



Course guide

320035 - AI - Industrial Automation

Last modified: 19/04/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: JOSE LUIS ROMERAL MARTINEZ

Others: ÁNGEL FERNÁNDEZ SOBRINO
LORENZO MARÍN MERCHÁN
JOAN VALLS PEREZ

REQUIREMENTS

Students are expected to have passed the second-year subject Industrial Control and Automation.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. ELO: Ability to design and control automation systems.

TEACHING METHODOLOGY

- Face-to-face lecture sessions.
- Face-to-face practical work sessions.
- Independent learning and exercises.

In the face-to-face lecture sessions, the lecturer will introduce the basic theory, concepts, methods and results for the subject and use examples to facilitate students' understanding.

Students will be expected to study in their own time so that they are familiar with concepts and are able to solve the exercises set.

LEARNING OBJECTIVES OF THE SUBJECT

This subject introduces students to various technologies used in automated systems and provides the basic knowledge necessary to assess, design, program and maintain the various types of industrial automation systems. Emphasis will be placed on the international industrial automation standard IEC-61131.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	30,0	20.00
Hours small group	30,0	20.00

Total learning time: 150 h

CONTENTS

TOPIC 1: INTRODUCTION

Description:

- 1.1. Objective of the subject
- 1.2. Review of the basics of automation
- 1.3. Distributed automation systems

Specific objectives:

- An understanding and command of the basic concepts of automation.
- The ability to analyse and solve automation problems.

Full-or-part-time: 8h

Theory classes: 2h

Laboratory classes: 2h

Self study : 4h

TOPIC 2: IEC-61131 STANDARDISED SYSTEMS

Description:

- 2.1. The IEC-61131 standard.
- 2.2. Types of data. Organisational units of an automation project.
- 2.3. Standard programming languages: IL, Ladder, FBD, SFC, ST.

Specific objectives:

- An understanding of the IEC international standard on industrial automation.
- The ability to program and structure automation systems.
- The ability to configure a high-level programmable automaton.
- The ability to outline and solve problems in the field of industrial automation and control.

Related activities:

- Resolution of practical automation problems using the presented techniques.
- Programming of industrial processes using programmable automatons.

Full-or-part-time: 25h

Theory classes: 5h

Laboratory classes: 5h

Self study : 15h



TOPIC 3: PROGRAMMING IN SFC (GRAFSET)

Description:

- 3.1. Basic elements.
- 3.2. Evolution rules.
- 3.3. SFC (Grafset) structures. Macrosteps.
- 3.4. Programming in SFC.

Specific objectives:

An understanding of the programming of complex automation systems.
The ability to program automation systems in SFC.
The ability to solve automation problems using these techniques.

Related activities:

Resolution of practical automation problems using the presented techniques.
Programming of industrial processes using programmable automatons.

Full-or-part-time: 25h

Theory classes: 5h
Laboratory classes: 5h
Self study : 15h

TOPIC 4: STRUCTURED TEXT (ST) PROGRAMMING

Description:

- 4.1. Introduction to PLC programming using high-level languages: ST.
- 4.2. Variables.
- 4.3. Programming functions and structures.

Specific objectives:

The ability to programme automation systems using high-level languages.

Related activities:

Resolution of practical automation problems using the presented techniques.
Programming of industrial processes using programmable automatons.

Full-or-part-time: 17h

Theory classes: 3h
Laboratory classes: 3h
Self study : 11h

TOPIC 5: ANALOGUE SIGNAL PROCESSING

Description:

- 5.1. Types of signals in automation systems.
- 5.2. Analogue sensors and actuators.
- 5.3. Structure of analogue input and output modules.
- 5.4. Programming automation applications with analogue signals.

Related activities:

Resolution of practical automation problems using the presented techniques.
Programming of industrial processes using programmable automatons.

Full-or-part-time: 25h

Theory classes: 5h
Laboratory classes: 5h
Self study : 15h



TOPIC 6: INDUSTRIAL COMMUNICATIONS

Description:

- 6.1. Introduction to communications.
- 6.2. Industrial communication networks
- 6.3. Standard fieldbuses.
- 6.4. Web servers and ethernet networks.

Related activities:

Resolution of practical automation problems using the presented techniques.
Programming of industrial communication systems using programmable automatons.

Full-or-part-time: 25h

Theory classes: 5h
Laboratory classes: 5h
Self study : 15h

TOPIC 7: SUPERVISION AND SECURITY OF AUTOMATION SYSTEMS

Description:

- 7.1. SCADA.
- 7.2. Programmable user interfaces.
- 7.3. System security rules.

Related activities:

Resolution of practical automation problems using the presented techniques.
Programming of industrial processes using SCADA.

Full-or-part-time: 25h

Theory classes: 5h
Laboratory classes: 5h
Self study : 15h

GRADING SYSTEM

- Automation theory examinations: 70% (25% 1st and 45% 2nd)
- Automation laboratory: 30%

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.

If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

BIBLIOGRAPHY

Basic:

- Stallings, William. Comunicaciones y redes de computadores [on line]. Madrid: Pearson Educación, 2004 [Consultation: 09/05/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1245. ISBN 8420541109.
- Mandado Pérez, Enrique. Sistemas de automatización y autómatas programables. Tercera edición. [Barcelona]: Marcombo, 2018. ISBN 9788426725899.
- Balcells Sendra, Josep; Romeral Martínez, José Luis. Autómatas programables. Barcelona: Marcombo, 1997. ISBN 8426710891.



Complementary:

- John, Karl Heinz; Tiegelkamp, Michael. IEC 61131-3: programming industrial automation systems: concepts and programming languages, requirements for programming systems, decision-making aids [on line]. Berlin, Heidelberg: Springer, 2010 [Consultation: 09/05/2022]. Available on: <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-642-12015-2>. ISBN 9783642120152.

- Piedrafita Moreno, Ramón. Ingeniería de la automatización industrial. 2a ed. Paracuellos de Jarama: Ra-Ma, 2004. ISBN 8478976043.

RESOURCES

Other resources:

PLCs manuals used in laboratory practices

IEC 61131 standards

ISO / IEC 7498-1: 1994, Open Systems Interconnections

Information and notes on ATENEA