

COURSE PROGRAM¹

Academic Year: 2021/2022

Identification and characteristics of the course			
Code ²	501067 / 503021	ECTS Credits	6
Course name (English)	Introduction to Automation		
Course name (Spanish)	Introducción a la Automática		
Degree programs ³	Degree in Electrical Engineering Degree in Electronics and Automatic Engineering Degree in Mechanical Engineering Degree in Industrial Technology		
Faculty/School ⁴	Industrial Engineering School		
Semester	4th	Type of course	Compulsory
Module	Common to the Industrial Field		
Matter	Automation and Control		
Lecturer/s			
Name	Office	E-mail	Web page
Jesús Lozano Rogado	D1.14	jesuslozano@unex.es	eii.unex.es
Pilar Merchán García	D1.10	pmerchan@unex.es	eii.unex.es
Subject Area	Systems Engineering and Automation		
Department	Electrical, Electronics Engineering and Automation		
Coordinating Lecturer ⁵ (If more than one)	Pilar Merchán García		
Competencies ⁶ (see table at http://bit.ly/competenciasGrados)			
Basic Competences Check With an " X "	General Competences Check With an " X "	Transversal Competences Check With an " X "	Specific Competences Basic Formation Check With an " X "
Specific Competences Common to the Industrial Branch Check With an " X "	Specific Competences Specific Technology Check With an " X "	Specific Competences Specific Technology Check With an " X "	Specific Competences Specific Technology Check With an " X "
CB1	CG1	X	CT1
CB2	CG2	X	CT2
CB3	CG3	X	CT3
CB4	CG4	X	CT4
CB5	CG5	X	CT5
	CG6	X	CT6
	CG7	X	CT7
	CG8	X	CT8
	CG9	X	CT9
	CG10	X	CT10
	CG11	X	CT11
	CG12	X	CT12
CEFB1	CEFB2	CEFB3	CEFB4
CEFB5	CEFB6	CEFB7	CEFB8
CECRI1	CECRI2	CECRI3	CECRI4
CECRI5	CECRI6	CECRI7	CECRI8
CECRI9	CECRI10	CECRI11	CECRI12
CETE1	CETE2	CETE3	CETE4
CETE5	CETE6	CETE7	CETE8
CETE9	CETE10	CETE11	CETE12
CETE13	CETE14	CETE15	CETE16
CETE17	CETE18	CETE19	CETE20
CETFG	CETFG	CETFG	CETFG

¹ In case of joint programmes, inter-faculty programmes, double degrees, etc., please collect information from all degrees and all faculties involved in the same document.

² In case there is more than one code for a given subject, please include all.


³ In case the subject is delivered in more than one degree, please include all (also double degrees).

⁴ In case the subject is delivered in more than one faculty, please include all.

⁵ In case the subject is delivered in more than one faculty, please include name of responsible lecturer at each one.


⁶ Competencies must conform to those specified in the "Degree's Verified Memory".

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Contents
Course outline⁶
Introduction to the Theory of Systems, Systems and Models, Feedback structures, Dynamic Systems, Automatism and Control Methods
Course syllabus
BLOCK 1: FUNDAMENTALS OF AUTOMATION
Name of lesson 1: Fundamentals of Automation. Contents of lesson 1: Theory (3 hours): <ol style="list-style-type: none"> 1.1. Introduction to automatic systems. 1.2. Process control and regulation systems. 1.3. Sequential or logical process control systems. 1.4. Examples.

BLOCK 2: INDUSTRIAL AUTOMATION.
Name of lesson 2: Introduction to industrial automation. Contents of lesson 2: Theory and problems (3 hours): <ol style="list-style-type: none"> 2.1. Introduction. 2.2. Industrial automation systems. 2.3. Programmable logic versus wired logic. Programmable logic controllers: Basic structure. 2.4. Industrial automation elements: sensors, actuators, etc. Description of the practical activities of lesson 2: <i>Introduction to the SIEMENS LOGO PLC (2 hours)</i>
Name of lesson 3: Analysis and synthesis of logical automatism. Contents of lesson 3: Theory and problems (3 hours): <ol style="list-style-type: none"> 3.1. Introduction 3.2. Combinational and sequential automatism. 3.3. Implementation of combinational automatism. Contact diagrams. Description of the practical activities of lesson 3: <i>Automatism implementation in SIEMENS LOGO PLC (I) (2 hours)</i>
Name of lesson 4: Synthesis of sequential automatism. Contents of lesson 4: Theory and problems (5 hours): <ol style="list-style-type: none"> 4.1. Introduction to GRAFCET. 4.2. Basic elements. 4.3. Logical structures. 4.4. Rules of evolution and marking. 4.5. Implementation of sequential automatism through GRAFCET. Description of the practical activities of lesson 4: <i>Automatism implementation in SIEMENS LOGO PLC (II) (2 hours)</i>

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BLOCK 3: AUTOMATIC CONTROL

Name of lesson 5: **Introduction to feedback control systems.**

Contents of lesson 5:

Theory and problems (2 hours):

- 5.1. Introduction.
- 5.2. Feedback Control.

