

Course guide 320020 - CAIA - Advanced Industrial Control and Automation

Last modified: 02/04/2024

Unit in charge: Teaching unit:	Terrassa School of Industrial, Aerospace and Audiovisual Engineering 707 - ESAII - Department of Automatic Control. 709 - DEE - Department of Electrical Engineering.		
Degree:	BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).		
Academic year: 2024	ECTS Credits: 6.0	Languages: Catalan	

LECTURER

Coordinating lecturer:	Romero Duran, David Perez Magrane, Ramon
Others:	Comasolivas Font, Ramon

PRIOR SKILLS

Students will be expected to have passed Industrial Control and Automation.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE25. ELE: Applied knowledge of power electronics.

CE21. ELE: Understanding of machine control, electric drive systems and their applications.

CE22. ELE: Ability to calculate and design high-voltage electrical installations.

CE26. ELE: Understanding of the principles of automatic control and their application to industrial automation.

Basic:

CB01. That students have demonstrated knowledge and understanding in a field of study that part of the basis of general secondary education, and is typically at a level which, although it is supported by advanced textbooks, includes some aspects that involve knowledge of the forefront of their field of study.

CB02. That students can apply their knowledge to their work or vocation in a professional manner and possess the competencies typically demonstrated through the development and defense of arguments and problem-solving within their field of study.

TEACHING METHODOLOGY

Face-to-face sessions

a) Classroom sessions. The lecturer presents the theoretical content of the subject, performs demonstrations using a computer, assigns exercises and answers questions.

- b) Laboratory sessions. Students carry out a series of laboratory practicals.
- c) Assessment sessions. Individual tests on the material. Take-home work.
- d) Individual study and exercise completion.
- e) Completion of assignments and exercises to be handed in.



LEARNING OBJECTIVES OF THE SUBJECT

This subject introduces students to various technologies used in automatic systems and provides the basic knowledge necessary to assess, design, program and maintain industrial automation and process-control systems.

In the first part of the subject, students learn about the basic concepts and characteristics of wired and programmable automation systems, as well as the various technologies that comprise them. Students study programmed systems (the basic elements of automation systems) and learn the generic structure of programmable automatons (PLCs), which is the basic element used in the laboratory practicals.

In the second part of the subject, students study the characteristics of continuous and discreet feedback control systems and controller design. This portion of the subject is conducted in the laboratory. Special emphasis will be placed on performance analysis (stability, precission and velocity). Students' training in automatic control skills is concentrated in this subject and in Industrial Control and Automation.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

AUTOMATION PART

Description:

TOPIC 1: INTRODUCTION (Automation)

Description:

- Objective of the subject.
- Review of the basics of automation.
- Distributed automation systems.

Full-or-part-time: 10h

Theory classes: 2h Laboratory classes: 2h Self study : 6h

TOPIC 2: IEC-61131 STANDARDISED SYSTEMS (Automation)

Description:

- Types of data.
- Organisational units of an automation project.
- Standard programming languages: IL, Ladder, FBD, SFC, ST.

Full-or-part-time: 20h

Theory classes: 4h Laboratory classes: 4h Self study : 12h



TOPIC 3: STANDARD PROGRAMMING LANGUAGES (Automation)

Description:

- Basic elements.
- Evolution rules.
- SFC (Grafcet) structures. Macrosteps.
- Programming in SFC.
- Introduction to PLC programming using high-level languages: ST.
- Variables.
- Programming functions and structures.

Full-or-part-time: 30h

Theory classes: 5h Laboratory classes: 7h Self study : 18h

TOPIC 4: ANALOGUE SIGNAL PROCESSING (Automation)

Description:

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

Full-or-part-time: 15h

Theory classes: 4h Laboratory classes: 2h Self study : 9h

(ENG) BLOC DE CONTROL

TOPIC 5: FEEDBACK CONTROL

Description:

- Control systems, description.
- Dynamic systems models.
- Feedback control.

laboratory description:

Identification of laboratory plant

Specific objectives:

Description of control systems Creation of dynamic systems models Analysis of feedback control systems

Related activities:

Master class, problems and lab.

Full-or-part-time: 25h Theory classes: 5h Laboratory classes: 5h Self study : 15h



TOPIC 6: ANALYSIS OF CONTROL SYSTEMS

Description:

- Precision analysis
- Stability analysis
- Velocity analysis

Laboratory description:

Estudy of control system caracteristics

Specific objectives:

- Analyser the precision, stability and velocity of a control loop
- Controller tunning

Related activities: Master class, problems and lab

Full-or-part-time: 25h

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

TOPIC 7: DESIGN OF CONTROL SYSTEMS

Description:

- Controler tunning (pole assignement and frequency)

Laboratory description:

Controler tunning

Specific objectives: Discreet models construction Discretized systems models Discreet controllers design

Related activities: Master class, problems and lab

Full-or-part-time: 25h Theory classes: 5h Laboratory classes: 5h Self study : 15h



GRADING SYSTEM

- 1rst exam: 25%
- 1rst lab exam: 15%
- Second exam: 25%
- 2ond lab exam: 15%
- Laboratory: 20%

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:

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

- Mandado, Enrique [et al.]. Autómatas programables: entorno y aplicaciones. Madrid: International Thomson Paraninfo, 2005. ISBN 8497323289.

- Phillips, Charles L. Digital control system analysis and design. Englewood Cliffs: Prentice-Hall, 1984. ISBN 0132120437.

- Ogata, Katsuhiko. Ingeniería de control moderna [on line]. 5ª ed. Madrid: Pearson Educación, 2010 [Consultation: 19/09/2022]. A vailable on:

https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1259. ISBN 9788483229552.

Complementary:

- Seborg, Dale E. [et al.]. Process dynamics and control [on line]. 4th ed. Hoboken, NJ: Wiley, 2017 [Consultation: 25/06/2024]. Available on:

https://web-p-ebscohost-com.recursos.biblioteca.upc.edu/ehost/ebookviewer/ebook?sid=e60b0ee7-b56f-4f9e-9cd2-f53d9a527780% 40redis&vid=0&format=EB. ISBN 9781119285915.