Last update: 23-04-2019

# 320020 - CAIA - Advanced Industrial Control and Automation

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 707 - ESAII - Department of Automatic Control
709 - EE - Department of Electrical Engineering

Academic year: 2019

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan

## Teaching staff

Coordinator: 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

Basic:

CB01. IND_DIS_AUD: 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. IND_DIS_AUD: That students can apply their knowledge to their work or vocation in a professional manner and have competences typically demonstrated through devising and defending arguments and solving problems within their field of study.

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.

## 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

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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

| | | | |
|---|---|---|---|
| Total learning time: 150h | Hours large group: | 30h | 20.00% |
| | Hours medium group: | 0h | 0.00% |
| | Hours small group: | 30h | 20.00% |
| | Guided activities: | 0h | 0.00% |
| | Self study: | 90h | 60.00% |

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## Content

### AUTOMATION PART

Degree competences to which the content contributes:

### TOPIC 1: INTRODUCTION (Automation)

Learning time: 10h

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

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

### TOPIC 2: IEC-61131 STANDARDISED SYSTEMS (Automation)

Learning time: 20h

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

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

### TOPIC 3: STANDARD PROGRAMMING LANGUAGES (Automation)

Learning time: 30h

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

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.

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| TOPIC 4: ANALOGUE SIGNAL PROCESSING (Automation) | Learning time: 15h<br>Theory classes: 4h<br>Laboratory classes: 2h<br>Self study : 9h |
|---|---|

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.

## (ENG) BLOC DE CONTROL

Degree competences to which the content contributes:

| TOPIC 5: FEEDBACK CONTROL | Learning time: 25h<br>Theory classes: 5h<br>Laboratory classes: 5h<br>Self study : 15h |
|---|---|

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

laboratory description:

Identification of laboratory plant

Related activities:
Master class, problems and lab.

Specific objectives:
Description of control systems
Creation of dynamic systems models
Analysis of feedback control systems

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| TOPIC 6: ANALYSIS AND DESIGN OF CONTROL SYSTEMS | Learning time: 25h<br>Theory classes: 5h<br>Laboratory classes: 5h<br>Self study : 15h |
|---|---|

Description:
- Precision analysis
- Stability analysis
- Velocity analysis
- Controler tunning

Laboratory description:

Estudy of control system caracteristics
Controller tunning

Related activities:
Master class, problems and lab

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

| TOPIC 7: DISCREET CONTROL SYSTEMS | Learning time: 25h<br>Theory classes: 5h<br>Laboratory classes: 5h<br>Self study : 15h |
|---|---|

Description:
- Discreet models
- Discreet control laws

Laboratory description:

Discreet control of the laboratory plant

Related activities:
Master class, problems and lab

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

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## Qualification 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.

Ogata, Katsuhiko. Sistemas de control en tiempo discreto. México: Prentice Hall Hispanoamericana, 1996. ISBN 9688805394.

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

Ogata, Katsuhiko. Ingeniería de control moderna [on line]. 3ª ed. México D.F. [etc.]: Prentice-Hall Hispanoamericana, 1998 [Consultation: 04/10/2018]. Available on: <http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1259>. ISBN 9701700481.

Complementary:

Seborg, Dale E. Process dynamics and control. New York: John Wiley and Sons, 1989. ISBN 0471859338.

Others resources: