

## 320015 - CAI - Industrial Automation and Control

Coordinating unit:	205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit:	707 - ESAll - Department of Automatic Control 710 - EEL - Department of Electronic Engineering 709 - EE - Department of Electrical Engineering
Academic year:	2019
Degree:	BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits:	6
Teaching languages:	Catalan, Spanish

### Teaching staff

Coordinator:	MASIP ALVAREZ, ALBERT
Others:	AJENJO ESCOLANO, ENRIQUE JAVIER CAYERO BECERRA, JULEN DAMUNT MASIP, JORDI DELGADO PRIETO, MIGUEL FERNÁNDEZ SOBRINO, ÁNGEL LAVÈRNIA FERRER, DAVID LOPEZ GONZALEZ, ALEJANDRO ESTEBAN MASIP ALVAREZ, ALBERT QUEVEDO CASIN, JOSEBA-JOKIN ROMERAL MARTINEZ, JOSE LUIS ROMERO DURAN, DAVID ROMERO PEREZ, DANIEL ROTONDO, DAMIANO SOLA DE LAS FUENTES, GLORIA

### Opening hours

Timetable:	It will be published during the lectures.
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### Prior skills

it is recommended to have passed the following subjects:

- Maths (I, II and III)
  - Physics
  - Electrical systems
  - Mechanical systems
  - Fundamentals of computer science
- for the proper understanding of the subject.

### Degree competences to which the subject contributes

Specific:

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CE12. IND\_COMMON: understanding of the fundamentals of automation and control methods.

Transversal:

06 URI N2. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

### Teaching methodology

- In-class lecture sessions.
- In-class practical work sessions.
- Autonomous learning and exercises.
- Preparation and completion of group activities subject to assessment.

The lecturer will introduce the theoretical fundamentals of the subject, concepts, methods and results during the in-class lectures. Every concept will be illustrated with relevant examples to ease their 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

Establish the theoretical fundamentals of automatic control. Link the techniques in this discipline to others previously learnt (mathematics, physics, circuits). Solve automatic control problems that may go beyond what is strictly covered in theoretical sessions by working in teams, finding information and taking decisions.

Describe the structure and importance of systems that make possible the automation of manufacturing and production processes in industrial environments. Identify and apply the various types of components used in automation processes. Use the tools and criteria to ensure that the most suitable components are selected. Establish the settings for programming programmable industrial systems and solve basic automation problems using the tools available.

### Study load

Total learning time: 144h	Hours large group:	30h	20.83%
	Hours medium group:	0h	0.00%
	Hours small group:	30h	20.83%
	Guided activities:	0h	0.00%
	Self study:	84h	58.33%

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### Content

#### TOPIC 1 on INDUSTRIAL CONTROL: MODELLING AND ANALYSIS OF DYNAMIC SYSTEMS

Learning time: 35h

Theory classes: 7h  
Laboratory classes: 7h  
Self study : 21h

##### Description:

- 1.1. Fundamental concepts in dynamic systems: systems, models, linearity, static behaviour, dynamic behaviour
- 1.2. Modelling of continuous dynamic systems
- 1.3. Definition of transfer function. Block diagrams
- 1.4. Time response in linear systems

##### Related activities:

- Activity 1: Laboratory deliverables  
Activity 2: Individual assessment test

##### Specific objectives:

For students to:

- Understand and have a full command of the basic concepts of continuous control.
- Understand and have a full command of modelling and simulation in continuous systems.
- Outline and solve problems in the field of industrial automation and control.

#### TOPIC 2 on INDUSTRIAL CONTROL: AUTOMATIC CONTROL

Learning time: 40h

Theory classes: 8h  
Laboratory classes: 8h  
Self study : 24h

##### Description:

- 2.1. Concepts of feedback. Robustness, stability, accuracy, ability to follow set-points
- 2.2. PID control. Empirical tuning and analytical tuning
- 2.3. Feedback loop instrumentation
- 2.4. Control structures

##### Specific objectives:

For students to:

- Analyse dynamic systems and design control systems.
- Outline and solve problems in the field of industrial automation and control.

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<p><b>TOPIC 3 on AUTOMATION: INTRODUCTION TO INDUSTRIAL AUTOMATION</b></p>	<p>Learning time: 10h Theory classes: 2h Laboratory classes: 2h Self study : 6h</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>3.1. Concept of industrial automation</li> <li>3.2. Continuous and discrete systems</li> <li>3.3. Integrated production systems: CAD/CAM, CAE and CIM</li> <li>3.4. General structure of an automated system</li> <li>3.5. Examples of automated production systems</li> </ul> <p>Related activities:</p> <ul style="list-style-type: none"> <li>Activity 1: Laboratory practicals</li> <li>Activity 2: Individual assessment test</li> </ul> <p>Specific objectives:</p> <p>For students to:</p> <ul style="list-style-type: none"> <li>- Understand and have a full command of the basic concepts of automation.</li> <li>- Identify the components used in automated processes.</li> </ul>	
<p><b>TOPIC 4 on AUTOMATION: COMPONENTS OF AN AUTOMATED SYSTEM</b></p>	<p>Learning time: 25h Theory classes: 5h Laboratory classes: 5h Self study : 15h</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>4.1. Control devices</li> <li>4.2. Sensors</li> <li>4.3. Actuators</li> </ul> <p>Related activities:</p> <ul style="list-style-type: none"> <li>Activity 3: Laboratory practicals</li> <li>Activity 4: Individual assessment test</li> </ul> <p>Specific objectives:</p> <p>For students to:</p> <ul style="list-style-type: none"> <li>- Select and connect the peripherals used in automated processes.</li> <li>- Select and connect the control devices used in automated processes.</li> </ul>	

