COURSE PROGRAM

Academic Year: 2019/2020

Identification and characteristics of the course				
Code	501067	ECTS Credits		6
Course name (English)	Introduction to Automation			
Course name (Spanish)	Introducción a la Automática			
Degree programs	Degree in Electrical Engineering Degree in Electronics and Automatic Engineering Degree in Mechanical Engineering Degree in Materials Engineering Degree in Industrial Technology			
Faculty/School	Industrial Engineering School			
Semester	4th	Type of course	Mandatory	
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 (If more than one)	Pilar Merchán García			

Competencies* (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"
CB1	X	CG1	X	CT1	X	CEFB1		CECRI1		CETE1	
CB2	X	CG2		CT2	X	CEFB2		CECRI2		CETE2	
CB3	X	CG3	X	CT3	X	CEFB3		CECRI3		CETE3	
CB4	X	CG4	X	CT4	X	CEFB4		CECRI4		CETE4	
CB5	X	CG5	X	CT5	X	CEFB5		CECRI5		CETE5	
		CG6	X	CT6	X	CEFB6		CECRI6	X	CETE6	
		CG7	X	CT7	X			CECRI7		CETE7	
		CG8		CT8	X			CECRI8		CETE8	
		CG9		CT9	X			CECRI9		CETE9	
		CG10		CT10	X			CECRI10		CETE10	
		CG11	X					CECRI11		CETE11	
		CG12						CECRI12		CETFG	

* The sections concerning competencies, course outline, educational activities, teaching methodologies, learning outcomes and assessment systems must conform to that included in the ANECA verified document of the degree program.

Contents

Course outline*

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 (1 hour):

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 (4 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 (6 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)
Automatisms implementation in SIEMENS LOGO PLC (III) (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 and behaviour of dynamic systems**
Contents of lesson 6:
Theory and problems (10 hours):
6.1. Introduction.
6.2. Modelling methodology.
6.3. Block diagrams.
6.4. Transfer function.
6.5. Dynamic behaviour:
a. Transient response analysis.
b. Analysis of the steady state error.
c. Stability.
Description of the practical activities of lesson 6:
Modelling and simulation of dynamic systems (2 hours)

Name of lesson 7: **Analysis in the frequency domain.**
Contents of lesson 7:
Theory and problems (10 hours):
7.1. Introduction.
7.2. Frequency Response Function.
7.3. Stability analysis using frequency response techniques.
Description of the practical activities of lesson 7:
Analysis of systems in time and frequency domain (2 hours)

Name of lesson 8: **Basic control actions.**
Contents of lesson 8:
Theory and problems (4 hours):
8.1. Introduction
8.2. Steps to Regulator Design
8.3. All-nothing controllers
8.4. PID controllers
Description of the practical activities of lesson 8:
Tuning of PID controllers (2 hours)

Educational activities *

Student workload in hours by lesson		Lectures	Practical activities				Monitoring activity	Homework
Lesson	Total	L	HI	LAB	COM	SEM	SGT	PS
1	4	2						2
2	9	3		2				4
3	17.5	4		2			1.5	10
4	21	5		4				12
Examen parcial	7	2						5

5	6	2						4
6	27	10		2				15
7	29.5	10		2			1.5	16
8	13	4		2				7
Assessment **	16	3		1				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*

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

Teaching methodology	Check with an "X" the ones used
1. Explanation and discussion of contents	X
2. Solution, analysis and discussion of examples and exercises	X
3. Oral presentation of assignments	
4. Development of practical cases in labs, computer rooms, seminars, etc.	X
5. Attention to the student and advice of the assignments in small groups	X
6. Search of information prior to the explanation of the contents of an unit or search of complementary information once the activities of a unit have been developed	X
7. Elaboration of assignments either individually or in groups	X
8. Study of each unit: study of contents, preparation of exercises or cases, preparation of the final exam, etc.	X

Learning outcomes *

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.

Assessment systems *

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: CB1, CB2, CB4, CB5, CG1, CG5-CG7, CG11, CT1 and CECRI6).

CE2: To be able to raise and solve problems on control and automation systems (related to: CB2, 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).

** Indicate the total number of evaluation hours of this subject.

CE4: To analyze the results of the practical activities critically and rigorously (related to: CB2, CB3, CG4, CG5, CG6, CG7, CT2, CT3, CT5, CT6 and CT10).

CE5: To demonstrate knowledge of automation and control equipment and systems (related to: CB2, 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: CB2, CB4, CB5, 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: CB3, CB4, 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%	75 %	75 %	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%* (unrecoverable)		
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 that the students will deliver after each session. It is necessary to have attended all of them to pass. Those students who do not attend all the sessions will be allowed to take a final exam of practical activities, both in the ordinary and in the extraordinary call.

Assessment Activity 3:

- In addition, various tasks proposed in class that students will perform in their homes will be collected throughout the course. The qualification of these tasks can add up to 1 point on the final grade, as long as the sum of all the scores of the rest of the evaluation activities is at least 4. This evaluation activity is not recoverable. As you can see, even when this activity is not done, the subject qualification can be 10, so it is a totally voluntary activity. In any case, the maximum note that will appear in the minutes is 10.

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, except in the case described in the remark 3.
3. In case of getting a grade between 4 and 5 in the mid-term exam, the student will be allowed to be tested in the final exam only of part 2 in the ordinary call, but he/she has to get a grade in that part that leads to a final grade greater than or equal to 5, taking into account the weightings for each part. Otherwise, he/she will be tested of the entire subject in the extraordinary call.

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

- K. Ogata, "Ingeniería de Control Moderna". Prentice Hall, 2010. ISBN: 978-84-8322-660-5. (disponible como recurso electrónico en el catálogo de la biblioteca de la UEX).
- Norman S. Nise, "Control System Engineering". John Wiley & Sons, 2011. ISBN: 978-0470-54756-4.
- Robert N. Bateson, "Introduction to Control System Technology". Pren-tice Hall, 2001. ISBN: 978-01-3030-688-3.

Complementary bibliography

BLOQUE 2

- 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

- - https://es.mathworks.com/ MathWorks Web site. Mathematical calculation software development company for engineers
- - The MathWorks, Inc. "Simulink® User's Guide. 2017. Available online at https://www.mathworks.com/help/pdf_doc/Simulink/sl_using.pdf.