UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: PROCESS ANALYSIS AND OPTIMIZATION
Code: 310741
Type: CORE COURSE
ECTS credits: 6
Degree: 2336 - MASTER DEGREE PROGRAM IN CHEMICAL ENGINEERING
Academic year: 2023-24
Center: 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY
Group(s): 20
Year: 1
Duration: First semester
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **MANUEL ANDRES RODRIGO RODRIGO** - Group(s): **20**

Building/Office	Department	Phone number	Email	Office hours
Enrique Costa. Despacho 01	INGENIERÍA QUÍMICA	3411	manuel.rodrigo@uclm.es	Monday, Wednesday and Friday 9:00-11:00 Please book with UCLM app for a better schedulling

Lecturer: **JOSE LUIS VALVERDE PALOMINO** - Group(s): **20**

Building/Office	Department	Phone number	Email	Office hours
Enrique Costa. Despacho 11	INGENIERÍA QUÍMICA	926295300	joseluis.valverde@uclm.es	Monday, Wednesday and Friday 11:00-13:00 Please book with UCLM app for a better schedulling

2. Pre-Requisites

Not established

3. Justification in the curriculum, relation to other subjects and to the profession

Not established

4. Degree competences achieved in this course

Course competences

Code	Description
CB07	To be able to apply acquired knowledge and problem-solving skills in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study
CB09	To be able to communicate their findings, and the ultimate knowledge and reasons behind them, to specialist and non-specialist audiences in a clear and unambiguous manner
CB10	To possess the learning skills to continue studying in a largely self-directed or autonomous manner.
E01	To 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.
E02	To design products, processes, systems and services of the chemical industry, as well as the optimization of others already developed, taking as technological base the diverse areas of the chemical engineering, comprehensive of processes and transport phenomena, separation processes and engineering of the chemical, nuclear, electrochemical and biochemical reactions.
E03	To conceptualize engineering models, apply innovative methods in problem solving and appropriate software applications, for the design, simulation, optimization and control of processes and systems.
E04	To have the ability to solve problems that are unknown, incompletely defined, and have competing specifications, considering the possible solution methods, including the most innovative ones, selecting the most appropriate one, and being able to correct the implementation, evaluating the different design solutions.
E10	To adapt to structural changes in society caused by factors or phenomena of an economic, energy or natural nature, in order to solve the resulting problems and provide technological solutions with a high commitment to sustainability.
G01	To have adequate knowledge 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 undergoes changes in its composition, state or energy content, characteristic of the chemical industry and other related sectors including the pharmaceutical, biotechnological, materials, energy, food or environmental sectors.
G02	To conceive, 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 environmental conservation.
G03	To direct and manage technically and economically projects, installations, plants, companies and technology centres in the field of chemical engineering and related industrial sectors.
G05	To know how to establish mathematical models and develop them by means of appropriate computing, as a scientific and technological basis for the design of new products, processes, systems and services, and for the optimization of others already developed.
G06	To have the capacity of analysis and synthesis for the continuous progress of products, processes, systems and services using criteria of safety, economic viability, quality and environmental management.
G07	To integrate knowledge and deal with the complexity of making judgments and decisions, based on incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice
G10	To adapt to changes, being able to apply new and advanced technologies and other relevant developments, with initiative and entrepreneurial spirit
G11	To possess the skills of autonomous learning in order to maintain and improve the competences of chemical engineering that allow the continuous development of the profession
MC1	To have acquired advanced knowledge and demonstrated an understanding of the theoretical and practical aspects and of the working

	methodology in the field of Chemical Engineering with a depth that reaches the forefront of knowledge
MC2	To be able, through arguments or procedures developed and supported by themselves, to apply their knowledge, understanding and problem-solving skills in complex or professional and specialized work environments that require the use of creative or innovative ideas
MC3	To have the ability to collect and interpret data and information on which to base their conclusions including, where necessary and relevant, reflection on social, scientific or ethical issues in the field of chemical engineering
MC4	To be able to deal with complex situations or those that require the development of new solutions in the academic, work or professional field of study of Chemical Engineering
MC5	To know how to communicate to all types of audiences (specialized or not) in a clear and precise way, knowledge, methodologies, ideas, problems and solutions in the field of the study of Chemical Engineering
MC6	To be able to identify their own training needs in the field of study of Chemical Engineering and work or professional environment and to organize their own learning with a high degree of autonomy in all kinds of contexts (structured or unstructured).

5. Objectives or Learning Outcomes

Course learning outcomes

Description

To have skills in the use of commercial simulators for the analysis and optimization of processes.

To be skilled in the application of mathematical techniques for system optimization.

To be able to handle the basic concepts of conceptual design of the optimization

To be able to pose complex optimization problems.

To know how to perform energy conservation and thermodynamic efficiency calculations for chemical processes.

