Universidad de Alcalá

TEACHING GUIDE

Automation

Degree in
Industrial Electronics and Automatics Engineering

Universidad de Alcalá

Academic Year 2026/2027

3rd Year - 1st Semester

Approved by the EPS School Board on June 15th, 2026

TEACHING GUIDE

Course Name:	**Automation**
Code:	**600013**
Degree in:	**Industrial Electronics and Automatics Engineering**
Department and area:	**Automática** **Systems Engineering and Automation**
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:	English

1. COURSE SUMMARY

Automation is a 6 ECTS compulsory course included in the first semester, third year of the Degree on Electronics and Industrial Automation. The main objective of this course is to study the design and implementation of discrete event systems and its industrial applications. The main industrial automation technologies (electrical, pneumatic, programmable) and some simulation tools are presented and used to implement practical cases of automation. 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/351/2009:

en_TR2 - Knowledge in basic and technological subjects, which enables them to learn new methods and theories, and gives them versatility to adapt to new situations.

en_TR3 - Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.

en_TR4 - Knowledge to carry out measurements, calculations, assessments, appraisals, appraisals, studies, reports, work plans and other similar works.

en_TR5 - Ability to handle specifications, regulations and mandatory standards.

en_TR9 - Ability to work in a multilingual and multidisciplinary environment.

en_TRU1 - Capacity of analysis and synthesis.

en_TRU2 - Oral and written competencies.

en_TRU3 - Ability to manage information.

en_TRU4 - Autonomous learning skills.

en_TRU5 - Team work.

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/351/2009:

en_CEI7 - Knowledge and capacity for modeling and simulation of systems.

en_CEI8 - Knowledge of automatic regulation and control techniques and their application to industrial automation.

en_CEI9 - Knowledge of principles and applications of robotic systems.

en_CEI11 - Ability to design control systems and industrial automation.

Learning Outcomes

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

RAAC1. Perform simple automations with contactors and relays, using the properties of Boolean

algebra.

RAAC2. Determine the used electrical components in automation for manoeuvre, control and detection of electrical and pneumatic systems.

RAAC3. Prepare the technical documentation of an automatism, using the standardized symbology.

RAAC4. Determine the necessary elements to carry out the automation of a machine or process.

RAAC5. Choose a programmable controller for a specific application, depending on the needed input / output and the available peripherals.

RAAC6. Develop and analyse basic programs for Programmable Logic Controllers (PLC) in instruction lists.

RAAC7. Design and analyse complex programs in ladder diagram.

RAAC8. Design sequential automations using Grafcet.

3. CONTENTS

Contents Blocks	Total number of hours
Subject introduction. Introduction to automation technologies.	2 hours
Module 1. Electric Automatisms. Control of three-phase motors with automation systems. Control and power schemes, design and normalized representation.	14 hours
Module 2. Design of pneumatic automation systems. Pneumatic schemes, design and normalized representation.	14 hours
Module 3. Industrial automation with PLC. Programming PCL following the IEC 61131-3 standard.	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: master classes where the teacher presents and explains the theoretical aspects, complemented by practical examples. Student participation will be encouraged from the theoretical concept developments, to the resolution of the proposed practical examples and the discussion of real cases. Resources: blackboard, audiovisual media, internet, bibliography.
Practical problem solving sessions	Methodology: master classes of troubleshooting workshops combined with group and individual workshops. Small group discussion to reach the problem approaching and to look for the relation with theory. Written and oral presentation of alternative resolutions. Sharing of proposed resolutions. Resources: blackboard, audiovisual, bibliography.
Hands-on labs	Methodology: groups of 2 persons maximum to work. Initial explanation and general discussion of the practice, collaborative work in each group with the teacher's guide, management and good use of the material, obtaining results, interpretation and presentation. Resources: blackboard, audiovisual, instrumentation and laboratory equipment.
Tutorials and seminars	Individual and/or group tutorials on the theoretical and practical subject contents.
Non-contact activities	Resolution of problems and practices by application of the theory, bibliographic search, 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.

Ordinary Call

Continous Assessment:

The evaluation consists of an intermediate evaluation test, a final test and the evaluation of laboratory practices. Students who take a number of tests whose total weight in the grade is less than 50% will be considered Non-Presented.The students, as a group, will deliver the reports of the laboratory practices following the established schedule. These practices will be evaluated by the professor responsible for the laboratory group, to assess if the objectives indicated in the script of the same have been met.

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.

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. .

EVALUATION INSTRUMENTS

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

1. **Intermediate Evaluation Test (PEI)**: based on the problem resolution about modelling, design, programming and evaluation of automation systems, as well as the demonstration of the knowledge of the technical characteristics of the systems.
2. **Lab works (EL)**: they consist of the design, programming and testing of parts or the totality of

industrial automation systems based on functional specifications and using computer-aided design, simulation and automation programming tools. The documentation corresponding to each stage of the industrial automation development (including calculations, drawings, software, test results, etc.) will also be prepared and submitted for assessment.

3. **Final Evaluation Test (PEF)**: based on the resolution of problems of modelling, design, programming and evaluation of automation systems, as well as the demonstration of the knowledge of the technical characteristics of the systems.

QUALIFICATION 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_TR2 - en_TR5, en_TRU1 - en_TRU5, en_CEI7, en_CEI8, en_CEI11	RAAC1-RAAC4	CE1-CE4	PEI	40%
en_TR2 - en_TR5, en_TRU1 - en_TRU5, en_CEI7, en_CEI8, en_CEI11	RAAC1-RAAC8	CE1-CE4	PEF	40%
en_TR2 - en_TR5, en_TR9, en_TRU1 - en_TRU5, en_TRU9, en_CEI7 - en_CEI9, en_CEI11	RAAC1-RAAC8	CE1-CE5	EL	20%

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_TR2 - en_TR5, en_TRU1 - en_TRU5, en_CEI7 - en_CEI9, en_CEI11	RAAC1-RAAC6	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_TR2 - en_TR5, en_TRU1 - en_TRU5, en_CEI7 - en_CEI9, en_CEI11	RAAC1-RAAC6	CE1-CE4	PEF	100%

The teaching-learning methodology and the evaluation process will be adjusted when necessary, with the guidance of the Diversity Support Unit, to apply curricular adaptations for students with specific needs.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Teaching material prepared by the faculty for the course, which will be provided to students through the e-learning platform of the University of 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.
- J. 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.