# Development and Introduction of Control Systems in the Chemical Industry

Code: 106066
ECTS Credits: 6

**2024/2025**

| Degree | Type | Year |
|---|---|---|
| 2500897 Chemical Engineering | OT | 4 |

## Contact

Name: Juan Antonio Baeza Labat

Email: juanantonio.baeza@uab.cat

## Teaching groups languages

You can view this information at the end of this document.

## Prerequisites

Experience in automatic process control, instrumentation, automation and programming languages.

## Objectives and Contextualisation

The overall objective of this course is to introduce in a practical way the steps needed to design and implement an automatic control system in the chemical industry.

Specific objectives.

- Implement a data acquisition system applicable to an industrial system.
- Program a data and metadata recording system.
- Design and implement an online monitoring system.
- Program and implement automatic control loops.
- Tune a controller with real inputs and outputs.
- Implement some característics of a SCADA.
- Program a control system in a programmable logic controller.

## Competences

- Analyse, evaluate, design and operate the systems or processes, equipment and installations used in chemical engineering in accordance with certain requirements, standards and specifications following the principles of sustainable development.
- Demonstrate basic knowledge of the use and programming of computers, and apply the applicable IT resources to chemical engineering.
- Demonstrate understanding of the main concepts for controlling chemical engineering processes.
- Develop personal work habits.
- Develop thinking habits.
- Work in a team.

## Learning Outcomes

1. Apply IT resources to the simulation and control of processes.
2. Develop a capacity for analysis, synthesis and prospection.
3. Develop critical thinking and reasoning
4. Use applicable computer assisted design techniques.
5. Use mathematical models of dynamic systems and processes in the field of chemical engineering.
6. Work autonomously.
7. Work cooperatively.

## Content

1. Introduction
2. Data acquisition. Digital inputs and outputs. Analog inputs and outputs. Communication protocols.
3. Data storage
4. Metadata. Data annotation
5. On-line monitoring
6. Digital control loops
7. Implementation of control loops. On-off and PID feedback control. Feedforward control.
8. PID tuning
9. SCADA systems
10. Programmable logic controllers

## Activities and Methodology

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| 01) Introduction | 4 | 0.16 | 1, 4 |
| 02) Data acquisition. Digital inputs and outputs. Analogic inputs and outputs. Communication protocols. | 4 | 0.16 | 1, 4 |
| 03) Data storage | 3 | 0.12 | 1, 4 |
| 04) Metadata. Data annotation | 1 | 0.04 | 1, 4 |
| 05) Online monitoring | 2 | 0.08 | 1, 4 |
| 06) Digital control loops | 2 | 0.08 | 2, 3, 7 |
| 07) Implementation of control loops. On-off and PID feedback control. Feedforward control. | 3 | 0.12 | 1, 4, 5 |
| 08) PID tuning | 2 | 0.08 | 1, 4, 5 |
| 09) SCADA systems | 2 | 0.08 | 1, 4, 5 |
| 10) Programmable logic controllers | 2 | 0.08 | 1, 4 |
| Type: Supervised | | | |

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|---|---|---|---|
| 02) Data acquisition. Digital inputs and outputs. Analogic inputs and outputs. Communication protocols. | 4 | 0.16 | 2, 3, 7 |
| 03) Data storage | 3 | 0.12 | 2, 3, 7 |
| 04) Metadata. Data annotation | 1 | 0.04 | 2, 3, 7 |
| 05) Online monitoring | 2 | 0.08 | 2, 3, 7 |
| 06) Digital control loops | 2 | 0.08 | 1, 4 |
| 07) Implementation of control loops. On-off and PID feedback control. Feedforward control. | 3 | 0.12 | 2, 3, 7 |
| 08) PID tuning | 2 | 0.08 | 2, 3, 7 |
| 09) SCADA systems | 2 | 0.08 | 2, 3, 7 |
| 10) Programmable logic controllers | 2 | 0.08 | 1, 2, 3, 7 |
| Type: Autonomous | | | |
| Software development and individual study | 89 | 3.56 | 1, 2, 3, 4, 5, 6 |

Two-hour classes with a theoretical introduction of the basic elements for each activity, followed by practical work by the students.
The virtual platform used for communication with students will be the UAB Moodle Virtual Campus.
Own laptop is required.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## Assessment

