COURSE PROGRAM[1]

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 tableathttp://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	Marcar con una " X"
CB1		CG1	X	CT1	X	CEFB1		CECRI1		CETE1		CETE11	
CB2		CG2		CT2	X	CEFB2		CECRI2		CETE2		CETE12	
CB3		CG3	X	CT3	X	CEFB3		CECRI3		CETE3		CETE13	
CB4		CG4	X	CT4	X	CEFB4		CECRI4		CETE4		CETE14	
CB5		CG5	X	CT5	X	CEFB5		CECRI5		CETE5		CETE15	
		CG6	X	CT6	X	CEFB6		CECRI6	X	CETE6		CETE16	
		CG7	X	CT7	X			CECRI7		CETE7		CETE17	
		CG8		CT8	X			CECRI8		CETE8		CETE18	
		CG9		CT9	X			CECRI9		CETE9		CETE19	
		CG10		CT10	X			CECRI10		CETE10		CETE20	
		CG11	X					CECRI11				CETFG	
		CG12						CECRI12					

[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".

Contents
Course outline[6]
Introduction to the Theory of Systems, Systems and Models, Feedback structures, Dynamic Systems, Automatisms and Control Methods
Course syllabus

BLOCK 1: FUNDAMENTALS OF AUTOMATION

Name of lesson 1: **Fundamentals of Automation.**
Contents of lesson 1:
Theory (3 hours):
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):
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:
Introduction to the SIEMENS LOGO PLC (2 hours)

Name of lesson 3: **Analysis and synthesis of logical automatisms**.
Contents of lesson 3:
Theory and problems (3 hours):
3.1. Introduction
3.2. Combinational and sequential automatisms.
3.3. Implementation of combinational automatisms. Contact diagrams.
Description of the practical activities of lesson 3:
Automatisms implementation in SIEMENS LOGO PLC (I) (2 hours)

Name of lesson 4: **Synthesis of sequential automatisms**.
Contents of lesson 4:
Theory and problems (5 hours):
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 automatisms through GRAFCET.
Description of the practical activities of lesson 4:
Automatisms implementation in SIEMENS LOGO PLC (II) (2 hours)

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)

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
Assessment[8]		4		1				
Mid-term exam	6	1						5
Final Assessm.	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 Methodologies[6]

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 outcomes[6]

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 systems[6]

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

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.

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

- Benjanmin C. Kuo, “Sistemas de Control Automático”. Prentice Hall, 1996. ISBN: 978-96-8880-723-1.
- Karl Johan °Aström, Richard M. Murray, “Feedback Systems. An Intro-duction 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”. Pren-tice 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