COURSE DATA

Data Subject	
Code	34772
Name	Process and product engineering I
Cycle	Grade
ECTS Credits	4.5
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	School of Engineering	3	Second term

Subject-matter

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	17 - Process and product engineering	Obligatory

Coordination

Name	Department
GIMENEZ GARCIA, JUAN BAUTISTA	245 - Chemical Engineering
RIBES BERTOMEU, JOSEP	245 - Chemical Engineering

SUMMARY

The main objective of the subject Products and Processes Engineering I is to get the student achieve basic knowledge that will be useful to industrial chemical processes analysis from an integral perspective. He will be able to use industrial chemical processes simulation and optimization tools that him to analyze, design, control, simulate and optimize processes and products.

The **contents** of this subject include analysis, design, control, simulation and optimization of processes and products, and they will be developed in the thematic units described in this guide.

This is a quarterly mandatory subject that is taught in the third year of the degree in Chemical Engineering, along the second half year. In the curriculum being in force at present it consist of a total of 4.5 credits ECTS. This subject is part of a main subject (Products and Processes Engineering) which represents a global weight of 10.5 ECTS, 6.0 of them correspond to the second part that will be taught in the fourth year of the degree.

The subject implies an integration of all the knowledge previously developed in basic subjects of the Chemical Engineering and it introduces the necessary knowledge to propose optimal solutions to the typical problems about design and simulation of industrial installations, where the basic operations studied in other subjects are joined.

Remarks: Theory classes will be given in catalan, while practical classes will be as detailed in the course teaching guide published in the website of this degree.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

In order to get a correct teaching-learning process of this subject it is required that the student has obtained the skills from the fundamental subjects of the Industrial branch (Applied thermodynamics and heat transfer, Fluid mechanics, and Dynamics and control), as well as from the subjects of the specific technology Industrial Chemistry: Basics of Chemical Engineering, Basic operations in Chemical Engineering, and Engineering of chemical reactions, which are studied in previous semesters.
It is also im

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

1401 - Degree in Chemical Engineering

- G4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering.
- G6 - Ability to deal with specifications, regulations and mandatory standards.
- G7 - Ability to analyse and assess the social and environmental impact of technical solutions.
- G10 - Ability to work in a multilingual and multidisciplinary environment.

- G11 - Knowledge, understanding and ability to apply the necessary legislation for practising professionally as a qualified industrial technical engineer.
- TE1 - Knowledge of material and energy balances, biotechnology, matter transfer, separation operations, chemical reaction engineering, reactor design, and valorisation and transformation of raw materials and energy resources.
- TE2 - Ability to analyse, design, undertake simulations and optimise processes and products.
- TE4 - Ability to design, manage and operate simulation, control and instrumentation procedures for chemical processes.

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

The expected learning results of this subject are:

- Understand the basic principles of product and process engineering (TE1, TE2).
- Design processes, equipment and facilities according to standards and specifications (G4, G6, TE1, TE2).
- Operate plant and equipment of the chemical process industry in accordance with standards and specifications (G4, G6, TE1, TE2).
- Analyse processes, equipment and facilities, assess their adequacy and propose alternatives (G4, G7, G10, TE1, TE2).
- Apply the main concepts of process instrumentation and control (G6, TE4).
- Be able to work in teams of their field of work or multidisciplinary (G4, G10).
- Have ability to manage information and use of Information and Communications Technology (G4, G10).
- Possess ability to organize and plan (G4, G10).
- Possess critical thinking skills, creativity and decision making (G4, G7, G11).
- Be able to gather and interpret information and make judgments on issues of social, scientific, technological or ethical (G6, G7, G11).
- Possess skills to continue learning and update their training throughout working life with a high degree of autonomy (G4).

After completing the course, students must:

- Be able to analyse the performance of a variety of unit operations of an industrial chemical process, both isolated and interconnected, and asses their different behaviour.
- Be able to find the optimal resolution strategy of a complex system in order to plan and solve the optimization of either the whole plant or only a specific part of chemical plants.
- Analyse flowcharts and evaluate the performance of process equipment under different operating conditions (production capacity, temperature, pressure, etc.)
- Know the different forms of mathematical modelling of a system and the importance of estimating the model parameters.
- Acquire basic knowledge on systems optimization and be able to apply basic optimization methods to a specific problem.
- Be able to find the optimum operating conditions of an industrial chemical or biotechnological process at the basic conceptual level.

- Be able to manage commercial simulators for design, simulation and optimization of basic industrial processes.
- Be able to work in a multilingual and multidisciplinary environment.

