Universidad de Alcalá

TEACHING GUIDE

Automation

Degree in
Industrial Technologies Engineering

Universidad de Alcalá

Academic Year 2025/2026

3rd Year - 1st Semester

Approved by the EPS School Board on June 16th, 2025

TEACHING GUIDE

Course Name:	**Automation**
Code:	**610020**
Degree in:	**Industrial Technologies Engineering**
Department and area:	**Automática** **Ingeniería de Sistemas y Automática**
Type:	**Compulsory**
ECTS Credits:	**6.0**
Year and semester:	**3rd Year, 1st Semester**
Teachers:	Por definir
Tutoring schedule:	Consultar al comienzo de la asignatura
Language:	Spanish/English Friendly

1. COURSE SUMMARY

The Automation course aims to introduce students to the technologies applied in industrial automation, including both traditional wired, electrical, and pneumatic automation, as well as programmable automation using logical controllers. It will provide basic knowledge for future studies related to Automation, enabling students to cover advanced programming studies in industrial automation, configuration and management of industrial buses, and systems for monitoring and controlling industrial processes.

Following the course will provide the students with skills for designing, maintaining, or repairing industrial automation installations. Given the practical nature of the course, a set of laboratory practices is proposed to reinforce fundamental theoretical aspects, using examples of real automation systems.

The basic aspects covered in previous courses of Physics, Informatics, and Digital Electronics constitute the grounds for this course.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the Annex to the Orden CIN/352/2009:

en_CG1 - Ability to develop projects in the field of industrial engineering whose purpose is the construction, reform, repair, conservation, demolition, manufacture, installation, assembly or exploitation of: structures, mechanical equipment, energy installations, electrical and electronic installations, industrial plants and facilities and manufacturing and automation processes.

en_CG3 - Ability to solve problems with initiative, decision making, creativity, critical reasoning and communication and transmission of knowledge, abilities and skills in the field of Industrial Engineering.

en_CG4 - Knowledge and ability to apply computational and experimental tools for solving problems in the field of Industrial Engineering.

en_CG5 - Knowledge and ability to apply current legislation as well as mandatory specifications, regulations and standards in the field of Industrial Engineering.

Professional Skills

This course contributes to acquire the following professional skills, which are defined in the Section 5 of the Annex to the Orden CIN/352/2009:

en_CRI6 - Knowledge about the basics of automatisms and control methods.

en_CTE6 - Knowledge and capacity for modeling and simulation of systems.

en_CTE8 - Ability to design control systems and industrial automation.

Learning Outcomes

After succeeding in this subject the students will be able to:

RAFSEA7: Design electrical, pneumatic, and programmable automation systems using contactors, relays, valves, PLCs... employing the properties of Boolean algebra, discrete event systems, and GRAFCET diagrams.

RAFSEA8: Identify/determine the necessary components for control, operation, and detection in electrical and pneumatic automation systems.

RAFSEA9: Prepare the technical documentation for an automation project according to standardized symbology.

RAFSEA10: Choose a programmable logic controller (PLC) for a specific application, based on input/output requirements and available peripherals.

RAFSEA11: Develop, program, and analyze PLC programs according to IEC 61131 standards as part of an automation project.

3. CONTENTS

Contents Blocks	Total number of hours
Introduction to the course. Introduction to technologies used in automation.	2 hours
Block 1. Electrical Automation: control circuits, power circuits, documentation.	14 hours
Block 2. Pneumatic Automation: basic pneumatic system, actuators, valves, design methods, diagram realization standards.	14 hours
Block 3. Programmable Automation: introduction to PLC (Programmable Logic Controller), introduction to PLC programming, PLC programming languages, study of a specific commercial PLC.	26 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (56 hours on-site +2 exams hours)
Number of hours of student work:	92
Total hours	150

4.2. Methodological strategies, teaching materials and resources

Theoretical Sessions	• **Methodology**: Lectures where the teacher presents and explains theoretical aspects, complemented with practical examples. Student participation will be encouraged from the development of theoretical concepts to the resolution of proposed practical examples and discussion of real cases. • **Resources**: Blackboard, audiovisual media, internet access, bibliography.
Problem-Solving Practical Sessions	• **Methodology**: Lectures combined with group and individual work workshops. Small group discussions on problem approaches and their relationship to theory. Written and oral presentation of resolution alternatives. Sharing of proposed solutions. • **Resources**: Blackboard, audiovisual media, bibliography.
Laboratory Practical Sessions	• **Methodology**: Practical work in groups of 2 people. Initial explanation and general discussion of the practice, collaborative work in each group with teacher guidance, management and proper use of material, obtaining results, interpretation, and presentation. • **Resources:** Blackboard, audiovisual media, instrumentation, and laboratory material.
Tutorials and Seminars	• Individual and/or group tutorials on the theoretical and practical contents of the course.
Non-face-to-face Activities	• Problem-solving and practical activities applying theory, bibliographic searches, group work..

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Preferably, students will be offered a continuous assessment system with formative evaluation characteristics, providing feedback in the teaching-learning process.

