the different design solutions.

3. Objectives

Chemical engineering fundamental knowledge applied to the development and innovation of commercial products.

1 INTRODUCTION TO INNOVATION IN PRODUCTS.

Understand the usefulness of patents as a source of funding for research and as a source of information.

Calculate the carbon footprint in the development of a product and how to reduce it.

Know different types of products, market, procurement and applications

Know how to obtain products from renewable raw materials, as an alternative to products obtained from petrochemical industry.

2. PRODUCT ENGINEERING DEVELOPMENT.

Develop innovative products, through knowledge of procurement and formulation processes.

Know different formulations in liquid phase, and the procedures to produce them.

Know different processes to obtain solid phase products with sizes of micro and nano-particles.

Know different processes to obtain formulations in solid phase.

Know lignin Biorefineries to obtained products.

Know products from cellulose and lignin.

3. DEVELOPMENT OF A PRODUCT.

Develop an innovative industrial product. Case studies.

Learn how to write and prepare a project application to obtain financing for the stages of research and development of a product.

4. Syllabus

SECTION 1. INTRODUCTION TO INNOVATION IN PRODUCT

1. SCIENTIFIC AND TECHNOLOGICAL SURVEILLANCE APPLIED TO PRODUCT DEVELOPMENT. Intellectual property protection: patents, trademarks and trade names.
2. SUSTAINABILITY IN THE PRODUCT. Carbon footprint and water footprint. The responsibilities of the chemical process industry.
3. TYPES OF PRODUCTS. Commodity products. Molecular products. Microstructures. Nanoparticles. Devices.

SECTION 2. PRODUCTS ENGINEERING DEVELOPMENT.

FORMULATION OF PRODUCTS

4. FORMULATION OF ACTIVE COMPOUNDS IN LIQUID PHASE: emulsions, nano suspensions, micelles and liposomes. Practical case: development of a liquid-phase active compound product.
5. FORMULATION OF ACTIVE COMPOUNDS IN SOLID PHASE I. Micro / nanoparticles. Methods "Top-down": milling and ultra-homogeneizacion. Methods "Bottom-up": crystallization / precipitation. Practical case: development a nano-suspension active compound product.
6 FORMULATION OF ACTIVE COMPOUNDS IN SOLID PHASE II. Encapsulation of active compounds. Encapsulation materials. Encapsulation techniques. Coacervation. Spray drying. Practical case: development nano-materials.

BIOMASS TO PRODUCTS

7 POLYMERS & BUILDING BLOCKS FROM LIGNOCELLULOSIC BIOMASS I. Lignocellulosic biomass biorefinery. Products from cellulose.
8 POLYMERS & BUILDING BLOCKS FROM LIGNOCELLULOSIC BIOMASS. II Lignocellulosic biomass biorefinery. Products from lignin.

SECTION 3. *CASE STUDIES.*

9. PRACTICAL CASES

Entrepreneurship (Incoming Professionals program).

Practical case study in starting an enterprise.

10. OPPORTUNITIES TO SUPPORT PROJECT DEVELOPMENT.

Research & development project proposals.

CHEMICAL ENGINEERING PRODUCT DESIGN PROJECT

Development of a product. Individual and group tutorials (Seminars 4 & 5).

SEMINARS & TASK

SEMINAR 1. Biopolymers from biomass I

Objective: To know and extract the information that can be obtained from the patents
Task 1. Patent study about a bio-based polymers selected among the highs mayor industrial production.

SEMINAR 2 Carbon Footprint.

Objective: Comparative study about the cost of energy from petroleum coke and from biomass that reduces the carbon footprint.
To use SENDECO2 Data Base. https://www.sendeco2.com/es/
Task 2. Evaluate the cost associated with the energy production by fuel, biomass pellets and wastes without a CO2 emission factor.

SEMINAR 3 Biopolymers from biomass. II

Task 3 Bibliographic study. Production processes, products, uses and market. Market study about commercial products made from the biopolymer and its composites.

SEMINAR 4 Development of a new product I.

Product proposal: background literature and patents study, market study about similar products. Project content.
First project inform.

SEMINAR 5. Development of a new product II.

Products development: product composition and characteristics, blocks diagram, mass balance and energy consume. Industrial equipment selection. specification sheets. Applications & marketing.
Second inform submission

SEMINAR 6 Research based products development. Case study.

Bibliography.

Product engineering. Molecular structure and properties. J Wei. Oxford University Press 2007.

Chemical product design. E L Clussler. G O Moggridge. Cambridge 2011

Surfactants science and technology. D Myers. Wiley.2006

Ullmann's Encyclopedia of Industrial Chemistry, John Wiley & Sons, 2003

Natural Product Extraction: Principles and Applications M A. Rostagno, and J Prado. RSC 2013.

Encapsulation Nanotechnologies. V Mittal. Wiley 2013.

http://www.epo.org/

Manuscripts about specific applications that will be distributed from the virtual classroom.

5. Teaching methods

The theoretical classes will use, mainly the expository method to transmit the fundamental knowledge of the subject. In the virtual campus the student will have in advance the material used for the presentations and a reference book on the subject presented.

Seminars where the student will develop tasks related to 1. the use of patent search engines, search of technical and scientific information in publications and patents.2 Bibliographic study about removable products. 3 Carbon Footprint practical exercises.

Project based learning. The student will develop different aspects of product development in case-based tasks.

Laboratory of experimentation with industrial equipment for products development.

6. Study hours

ON-SITE ACTIVITIES	HOURS	OFF-SITE ACTIVITIES	HOURS
Lectures	12	Self-study and individual work	48
Lab innovative products develoment	9	Study and autonomous group work	20
Seminars	24		
Total on-site	**45**	**Total off-site**	**68**

7. Assessment methods – Summary table

ACTIVITY	WEIGHT ON FINAL MARK	COMMENTS
Tasks	25 %	
Cases study	15 %	
Project + oral exam	30 %	
Written test	30 %	

ASSESSMENT CRITERIA
• **Ordinary exam:** Topics from section 2. Product project • **Extraordinary exam:** written + oral part (20% + 20%), tasks 30%, product project 30% (document 20%+10% oral)

8. Closing remarks

ADDENDUM to the Project/Teaching guide of the subject. Adapted to the New Normality

Criteria for this addendum to force into action:

When more than 50% of the university teaching days of the term are spent in a contingency situation, the evaluation criteria will be that as indicated in this addendum.

A4. Contents and Thematic Blocks

d. On-line teaching methods

If face-to-face teaching is not possible, classes and seminars will be given from the virtual classroom.

If it is not possible to do the evaluation in person. The evaluation will be completed by an oral exam using VirtUva tools

e. On-line evaluation

If a face-to-face assessment is not possible. The evaluation will be completed by an oral exam using VirtUva tools.