Name of lesson 6: **Modelling of dynamic systems**

Contents of lesson 6:

Theory and problems (4 hours):

- 6.1. Introduction.
- 6.2. Modelling methodology.
- 6.3. Block diagrams.
- 6.4. Transfer function.

Description of the practical activities of lesson 6:

Introduction to Simulink: System modelling (2 hours)

Name of lesson 7: **Dynamic behaviour.**

Contents of lesson 7:

Theory and problems (8 hours):

- 7.1. Introduction.
- 7.2. Transient response analysis.
- 7.3. Analysis of the steady state error.
- 7.4. Stability.

Description of the practical activities of lesson 7:

Modelling and simulation of dynamic systems (2 hours)

Name of lesson 8: **Analysis in the frequency domain.**

Contents of lesson 8:

Theory and problems (9 hours):

- 8.1. Introduction.
- 8.2. Frequency Response Function.
- 8.3. Stability analysis using frequency response techniques.

Description of the practical activities of lesson 8:

Analysis of systems in frequency domain (2 hours)

Name of lesson 9: **Basic control actions.**

Contents of lesson 9:

Theory and problems (5 hours):

- 9.1. Introduction
- 9.2. Steps to Regulator Design
- 9.3. All-nothing controllers
- 9.4. PID controllers

Description of the practical activities of lesson 9:

Tuning of PID controllers (2 hours)

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Educational activities ⁷								
Student workload in hours by lesson		Lectures	Practical activities				Monitoring activity	Homework
Lesson	Total	L	HI	LAB	COM	SEM	SGT	PS
1	6	3						3
2	9	3		2				4
3	16,5	3		2			1,5	10
4	19	5		2				12
5	5	1						4
6	13	4		2				7
7	18	8		2				8
8	27,5	9		2			1,5	15
9	14	5		2				7
Assessment⁸		4		1				
Mid-term exam	6	1						5
Final Assesm.	16	3 (AA1)		1 (AA2)				12
TOTAL	150	45		15			3	87

L: Lectures (100 students)
 HI: Hospital internships (7 students)
 LAB: Laboratory or field practices (15 students)
 COM: Computer room or language laboratory practices (30 students)
 SEM: Problem classes or seminars or case studies (40 students)
 SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)
 PS: Personal study, individual or group work and reading of bibliography

Teaching Methodologies⁶

Among the teaching methodologies included in the formative program, in this course the following are used:

Teaching methodology	Used methodologies labelled as "X"
1. Explanation and discussion of theoretical contents.	X
2. Resolution, analysis and discussion of support examples or previously proposed exercises.	X
3. Exposition of related topics by students.	
4. Development of case studies or demonstrations at laboratory, computer room, etc.	X
5. Resolution of specific doubts in small groups in order to identify potential problems in the teaching-learning process, and academic guidance for essays, case studies, practical works, demonstrations, etc.	X
6. Search for information prior to the development of the topics, or for complementary information once they are in progress.	X
7. Preparation of essays, either individually or in groups.	X
8. Study of each topic, which may consist of: content study, analysis of practical exercises or case studies, preparation for examinations, etc.	X

Learning outcomes⁶

Students will gain knowledge about the basic concepts of automation and basic control methods, as well as for solving real problems and basic automation projects.

⁷ The contents of this table must literally conform to the information of document 12c.

⁸ Specify total number of hours devoted to assessment in the present subject.

Assessment systems⁶

Assessment criteria:

CE1: To understand, recognize and manage the main concepts of the subject: feedback, systems, control actions, automatisms, etc., clearly and rigorously exposing the acquired knowledge (related to: CG1, CG5-CG7, CG11, CT1 and CECRI6).

CE2: To be able to raise and solve problems on control and automation systems (related to: CG4, CT2, CT6 and CECRI6).

CE3: To use properly some applications of computer science and TIC's in the automation (related to: CT4, CT5, CT6 and CECRI6).

CE4: To analyze the results of the practical activities critically and rigorously (related to: CG4, CG5, CG6, CG7, CT2, CT3, CT5, CT6 and CT10).

CE5: To demonstrate knowledge of automation and control equipment and systems (related to: CG5 and CECRI6).

CE6: To demonstrate ability to plan and distribute teamwork. Actively participate in group activities, demonstrating ability to cooperate with the rest of the members of the group and leadership capacity in the activities he/she coordinates (related to: CG1, CG4, CG6, CG11, CT2, CT3, CT5, CT8, CT9 and CT10).