DESCRIPTION OF CONTENTS

1. Design and process integration

Types of processes in the chemical industry. Hierarchies of design and process integration. Process redesign. Industrial process control.

2. Process simulation in Chemical Engineering

Mathematical modelling of chemical processes: Types of models. Parameter estimation. Sensitivity and uncertainty analysis. Practical examples of process modelling.
Simulation tools: Introduction to the simulators. Components of a simulator. Simulation using spreadsheets. Simulation and optimization using Matlab®. Description and use of commercial simulators (Aspen Hysys®). Practical exercises on simulation and optimization with Hysys®.

3. Systems structure

System and subsystems. Interaction of systems. Degrees of freedom of a system. Information flow diagrams. Selection of the design variables.

4. Process optimization in chemical engineering

Basics of optimization: Objective function. Equality and inequality constraints. Properties of functions: topology, continuity, differentiability, monotony and convexity. Local optimum and global optimum. Types of optimization problems.
Nonlinear functions optimization: Analytical methods. Numerical optimization methods. Optimization of one-dimensional systems: five points method, golden section, Coggins method. Optimization of N-dimensional systems: direct search methods, gradient methods, advanced methods for global optimization. Optimization with Matlab ®. Practical optimization exercises in chemical engineering.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	25,00	100
Classroom practices	20,00	100
Development of group work	5,00	0
Study and independent work	10,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	10,00	0
Resolution of case studies	20,00	0
Resolution of online questionnaires	2,50	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

The development of the course is structured around three axis: the theory classes, practical classes and tutoring classes:

Theoretical activities: In the lectures, through the participatory magisterial lesson, the topics will be developed by providing a global and inclusive perspective, analysing the key and more complex issues in detail, and always promoting student participation. For further preparation of the subject in depth by the student the appropriate resources will also be recommended. The main competences worked on by these activities will be G7, G10, G11 and TE1.

Practical Activities: Practical classes will complement the theoretical activities in order to apply the basic concepts and extend them with knowledge and experience they acquire during the performance of the proposed work. This will be done in the classroom or in small groups and the competences G4, G6, G7, G10, G11, TE2 and TE4 will be worked on. They include the following types of classroom activities:

- Classes of exercises and questions in the classroom. The professor will explain a number of sample exercises that allow students to acquire the necessary skills to analyse, formulate and solve the exercises of each theme. Some exercises will be resolved in small group practical classes.
- Discussion sessions and exercises/homework solving. In these sessions, which will be held in small groups, a series of exercises or works previously raised by the teacher and worked by the students in small groups will be analysed and discussed. These sessions will be conducted in small group practical classes.
- Practical activities in computer classroom. In these sessions, students will use the commercial simulator Aspen Hysys® for the practical application of knowledge and skills on design, simulation and optimization developed over the course. These sessions will be conducted in small groups.

Tutoring classes: The tutoring classes will arise as voluntary sessions to resolve any doubts arising in the resolution of problems or of the work that students must perform on their own. In addition, the teacher will guide the student on the most appropriate methodology for learning the fundamental knowledge of the subject. The competences G4, G7, G11, TE1, TE2 and TE4 will be strengthened.

For the development of all these activities both students and the teacher will use the platform called "Aula Virtual".

EVALUATION

The evaluation of student learning will take place via two optional modes. In a first option, the following items will be considered in the final mark: a continuous evaluation, with attendance and practical activities, and a final evaluation exercise. In the second option only a final evaluation exercise will be considered.

Continuous evaluation: It will be based on participation and involvement of the student in the teaching-learning process, considering: the regular attendance at classroom activities, and the resolution of proposed exercises either individually or in small groups. It will weight a 40% of the final mark. Achievement of competences G4, G7, G10, G11 and TE1 will be evaluated.

Final evaluation exercise: The student must perform a single objective test, which will consist of an examination at the end of the semester that will be valued at 60% of the final mark. The exam will consist of both theoretical and practical questions and exercises in order to verify that the students have assimilated the basic concepts of the subject. Achievement of competences G4, G6, G7, G11, TE1 and TE2 will be evaluated.

In sum, the evaluation of student learning for each mode will consist of:

Mode A:

Item	% ON FINAL MARK
Continuous evaluation	40

Final exam	60

Mode B:

Item	% ON FINAL MARK
Final exam	100

To pass the subject, it is necessary to obtain an average mark of 5 out of 10, provided that a mark equal to or greater than 4 points (out of 10) is obtained in the final exam.

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" (http://links.uv.es/xB38OW0).

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