GUÍAS DOCENTES

Universidad de Jaén

School of Engineering of Linares

Control and instrumentation of chemical processes

2024-2025

Grado en Ingeniería Química Industrial
Doble Grado en Ingeniería de Recursos Energéticos e Ingeniería Química Industrial

Guías docentes UJA

Horarios de tutorías

Llamamientos PAU

Syllabus 2024-25 - 14412005 - Control and Instrumentation of Chemical Processes (Control e instrumentación de procesos químicos)

Caption
- Level 1: Tutorial support sessions, materials and exams in this language
- Level 2: Tutorial support sessions, materials, exams and seminars in this language
- Level 3: Tutorial support sessions, materials, exams, seminars and regular lectures in this language

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DEGREE: Grado en Ingeniería química industrial (14412005)
FACULTY: SCHOOL OF ENGINEERING OF LINARES
DEGREE: Doble grado en Ingeniería de recursos energéticos e Ing. química industrial (15112005)
FACULTY: SCHOOL OF ENGINEERING OF LINARES
ACADEMIC YEAR: 2024-25
COURSE: Control and Instrumentation of Chemical Processes

SYLLABUS

1. COURSE BASIC INFORMATION

NAME: Control and Instrumentation of Chemical Processes
CODE: 14412005 (*) ACADEMIC YEAR: 2024-25
LANGUAGE: English LEVEL: 1
ECTS CREDITS: 6.0 YEAR: 4 SEMESTER: SC

2. LECTURER BASIC INFORMATION

NAME: MATEO QUERO, MARÍA DE LA SOLEDAD
DEPARTMENT: U122 - INGENIERÍA QUIM.,AMBIENTAL Y DE LOS MAT.
FIELD OF STUDY: 555 - INGENIERÍA QUÍMICA
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LANGUAGE: - LEVEL: 1

3. CONTENT DESCRIPTION

PART A: CHEMICAL PROCESS CONTROL

TOPIC 1.- GENERALITIES

Introduction. Basic concepts and definitions: measurement process, components of a control system, classification of measuring instruments, transmission of the measure (information coding). Piping and instrumentation diagram. Bibliography. Exercises.

TOPIC 2.- TRANSMITTERS

Introduction to transmitters. Types of transmitters: pneumatic transmitters, electronic transmitters, digital transmitters. Comparison of transmitters. Bibliography.

TOPIC 3.- INTRODUCTION TO CONTROLLERS

Basic definitions. Control loop. Types of control. Selection of a PID controller. Tuning rules of a PID controller. Bibliography. Exercises.

TOPIC 4.- MODELING OF THE DYNAMIC BEHAVIOR OF A CHEMICAL PROCESS.

Introduction. General considerations related to mathematical processes. Examples of dynamic models of chemical processes. Bibliography.

TOPIC 5.- DYNAMIC ANALYSIS OF PROCESSES IN THE TIME DOMAIN.

Introduction. Linearization of dynamic models of chemical processes. First order systems. Second order systems. Higher order systems. Bibliography. Exercises.

TOPIC 6.- DYNAMIC ANALYSIS IN THE LAPLACE DOMAIN. TRANSFER FUNCTIONS.

Introduction. Laplace transform. Solving linear differential equations. Transfer functions and input-output models. Transfer functions of distributed parameter systems. Qualitative analysis of the dynamic behavior of a system and concept of stability. Block diagrams. Transfer function model reduction. Bibliography. Exercises.

TOPIC 7.- DYNAMIC ANALYSIS IN THE FREQUENCY DOMAIN.

Introduction. Generalities about frequency response. Frequency response of systems based on several functions. Bibliography.

TOPIC 8.- EMPIRICAL MODELS FOR PROCESS CONTROL.

Introduction. General methodology. Reaction curve method. Bibliography.

TOPIC 9.- TUNING OF PID CONTROLLERS.

Introduction. Response quality criteria. Controller type selection and tuning. Empirical methods of controller tuning. Bibliography.

TOPIC 10.- FINAL ELEMENTS OF CONTROL. CONTROL VALVES.

Introduction to the final elements of control. Parts of a valve. Types of control valves. Inherent characteristic of a valve. Sizing of a valve. Sizing criteria. Cavitation. Noise in valves. Valve controller. Bibliography.

PART B.- INSTRUMENTATION OF CHEMICAL PROCESSES

TOPIC 11.- TEMPERATURE SENSORS.

Introduction. Factors involved in temperature measurement. Types of temperature sensors. Comparison of temperature sensors. Bibliography.

TOPIC 12.- LEVEL SENSORS.

Introduction. General concepts. Classification of the level sensors. Comparison of the level sensors. Bibliography.

TOPIC 13.- FLOW SENSORS.

Flow measurement. Classification of flow sensors. Choice of a flow sensor. Bibliography.

TOPIC 14.- PRESSURE SENSORS.

Concept of pressure and units. Types of pressure sensors. Pressure gauges accessories. Criteria for choosing a pressure gauge. Bibliography.

SEMINAR I : Introduction to sensors. Applications.

SEMINAR II: Exhibition of works on Instrumentation.

LABORATORY PRACTICES

Practice 1: Experimental determination of the parameters of a PID controller.
Practice 2: Filling of the B101 tank of the control unit.
Practice 3: Automatic flow control.
Practice 4: Automatic pressure control.
Practice 5: Automatic level control.

The contents of this course are intended to contribute to Sustainable Development Goal 4: "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

One of the goals (4.4) related to this objective is that students acquire the necessary competencies, particularly technical and professional, to access employment, teaching work and entrepreneurship.

4. COURSE DESCRIPTION AND TEACHING METHODOLOGY

The expository classes in large groups (M1, M3 and M4) will be dedicated to explain the contents of fundamentally theoretical character related to Modern Industrial Control.

The hours dedicated to practical classes will be divided into laboratory practices (M9), discussions (M8), seminars (M7), as well as the development of practical activities and exercise resolution (M6 and M11); some of the practical activities could be based on the analysis of processes with computer tools. Finally, some hours will be dedicated to the presentation and defense of a theoretical-practical work previously developed by the student and related to the topics integrated in the Block of "Instrumentation in Industrial Processes".

The methodologies used, as well as the proposed activities, will allow the acquisition of the competences CB2, CB4, CB3, CB5 and CEQ4, through the learning outcomes Resul-13 and Resul-14.

Students with special educational needs should contact the Student Attention Service (Servicio de Atención y Ayudas al Estudiante) in order to receive the appropriate academic support

5. ASSESSMENT METHODOLOGY

To pass the subject, both in the ordinary and extraordinary exams, students must pass a final face-to-face theoretical-practical exam that will account for 50% of the total weight of the evaluation. The evaluation of the practical part of the subject will be carried out through the delivery of a report (qualified as apt or not) in relation to the work performed in the teaching laboratory of the Department, as well as the completion of a group work (or individual, if it is considered more convenient) related to the syllabus of the subject; the student will have to defend this work in front of the teacher and its weight in the final evaluation will be 20%. Carrying out the proposed activities during the semester will account 20% of the final grade for the subject. Finally, attendance will be controlled, assessing participation and active attitude in class, which will mean 10% of the final grade. To pass the subject, the student must obtain a final overall grade equal to or greater than 5.0 points.

This will allow evaluating the learning results: Resul-13 and Resul-14.

The achievement, by the students, of the aforementioned learning outcomes, contributes to the acquisition of the competences: CB2, CB3, CB4, CB5 and CEQ4.

Note 1: To pass the subject, in general, the score obtained in the theoretical exam must be at least 4.5. If this value is not exceeded, the score obtained in the evaluation corresponding to the practical activities of the subject will not count in the final grade of the same, with which the final grade of the subject will coincide, in this case, with the mark obtained in the theoretical exam.

Note 2: The previous evaluation system would be applied to those students who can attend class regularly (continuous evaluation system). However, there are specific cases of students who cannot follow the aforementioned system. In that case, after justification of the impossibility of adapting to the continuous evaluation system, the student would be evaluated exclusively through the written exam, carried out within the calendar established for the final exams, and would pass the subject by obtaining a minimum grade equal to 5.0 points.

This evaluation system will apply both ordinary and extraordinary exams.

In any case, the evaluation system will be subject to the provisions of the Regulations for Academic Regime and Student Evaluation of the University of Jaén.

6. BOOKLIST (Access the bibliography in the Library catalog)

MAIN BOOKLIST:

- Control e instrumentación de procesos químicos. Edition: -. Author: Ollero de Castro, Pedro. Publisher: Madrid : Editorial Síntesis, D.L. 1997 (Library)

7. SUSTAINABLE DEVELOPMENT GOALS

Educación de calidad

DETAILED INFORMATION

The contents of this course are intended to contribute to Sustainable Development Goal 4: "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

One of the goals (4.4) related to this objective is that students acquire the necessary competencies, particularly technical and professional, to access employment, teaching work and entrepreneurship.

8. VIRTUAL / CLASSROOM TEACHING SCENARIO

SCENARIO : Groups of students below the limited capacity in the classroom.

