UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: INSTRUMENTATION AND CONTROL OF CHEMICAL PROCESSES
Code: 57724
Type: CORE COURSE
ECTS credits: 6
Degree: 344 - CHEMICAL ENGINEERING
Academic year: 2023-24
Center: 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY
Group(s): 21
Year: 3
Duration: C2
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **JAVIER LLANOS LOPEZ** - Group(s): **21**

Building/Office	Department	Phone number	Email	Office hours
Enrique Costa/Despacho 7	INGENIERÍA QUÍMICA	3508	javier.llanos@uclm.es	Monday, tuesday and wednesday 12 a 14 horas. Pls book by email

Lecturer: **MANUEL ANDRES RODRIGO RODRIGO** - Group(s): **21**

Building/Office	Department	Phone number	Email	Office hours
Enrique Costa. Despacho 01	INGENIERÍA QUÍMICA	3411	manuel.rodrigo@uclm.es	Monday, Wednesday and Friday 16:00-18:00 Please book with UCLM app for a better schedulling

2. Pre-Requisites

Although there are no previour requirement, it is highly recommended to have previous knowledge on

(1) operation of units operations and reactor

(2) Solving Differential Equations using Laplace

(3) Electronic instruments

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

Most of the subjects that the student of the Bachelor's Degree in Chemical Engineering has taken up to this moment are aimed at describing the equipment used in the chemical industry and the models through which they are designed, so that the student who arrives at this subject must have developed skills that allow him to design equipment, understand how it works, and compare between different equipment that is used to perform the same task.

However, it does not know how a team in dynamic operating regime will evolve when any of the variables on which its operation depends undergoes a change and, coincidentally, this type of evolution is the one that most interests the chemical engineer who works in the plant. Nor does he know that maintaining these conditions in reality requires the use of instrumentation and algorithms that the engineer must know and know how to apply.

En esta asignatura se pretende conseguir que los alumnos adquieran competencias en el campo de la instrumentación de procesos químicos y en el diseño de sistemas de control.

4. Degree competences achieved in this course

Course competences

Code	Description
CB02	Apply their knowledge to their job or vocation in a professional manner and show that they have the competences to construct and justify arguments and solve problems within their subject area.
CB04	Transmit information, ideas, problems and solutions for both specialist and non-specialist audiences.
CB05	Have developed the necessary learning abilities to carry on studying autonomously
E19	Knowledge about material and energy balances, biotechnology, material transfer, separation operations, chemical reaction engineering, reactor design, and recovery and transformation of raw materials and energy resources.
E20	Capacity for analysis, design, simulation and optimization of processes and products.
E22	Ability to design, manage and operate simulation, control and instrumentation procedures of chemical processes.
G01	Ability to write, sign and develop projects in the field of chemical engineering that are intended, according to the knowledge acquired as established in section 5 of order CIN / 351/2009 of February 9, construction, reform, repair, conservation, demolition, manufacture, installation, assembly or operation of: structures, mechanical equipment, energy installations, electrical and electronic installations, industrial facilities and processes and manufacturing and automation processes.
G02	Capacity for the direction, of the activities object of the engineering projects described in the competence G1.
G03	Knowledge in basic and technological subjects, which enables them to learn new methods and theories, and give them versatility to adapt to new situations.
G04	Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Chemical Engineering.
G05	Knowledge for the realization of measurements, calculations, valuations, appraisals, surveys, studies, reports, work plans and other analogous works.
G10	Ability to work in a multilingual and multidisciplinary environment.

G12	Proficiency in a second foreign language at level B1 of the Common European Framework of Reference for Languages
G19	Capacity for teamwork
G20	Ability to analyze and solve problems
G22	Ability to apply theoretical knowledge to practice

5. Objectives or Learning Outcomes

Course learning outcomes

Description

To have the ability to tune PID controllers.

To have the ability to project the instrumentation of a complex process.

To know the typical instrumentation used in chemical plants, from the basic instrumentation needed for the local control of a process to the architecture of the distributed control systems.

To have the ability to analyze the functioning of chemical-industrial processes in a dynamic operating regime.

To have knowledge about the stability of control loops through feedback.

To have knowledge about PLC programming.

6. Units / Contents

Unit 1: Instrumentation

- **Unit 1.3** Measurement of pressure, level and flowrate
- **Unit 1.4** Measurement of temperature, composition and other parameters
- **Unit 1.5** Transmission and control
- **Unit 1.6** Final elements

Unit 2: Process Dynamics

- **Unit 2.1** Introduction to Process Dynamics. First order systems
- **Unit 2.2** Other dynamic systems.