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<p><b>TOPIC 5 on AUTOMATION: PROGRAMMABLE CONTROLLERS</b></p>	<p>Learning time: 28h Theory classes: 4h Laboratory classes: 8h Self study : 16h</p>
<p>Description: 5.1. General structure. Scan cycles 5.2. Programming programmable controllers 5.3. Selection criteria of automation components</p> <p>Related activities: Activity 3: Laboratory practicals Activity 4: Individual assessment test</p> <p>Specific objectives: For students to: - Design and program automated industrial processes.</p>	
<p><b>TOPIC 6 on AUTOMATION: DISTRIBUTED PROGRAMMABLE CONTROLLER SYSTEMS</b></p>	<p>Learning time: 12h Theory classes: 4h Self study : 8h</p>
<p>Description: 6.1. Interconnection of components: Industrial communication networks 6.2. Monitoring and control systems 6.3. Remote control</p> <p>Related activities: Activity 3: Laboratory practicals Activity 4: Individual assessment test</p> <p>Specific objectives: For students to: - Gain an initial understanding of the distributed automated systems used in industrial communication networks and process monitoring systems.</p>	

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### Planning of activities

(ENG) ACTIVITAT 1: PRÀCTIQUES; ACTIVITATS DE LABORATORI DE CONTROL	Hours: 15h Practical classes: 15h
(ENG) ACTIVITAT 2: PROVA INDIVIDUAL D'AVALUACIÓ DE CONTROL	Hours: 3h Theory classes: 3h
(ENG) ACTIVITAT 3: PRÀCTIQUES DE LABORATORI D'AUTOMATITZACIÓ	Hours: 15h Laboratory classes: 15h
(ENG) ACTIVITAT 4: PROVA INDIVIDUAL D'AVALUACIÓ D'AUTOMATITZACIÓ	Hours: 3h Theory classes: 3h

### Qualification system

Oral and written exams (60%):

- Control, theoretical: 30%
- Automation, theoretical: 30%

Laboratory (30%):

- Control, laboratory: 15%
- Automation, laboratory: 15%

Generic competence "Effective use of information resources level 2" (10%):

- Questionnaires related to the training activity in the Campus Library of Terrassa: 5%
- Evaluable work linked to generic competence: 5%

In order to return the unsatisfactory results of the theoretical midterm exam you have the chance of doing, in the act of evaluation of the second exam, a final theoretical exam that includes the contents of the first and second parts of the subject. All the students can accede to this modality. The grade of this final theory exam corresponding to the issues of the first part will replace that obtained in the first part only if it is higher.

Whoever wants to opt for this mechanism of renewal can do it by previous enrollment in the Digital Campus of the subject until 48 hours before the date of the final examination. Laboratory practice notes are excluded from this re-engaging mechanism.

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.

### Regulations for carrying out activities

Lab sessions, theoretical exams and generic competence work are all mandatory.

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### Bibliography

#### Basic:

- Dorf, Richard C. Sistemas modernos de control. 2ª ed. Argentina: Addison-Wesley Iberoamericana, 1989. ISBN 0201644177.
- Ogata, Katsuhiko. Ingeniería de control moderna [on line]. 3ª ed. México D.F: Prentice-Hall, 1998 [Consultation: 04/10/2018]. Available on: <[http://www.ingebook.com/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=1259](http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1259)>. ISBN 9701700481.
- Aström, Karl; Murray, Richard M. Feedback systems: an introduction for scientists and engineers. Princeton: Princeton University Press, 2008. ISBN 978-1-4008-2873-9.
- Goodwin, G.; Graebe, S.F.; Salgado, M. Control system design. Upper Saddle River, N.J: Prentice-Hall, 2001. ISBN 0139586539.
- Piedrafita, R. Ingeniería de la automatización industrial. Madrid: Ra-ma, 1999. ISBN 8478973842.
- Mandado Pérez, Enrique [et al.]. Autómatas programables: entorno y aplicaciones. Madrid: International Thomson Paraninfo, 2005. ISBN 8497323289.
- Bryan, L.A.; Bryan, E.A. Programmable controllers: theory and implementation. 2nd ed. Atlanta: Industrial Text, 1997. ISBN 094410732X.
- Stallings, W. Comunicaciones y redes de computadores [on line]. 7ª ed. Madrid: Pearson Educación, 2004 [Consultation: 16/07/2019]. Available on: <[http://www.ingebook.com/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=1245](http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1245)>. ISBN 8420541109.
- Groover, M.P. Automation, production systems and computer-integrated manufacturing. 2nd ed. Upper Saddle River, NJ: Prentice-Hall, 2001. ISBN 0130889784.
- Masip-Alvarez, Albert. Ingeniería de control. Terrassa: Universitat Politècnica de Catalunya. Departament d'Enginyeria de Sistemes, Automàtica i Informàtica Industrial,