The teaching methodology to be used in the development of the teaching-learning process for this subject as well as the different activities to be performed in the practical sessions are:

Training activities developed	Format	Teaching methodology used
2 practical sessions in teaching laboratories	Face-to-face 100% as far as the socio-sanitary situation allows it.	Development of 2 practical sessions, each lasting two hours, in the teaching laboratories of the department.
30 theory sessions on the contents of the program	Face-to-face 100% insofar as the social and health situation allows it	30 sessions of participatory lectures, each lasting one hour, held in the classroom

18 sessions of problem solving/exercises. Delivery of Seminar I	Face-to-face 100% as far as the socio-sanitary situation permits.	It will consist of 18 classroom sessions, each lasting one hour.
4 sessions for the presentation of group work and an activity related to the presentation.	Face-to-face 100% as far as the socio-sanitary situation allows it.	Consist of 4 face-to-face sessions in the classroom, of two hours duration each one.
Tutorials	Face-to-face + On-line	Some tutoring sessions will be face-to-face and others online (synchronous and asynchronous).

The expository classes in groups (master classes, introductory activities, and conferences when the situation allows it) will be dedicated to explain contents of fundamentally theoretical character, related to the Modern Industrial Control. They will allow the student to reach the competences CB2, CB3, CB4, CB5 and CEQ4.

On the other hand, the practical activities (problem solving, practical exercises, seminars, discusions, exhibitions and laboratory practices), will allow the student to achieve the competences CB2, CB3, CB4 and CEQ4.

Theoretical classes will be generally supported by the use of different didactic and audiovisual resources such as: cannon, blackboard, computer, internet connection, etc. In the laboratory practices, specific process control teaching equipment will be used. The didactic resources available in the UJA library, both in paper and electronic format, as well as other resources available on the Internet, will be used as support teaching materials.

In the case of online tutoring, this work will be carried out using tools such as e-mail, teaching platform (PLATEA), google meet or any other videotelephony service, etc.

The evaluation criteria will be the same as those established in the first scenario, corresponding to a face-to-face teaching, both for the ordinary and extraordinary call. This system will allow the evaluation of the learning results Result-13 and Result-14.

In the multimodal and/or non face-to-face scenario, when appropriate, the teaching staff involved in teaching reserves the right not to give consent for the capture, publication, retransmission or reproduction of their speech, image, voice and explanations, in the exercise of their teaching functions, within the scope of the University of Jaén.

9. VIRTUAL TEACHING SCENARIO

In this case, the teaching methodology to be used in the development of the teaching-learning process for this subject as well as the different activities to be developed in the practical sessions are:

Training Activities	Format (on-line)	Teaching methodology Description
2 Sessions (to replace the practical sessions in teaching laboratories)	Non face-to-face (synchronous and asynchronous modality)	Substitution of the 2 practical laboratory sessions (two hours each one) by on-line training activities: - Comments on aspects included in the practice scripts. - Presentation of the operation of the Control unit and its sensors. - Viewing of videos related to contents of interest
30 Theory sessions on the contents of the program.	Non-attendance (synchronous)	30 sessions of participative master classes, of one hour duration each, carried out by videoconference.

18 sessions of problem solving/exercises.	Non-attendance (synchronous)	They will consist of 18 synchronous on-line sessions, each lasting one hour, in which exercises related to the topics in which the course is structured will be solved.
4 sessions for the exposition of group works and realization of an activity related to the exposition.	Non-attendance (synchronous)	They will consist of 4 non face-to-face sessions, of two hours each, in which expositions and on-line defenses of the proposed works will be contemplated using virtual teaching tools.
Tutorials	Non face-to-face (synchronous and asynchronous)	All tutoring sessions will be held online (both synchronous and asynchronous) using different interview and communication mechanisms.

The expository classes in groups (master classes, introductory activities, and conferences, when the situation allows it) will be dedicated to explain contents of fundamentally theoretical character, related to the Modern Industrial Control. They will allow the student to reach the competences CB2, CB3, CB4, CB5 and CEQ4.

On the other hand, the practical activities (problem solving, practical exercises, seminars and debates), will allow the students to achieve the competences CB2, CB3, CB4 and CEQ4.

The synchronous non face-to-face teaching will be given by videoconference using the Hangouts meet tool (from Google) or any other videotelephony tool. Some ICT resources will be used, together with the virtual teaching platform as well as the use of e-mail as mechanisms that will allow the teaching-learning process to be carried out. These same tools will be used for tutoring.

Aspect	Criteria	Instrument/Format	Weight
Attendance and/or participation in face-to-face and/or virtual activities.	Active participation in scheduled activities. Participation in discussions.	Observation and teacher's notes (attendance lists). On-line synchronous	10%
Theoretical concepts of the subject	Mastery of the theoretical and operative knowledge of the subject.	Theoretical exam synchronous on-line	40%
Completion of assignments, cases or exercises	Delivery of well solved problems. Attendance to practices is mandatory. Delivery of the practice notebook. Defense of a problem and/or work related to the subject of the course. Evaluation of the structure, quality of the documentation and presentation	◦ Delivery and/or defense of a practical exercise/problems (on-line synchronous and asynchronous). Delivery and defense of an assigned work (evaluation by means of rubric) (on-line asynchronous and synchronous, respectively).	50%

	of the work (related to sensors).		