6. Units / Contents

Unit 1: Mathematical techniques for funtion optimization

- **Unit 1.1** Direct investigation
- **Unit 1.2** Dynamic programming
- **Unit 1.3** Macrosystems

Unit 2: Optimization problem formulation

- **Unit 2.1** Optimization in parameter estimation. Optimization in balance reconciliation
- **Unit 2.2** Economic optimization in desing and operation of chemical processes
- **Unit 2.3** Optimization in distribution problems
- **Unit 2.4** Case studies

Unit 3: Design of separation trains

- **Unit 3.1** Selection criteria. Sequencing separation processes and distillation columns
- **Unit 3.2** Gas splitting systems. Case studies

Unit 4: Energy conservation and thermodynamic efficiency in separation operations

- **Unit 4.1** Minimum separation work. Net work consumption and thermodynamic efficiency. Case studies
- **Unit 4.2** Reduction in energy consumptions. Case studies

Unit 5: Heat integration

- **Unit 5.1** Introduction to pinch analysis. Heat exchange networks. Auxiliaty services
- **Unit 5.2** Pre-desing of heat exchangers. Case studies

ADDITIONAL COMMENTS, REMARKS

According to the schedule of activities, part of the syllabus will be taught in English, especially cases and practical activities. Students' level of English will not be assessed.

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]		CB07 CB09 CB10 E01 E02 E03 E04 E10 G01 G02 G03 G05 G06 G07 G10 G11 MC1 MC2 MC3 MC4 MC5 MC6	0.72	18	N	-	
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	CB07 CB09 CB10 E01 E02 E03 E04 E10 G01 G02 G03 G05 G06 G07 G10 G11 MC1 MC2 MC3 MC4 MC5 MC6	0.6	15	Y	N	
Class Attendance (practical) [ON-SITE]	Case Studies	CB07 CB09 CB10 E01 E02 E03 E04 E10 G01 G02 G03 G05 G06 G07 G10 G11 MC1 MC2 MC3 MC4 MC5 MC6	1	25	Y	N	
Other off-site activity [OFF-SITE]		CB07 CB09 CB10 E01 E02 E03 E04 E10 G01 G02 G03 G05 G06 G07 G10 G11 MC1 MC2 MC3 MC4 MC5 MC6	3.6	90	N	-	
Progress test [ON-SITE]		CB07 CB09 CB10 E01 E02 E03 E04 E10 G01 G02 G03 G05 G06 G07 G10 G11 MC1 MC2 MC3 MC4 MC5	0.08	2	Y	Y	

		MC6					
			Total:	**6**	**150**		
			Total credits of in-class work: 2.4				**Total class time hours: 60**
			Total credits of out of class work: 3.6				**Total hours of out of class work: 90**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Final test	40.00%	100.00%	
Practicum and practical activities reports assessment	30.00%	0.00%	
Assessment of problem solving and/or case studies	30.00%	0.00%	
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

Minimum grade 4.0/10 in each of the evaluation systems and average value higher than 5.0/10.

Non-continuous evaluation:

Students who have not done the corresponding part of problems or cases of the subject, will be evaluated of these competences in the final exam.

Specifications for the resit/retake exam:

There are no particularities. The grades obtained in the problems or cases are maintained for the students who have passed them in the ordinary call

Specifications for the second resit / retake exam:

There are no particularities.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Class Attendance (theory) [PRESENCIAL][]	18
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	15
Class Attendance (practical) [PRESENCIAL][Case Studies]	25
Other off-site activity [AUTÓNOMA][]	90
Progress test [PRESENCIAL][]	2

General comments about the planning: The assignment of hours to specific topics is not an element that the teacher considers relevant in the programming of the course, since some of the training activities correspond to several topics simultaneously. In the corresponding course planning guide, agreed in the title commission, all the dates of classes and seminars are collected, although they can be slightly modified according to situations that make it necessary.

Global activity

Activities	hours
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	15
Class Attendance (practical) [PRESENCIAL][Case Studies]	25
Class Attendance (theory) [PRESENCIAL][]	18
Other off-site activity [AUTÓNOMA][]	90
Progress test [PRESENCIAL][]	2
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
W.D. Seider; D. R. Lewin; J.D. Seader; S. Widagno; R. Gani; K.M. Ng	Product and process design principles synthesis, analysis, a	John Wiley & Sons,		978-1-119-58800-9 (	2017	
Kemp, Ian	Pinch analysis and process integration : a user guide on pro	Elsevier		0-7506-8260-4	2007	
M.A. Rodrigo	Tecnicas de optimización para Ingenieros Químicos	Puntoicoma soluciones graficas		978-84-615-4081-5	2011	
Seider, Warren D.	Process design principles : synthesis, analysis and evaluati	John Wiley and Sons		0-471-24321-4	1998	
Serth, R. W.	Proccess heat transfer, principles and applications	Elsevier		978-0-12-373588-1	2007	
	chemical engineer handbook					
	Perry's chemical engineers' handbook /	McGraw-Hill Book Company,		978-0-07-142294-9	2008	