Ordinary Call

Continous Assessment:

In the ordinary call, all students will be evaluated through continuous assessment, which will consist of an intermediate evaluation test, a final test, and the evaluation of laboratory practices. Students who have followed continuous assessment and not passed it will not be able to opt for the final assessment of the ordinary call. Students who take a number of tests with a total weight in the grade of less than 50% will be considered as Not Presented.

Final Assessment:

Students who submit a written request to the Head of the School may be assessed by final evaluation. This evaluation consists of a final examination with theoretical and practical tests. The deadline for application is two weeks from the start of classes or, if later, from registration for the course.

Assessment through final exam:

In the case of evaluation by means of a final exam, the evaluation elements to be used will be the following:

Extraordinary Call

Students who have not passed the ordinary call will take a test that will include theoretical questions and problem solving.

5.2. EVALUATION

EVALUATION CRITERIA

The assessment criteria measure the level in which the competences have been acquired by the student. For that purpose, the following are defined:

CE1: The student shows ability to resolve practical problems associated with the design of industrial automation systems.

CE2: The student shows ability to implement a complete automation design about electric, pneumatic or programming from a list of functional specifications.

CE3: The student shows the technical knowledge about technologies to implement an automation system.

CE4: The student shows ability to prepare technical documentation about automation projects using the standardized symbology.

CE5: The student shows ability to work with informatics tools to design, simulate, and programming of industrial automation systems.

GRADING TOOLS

This section specifies the assessment instruments that will be applied to each of the Evaluation criteria:

1. **Intermediate Evaluation Test (PEI):** Consists of solving practical problems of modeling, design, programming, and calculation of automation systems, as well as demonstrating knowledge of their technical characteristics.

2. **Lab works (EL):** Consist of the design, programming, and testing of parts or the entirety of industrial automation systems based on functional specifications and using computer tools for assisted design, simulation, and programming of automation systems. Documentation

(calculations, drawings, programs, test results, etc.) associated with each part of the development of an industrial automation system will also be generated and submitted for grading. These practices will be evaluated biweekly or monthly (depending on their complexity) as they are completed.

3. **Final Evaluation Test (PEF):** Consists of solving practical problems of modeling, design, programming, and calculation of automation systems, as well as demonstrating knowledge of their technical characteristics. This test covers the theoretical and practical content of the entire course.

GRADING CRITERIA

In the ordinary call-continuous assessment the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
en_CG1, en_CG3-en_CG5, en_CRI6, en_CTE6, en_CTE8	RAFSEA7-RAFSEA9	CE1-CE4	PEI	40%
en_CG1, en_CG3-en_CG5, en_CRI6, en_CTE6, en_CTE8	RAFSEA7-RAFSEA11	CE1-CE4	PEF	40%
en_CG1, en_CG3-en_CG5, en_CRI6, en_CTE6, en_CTE8	RAFSEA7-RAFSEA11	CE1-CE5	EL	20%

Students who take a number of tests with a total weight in the grade of less than 50% will be considered as Not Presented.

In the ordinary call-final evaluation, the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
en_CG1, en_CG3-en_CG5, en_CRI6, en_CTE6, en_CTE8	RAFSEA7-RAFSEA11	CE1-CE4	PEF	100%

Extraordinary call

In the extrordinary call evaluation, the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
en_CG1, en_CG3-CG5, en_CRI6, en_CTE6, en_CTE8	RAFSEA7-RAFSEA11	CE1-CE4	PEF	100%

The teaching-learning methodology and the assessment process will be adapted as needed, in accordance with the guidelines of the Diversity Support Unit, to implement curricular adaptations for students with specific needs.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Material docente preparado por el profesorado para la asignatura, que será proporcionada a los alumnos a través de la plataforma e-learning de la Universidad de Alcalá.
- P. Ubieto Artur y P. Ibañez Carabantes.Diseño básico de automatismos eléctricos. 4ª edición. Paraninfo 1999.
- A. Serrano Nicolás. Neumática. Paraninfo, 1996.
- Karl-Heinz John y Michael Tiegelkamp. IEC 61131-3: Programming Industrial Automation Systems. Springer, 2010.

6.2. Additional Bibliography

- Germán Santamaría y Agustín Castejón. Manual de automatización eléctrica. Arco/Libro S.A., 1985.
- Vicente Lladonosa. Arranque de motores mediante contactores (Partes I a VI). Marcombo, 1988.
- Salvador Villar Moyo. Automatización electroneumática. Akal, 1999.
- W. Deppert y K. Stoll. Dispositivos neumáticos. Introducción y fundamentos. Marcombo, 1991.
- Pedro Romera, J. Antonio Lorite y Sebastián Montoro.Automatización. Problemas resueltos con autómatas programables. Paraninfo, 1994.

Disclosure Note

During the evaluation tests, the guidelines set out in the Regulations establishing the Rules of Coexistence of the University of Alcalá must be followed, as well as the possible implications of the irregularities committed during said tests, including the consequences for committing academic fraud according to the Regulation of Disciplinary Regime of the Students of the University of Alcalá.