In order to pass the course, students must pass an on-line theoretical-practical exam that will represent 40% of the total weight of the evaluation. The evaluation of the practical part of the course will be done through the delivery of a report (qualified as pass or fail) in relation to the work done in the teaching laboratory of the Department, as well as the completion of a group work (or individual, if considered more appropriate) related to the subject of the course (instrumentation part: sensors); the student will have to defend this work before the teacher and its weight in the final evaluation will be 25%. The completion of the activities proposed during the four-month period will account for 25% of the final grade of the course. Finally, attendance will be controlled, valuing the participation and active attitude in class, which will represent 10% of the final grade. To pass the course, the student must obtain a final overall grade equal to or higher than 5.0 points.

Note 1: In order to pass the course, in general, the score obtained in the theoretical exam must be at least 4.0. If this value is not exceeded, the score obtained in the evaluation corresponding to the practical activities of the course will not count in the final grade of the same, so that it will coincide, in this case, with the grade obtained in the theoretical exam.

Note 2 : The above evaluation system will be applied to those students who can regularly attend the virtual sessions (continuous evaluation system). However, there are specific cases of students who cannot follow the above mentioned system. In that case, the student would be evaluated exclusively by means of the written exam, carried out within the calendar foreseen for the final exams, and would pass the subject by obtaining a minimum grade equal to 5.0 points.

This system will allow the evaluation of the learning results Result-13 and Result-14.

This evaluation system will be applicable both in the ordinary and extraordinary exams.

In the multimodal and/or non face-to-face scenario, when appropriate, the teaching staff involved in the teaching reserves the right not to give consent for the capture, publication, retransmission or reproduction of their speech, image, voice and explanations, in the exercise of their teaching functions, within the University of Jaén.

DATA PROTECTION CLAUSE (on line exams)

Institution in charge of data processing: Universidad de Jaén, Campus Las Lagunillas, s/n, 23071 Jaén

Data Protection Delegate: dpo@ujaen.es

Purpose: In accordance with the Universities Law and other national and regional regulations in force, carrying out exams and assessment tests corresponding to the courses students are registered in. In order to avoid frauds while sitting the exam, the exam will be answered using a videoconference system, being able the academic staff of the University of Jaén to compare and contrast the image of the person who is answering the exam with the student's photographic files. Likewise, in order to provide the exam with evidential content for revisions or claims, in accordance with current regulation frameworks, the exam will be recorded and stored.

Legitimacy: compliance with legal obligations (Universities Law) and other national and regional regulations currently in force.

Addressees: service providers who are the owners of the platforms where the exams are carried out and with whom the University of Jaén has signed the corresponding data access contracts.

Storage periods: those established in current in force regulations. In the specific case of exam videoconference recordings, not before the examination records and transcripts are closed or the exam can still be reviewed or challenged.

Rights: you can exercise your right of access, amendment, cancellation, opposition, suppression, limitation and portability by sending a letter to the postal or electronic address indicated above. In the event that you consider that your rights have been violated, you may submit a complaint to the Andalusian Council for Transparency and Data Protection www.ctpdandalucia.es

CLASS RECORDING CLAUSE PERSONAL DATA PROTECTION

Person in charge: Universidad de Jaén, Paraje Las Lagunillas, s/n; Tel.953 212121; www.ujaen.es

Data protection delegate (DPO): TELEFÓNICA, S.A.U. ; Email: dpo@ujaen.es

Procedure aim: To manage proper recordings of teaching sessions with the aim of facilitating learning process under a multimodal and/or online teaching

Period for record storage: Images will be kept during legal term according to regulations in force

Legitimacy: Data will be managed according to legal regulations (Organic Law 6/2001, December 21, on Universities) and given consent provided by selecting corresponding box in legal admission documents

Data recipients (transfers or assignments): Any person allowed to get access to every teaching modality

Rights: You may exercise your rights of access, rectification, cancellation, portability, limitation of processing, deletion or, where appropriate, opposition. To exercise these rights, you must submit a written request to the Information, Registration and Electronic Administration Service of the University of Jaen at the address above, or by e-mail to the address above. You must specify which of these rights you are requesting to be satisfied and, at the same time, you must attach a photocopy of your ID card or equivalent identification document. In case you act through a representative, legal or voluntary, you must also provide a document that proves this representation and identification. Likewise, if you consider that your right to personal data protection has been violated, you may file a complaint with the Andalusian Data Protection and Transparency Council www.ctpdandalucia.es