## Continous Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Activity 1. Implementation of a data acquisition system | 10% | 2 | 0.08 | 1, 2, 3, 4, 7 |
| Activity 2. Data recording system | 10% | 2 | 0.08 | 1, 2, 3, 4, 7 |
| Activity 3. Online monitoring | 10% | 2 | 0.08 | 1, 2, 3, 4, 7 |
| Activity 4. Control loop implementation | 10% | 2 | 0.08 | 1, 2, 3, 4, 5, 7 |
| Activity 5. Tuning of a control loop | 10% | 2 | 0.08 | 1, 2, 3, 4, 5, 7 |
| Activity 6. SCADA | 10% | 2 | 0.08 | 1, 2, 3, 4, 5, 7 |
| Activity 7. Programmable logic controller | 10% | 2 | 0.08 | 1, 2, 3, 7 |
| Activity 8. Oral defence of the work done | 30% | 1 | 0.04 | 1, 2, 3, 4, 5, 6 |

a) Planned assessment process and activities

The evaluation activities of the subject are detailed below, with their percentage of weight in the final grade:

- Activity 1 (10%, in group). Implementation of a data acquisition system.
- Activity 2 (10%, in group). Data recording system.
- Activity 3 (10%, in group). Online monitoring.
- Activity 4 (10%, in group). Control loop implementation.
- Activity 5 (10%, in group). Tuning of a control loop.
- Activity 6 (10%, in group). Supervisory control.
- Activity 7 (10%, as a group). Programmable logic controller.
- Activity 8 (30%, individual). Oral defence of the work done.

To apply the calculation of the final mark, a minimum mark of 4 in activity 8 is required.
If this criterion is not met, the maximum final mark for the course will be 4.0.
Failure to attend class when taking assessment tests will result in a zero for the activity, with no possibility of recovery.

b) Scheduling of assessment activities

The schedule of assessment activities will be given on the first day of the course and will be published on the Virtual Campus.

c) Recovery process

Students may sit the make-up exam provided that they have submitted a set of activities that represent a minimum of two thirds of the total grade for the subject.
A minimum of 4.0 in Activity 8 will be required. If this criterion is not met, the maximum final grade for the course will be 4.0.
In agreement with the coordination of the Degree and the management of the School of Engineering, the following activities cannot be recovered: evaluative activities of any kind in which the student has committed an irregularity (copying, plagiarising, allowing copying).

d) Procedure for the revision of grades

For each assessment activity, a place, date and time of review will be indicated where students can review the activity with the teacher. In this context, claims maybe made about the grade of the activity, which will be evaluated by the lecturer responsible for the subject. If the student does not attend this review, the activity will not be reviewed later.

e) Grades

Honours. It is the decision of the lecturers responsible for the subject to award an honours degree (MH). UAB regulations state that MH may only be awarded to students who have obtained a final grade of 9.00 or higher. Up to 5% of the total number of students enrolled may be awarded MH.
A student will be considered non-assessable (NA) if he/she has not appeared in a set of activities whose weight equals a minimum of two thirds of the total grade of the subject.

f) Irregularities on the part of students, copying and plagiarism

Without prejudice to other disciplinary measures that may be considered appropriate, irregularities committed by the student that may lead to a variation in the grade of an evaluation act will be graded with a zero. Therefore, copying, plagiarism, cheating, allowing copying, etc. in any of the assessment activities will result in a zero. Assessment activities graded in this way and by this procedure will not be recoverable.

g) Evaluation of repeating students

There are no changes with respect to new students.

h) Single assessment

This subject does not offer a single assessment.

## Bibliography


- MATLAB. The MathWorks MATLAB® http://es.mathworks.com/
- Arduino. https://www.arduino.cc/


## Software

Use of hardware based on Arduino PLCs.
Matlab and C programming for Arduino.
Siemens Step7 - Microwin for PLC programming.

## Language list

| Name | Group | Language | Semester | Turn |
|---|---|---|---|---|
| (PAUL) Classroom practices | 1 | English | second semester | morning-mixed |
| (SEM) Seminars | 1 | English | second semester | morning-mixed |
| (TE) Theory | 1 | English | second semester | morning-mixed |