CE7: To be able to present the results of a work, design or project (related to: CG1, CT3, CT4, CT5, CT7, CT9 and CECRI6)

Assessment activities:


Among the assessment activities included in the formative program, in this course the following are used:

	Range fixed	Ordinary call	Extraordinary call	Global assessment
1. Final exam and/or partial examinations.	0%-80%	65%	65%	75 %
2. Practical activities in: classroom, lab, computers room, visits, etc	0%-50%	25 %	25 %	25 %
3. Solution and submission of activities (cases, exercises, assignments, projects, etc.), individually and/or in groups	0%-50%	10%	10%	
4. Active participation in the learning activities.	0%-10%			
5. Attendance to the learning activities.	0%-10%			

Description of the assessment activities:

Assessment Activity 1:

- A **mid-term exam** of Block 1 and 2 will be made. Its grade will be 40% of the final exam grade. Students who pass this exam (grading 5 or more), will only be tested of Block 3, in both the ordinary and the extraordinary calls. Those students who do not pass it will have to attend the final exam and be tested of the whole subject.
- The **final exam** will have two parts: one for Blocks 1 and 2 (part 1) and one

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for Block 3 (part 2). The grade for part 2 will be 60% of the final exam grade. The students will be tested of the parts that have not passed previously.

Assessment Activity 2:

- The evaluation of the practices will be based on the reports submitted by the students at the end of each session. It is necessary to pass the practices in order to pass the course. To pass the practices, it is necessary to attend all the sessions and to have favorable reports. Those students who do not attend all the sessions may take a final exam for the internship, both in the ordinary and extraordinary sessions.

Assessment Activity 3:

- In addition to the above, various tasks proposed in class or on the virtual campus will be carried out by students at home throughout the course. Their grade will be 10% of the final mark. This evaluation activity is not recoverable.

Remarks:

1. Any test will be scored on 10 and the indicated weighting will be applied later.
2. A minimum knowledge of each part is required to pass the subject. This means 5 out of 10 in each of the GG exams.

The global assessment will be held the same day scheduled for the final exam of each call. It will consist of the following parts:

- Written exam consisting of two parts, one corresponding to blocks 1 and 2 and the other to block 3. In the extraordinary call, the students will only have to sit those that do not have been passed previously. The grade of this exam will represent 75% of the final mark.
- Practical activities exam. The grade of this exam will be 25% of the final grade.

Bibliography (basic and complementary)


Basic Bibliography:

BLOCKS 1 & 2

- Miguel López Ramírez, "Iniciación a la automatización mediante ejercicios prácticos". Marcombo, 2017. ISBN:978-84-267-2433-5.
- Juan Martínez Cabeza de Vaca Alajarín y Luis-Manuel Tomás Balibrea, "Problemas resueltos con autómatas programables mediante GRAGCET". Universidad de Murcia, 1999. ISBN:4-8371-007-2.
- J. Balcells J. L. Romeral, "Autómatas Programables". Marcombo, 1997. ISBN:84-267-1089-1.
- Sergio Ortiz Sousol, José manuel Espinosa Malea, "Sistemas secuenciales programables". Marcombo, 2014. ISBN:978-84-267-2014-4.

BLOCKS 2 & 3

- Norman S. Nise, "Control System Engineering". John Wiley & Sons, 2011. ISBN: 978-0470-54756-4.K.
- Ogata, "Ingeniería de Control Moderna". Prentice Hall, 2010. ISBN: 978-84- 8322-660-5.
- Robert N. Bateson, "Introduction to Control System Technology". Pren-tice Hall, 2001. ISBN: 978-01-3030-688-3.

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Complementary Bibliography:

BLOCK 2


- García Moreno, E., "Automatización de Procesos Industriales". Serv. Pub. de la UPV, 1999. ISBN:
- Mandado Pérez, Enrique; Marcos Acevedo, Jorge; Fernández Silva, Celso; Armesto Quiroga, José I., "Autómatas Programables y Sistemas Automatizados". Marcombo, 2009. ISBN: 978-84267-1575-3.
- E. Mandado, "Autómatas Programables – Entorno y aplicaciones" Thomson. 2005.

BLOCK 3

- Benjamin C. Kuo, "Sistemas de Control Automático". Prentice Hall, 1996. ISBN: 978-96-8880-723-1.
- Karl Johan Aström, Richard M. Murray, "Feedback Systems. An Introduction for Scientists and Engineers". Princeton University Press, 2011. ISBN: 978-0-691-13576-2.
- Jairath A.K., "Problems and Solutions of Control Systems: With Essential Theory". CBS Publishing, 2015. ISBN: 978-81-2392-572-1.
- Anastasia Veloni, Alex Palamides, "Control System Problems: Formulas, Solutions, and Simulation Tools". CRC Press, 2011. ISBN: 978-14-3986-850-8.
- Richard C. Dorf and Robert H. Bishop, "Modern Control Systems". Prentice Hall, 2011. ISBN: 978-0-13-602458-3.

Other resources and complementary educational materials

- J. M. González de Durana "Automatización de Procesos Industriales". Disponible en:
<http://www.vc.ehu.es/campus/centros/peritos/deptos-p/depsi/jg/API.pdf>
- <https://es.mathworks.com/> Página web de MathWorks.
- The MathWorks, Inc. "Simulink® User's Guide". 2017. Available online en https://www.mathworks.com/help/pdf_doc/Simulink/sl_using.pdf

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