Unit 3: Local control

- **Unit 3.1** Dynamics of feedback regulated systems
- **Unit 3.2** Setting a PID controller
- **Unit 3.3** Programmable logic controllers

Unit 4: Advaced Process Control. Control of functional units and plants

- **Unit 4.1** Cascade and Selective Control
- **Unit 4.2** Classic multivariable process control
- **Unit 4.3** DCS and SCADA

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]	Combination of methods	CB02 CB04 CB05 E19 E20 E22 G01 G02 G03 G04	1.4	35	N	-	Theoretical classes by master class and resolution of exercises. A part of this activity will be carried out in English.
Workshops or seminars [ON-SITE]	Workshops and Seminars	CB02 CB04 CB05 E19 E22 G01 G02 G03 G04 G20 G22	0.1	2.5	Y	N	Tuning PID controllers
Workshops or seminars [ON-SITE]	Group Work	CB02 CB04 CB05 E19 E20 E22 G01 G02 G03 G04 G10 G12 G19 G20 G22	0.7	17.5	Y	N	Seminar on problems and case studies. A part of this training activity will be carried out in English.
Workshops or seminars [ON-SITE]	Cooperative / Collaborative Learning	CB02 CB04 CB05 E19 E20 E22 G01 G02 G03 G04 G10 G12 G20 G22	0.1	2.5	Y	N	Discussion and resolution in small groups of concepts and doubts
Final test [ON-SITE]	Assessment tests	CB02 CB04 CB05 E19 E20 E22 G01 G02 G03 G04 G10 G12 G20 G22	0.1	2.5	Y	N	
Other off-site activity [OFF-SITE]	Self-study	CB02 CB04 CB05 E19 E20 E22 G01 G02 G03 G04 G05 G10 G12 G19 G20 G22	3.6	90	N	-	
		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
Assessment of problem solving and/or case studies	20.00%	20.00%	Case study on the dynamic analysis of a process
Assessment of problem solving and/or case studies	20.00%	20.00%	PID Controller Tuning Case Study
			Project of instrumentation of an industrial chemical process. It

Assessment of problem solving and/or case studies	20.00%	20.00%	will be held in English and will be defended by public exhibition
Test	40.00%	40.00%	exam with practical questions about the rest of the contents taught in the subject
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:

Mininum rate 4.0/10 in each of the evaluation system and average rate over 5.0/10.

Non-continuous evaluation:

Students who have not completed the corresponding part of problems or cases of the subject, will be evaluated of those competences in the final exam.
Mininum rate 4.0/10 in each of the evaluation system and average rate over 5.0/10.

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][Combination of methods]	35
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	5
Workshops or seminars [PRESENCIAL][Group Work]	15
Workshops or seminars [PRESENCIAL][Cooperative / Collaborative Learning]	2.5
Final test [PRESENCIAL][Assessment tests]	2.5
Other off-site activity [AUTÓNOMA][Self-study]	90

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**
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	5
Class Attendance (theory) [PRESENCIAL][Combination of methods]	35
Workshops or seminars [PRESENCIAL][Group Work]	15
Workshops or seminars [PRESENCIAL][Cooperative / Collaborative Learning]	2.5
Final test [PRESENCIAL][Assessment tests]	2.5
Other off-site activity [AUTÓNOMA][Self-study]	90
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Balcells Sendra, José	Autómatas programables	Marcombo		84-267-1089-1	2003	
Luyben, William L.	Plantwide process control	McGraw-Hill		0-07-006779-1	1999	
Luyben, William L.	Process modeling, simulation, and control for chemical engin	McGraw-Hill		0-07-039159-9	1990	
Martínez Cabeza de Vaca Alajarín, Juan	Problemas resueltos con autómatas programables mediante graf	Universidad de Murcia, Servicio de Publicacione		84-8371-007-2	1999	
Martínez Sánchez, Victoriano Ángel	Automatizar con autómatas programables	Ra-Ma		84-7897-022-3	1991	
Ogata, Katsuhiko	Dinámica de sistemas	Prentice-Hall hispanoamericana		968-880-074-0	1987	
Ogata, Katsuhiko	Ingeniería de control moderna	Pearson-Prentice Hall		978-84-8322-660-5	2010	
Ogunnaike, Babatunde A.	Process dynamics, modeling, and control	Oxford University Press		0-19-509119-1	1994	
Ollero de Castro, Pedro	Control e instrumentación de procesos químicos	Editorial Síntesis		84-7738-517-3	2006	
Seborg, Dale E.	Process dynamic and control	[John Wiley and Sons		0-471-86389-0	1989	
Stephanopoulos, George	Chemical process control : an introduction to theory and pra	Prentice Hall		0-13-128629-3	1984	
	Perry's chemical engineers' handbook	McGraw-Hill Book Company		978-0-07-142294-9	2008	
Shinskey, F. G.	Sistemas de control de procesos : aplicación, diseño y sinto	McGraw-Hill		970-10-0934-7	1996	
King, Myke (1951-)	Process control : a practical approach /	Wiley,		978-0-470-97587-9 (c	2011	