# 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:** 2021-22
**Center:** 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY
**Group(s):** 21 22
**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 22**

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Lecturer: **MANUEL ANDRES RODRIGO RODRIGO** - Group(s): **21 22**

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## 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

Not established

## 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 | Capacity for the direction, of the activities object of the engineering projects described in the competence G1. |
| G02 | Knowledge in basic and technological subjects, which enables them to learn new methods and theories, and give them versatility to adapt to new situations. |
| G03 | 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. |
| G04 | Knowledge for the realization of measurements, calculations, valuations, appraisals, surveys, studies, reports, work plans and other analogous works. |
| G05 | Ability to handle specifications, regulations and mandatory standards. |
| G10 | Knowledge, understanding and ability to apply the necessary legislation in the exercise of the profession of Industrial Technical Engineer |
| G12 | Knowledge of Information and Communication Technologies (ICT). |
| G19 | Ability to analyze and solve problems |
| G20 | Ability to learn and work autonomously |
| G22 | Creativity and initiative |

## 5. Objectives or Learning Outcomes

**Course learning outcomes**

Description

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.

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

## 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 | - | |
| 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 | |
| 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 | |
| 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 | |
| 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% | |
| Assessment of problem solving and/or case studies | 20.00% | 20.00% | |
| Assessment of problem solving and/or case studies | 20.00% | 20.00% | |
| Test | 40.00% | 40.00% | |
| **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:**

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

**Non-continuous evaluation:**

Evaluation criteria not defined

## 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 |

| Global activity | |
|---|---|
| **Activities** | **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 |
| **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 | |
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| 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 | |
| Shinskey, F. G. | Sistemas de control de procesos : aplicación, diseño y sinto | McGraw-Hill | | 970-10-0934-7 | 1996 | |
| 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 | |