COURSE PROGRAM[1]

Academic Year: 2022/2023

Identification and characteristics of the course			
Code[2]	501103	ECTS Credits	6
Course name (English)	Automation I		
Course name (Spanish)	Automatización I		
Degree programs[3]	Degree in Electronic Engineering and Automation (Industrial Branch)		
Faculty/School[4]	School of Industrial Engineering		
Semester	6	Type of course	Compulsory
Module	Specific Technology: Industrial Electronics and Automation		
Matter	Automation and Control		
Lecturer/s			
Name	Office	E-mail	Web page
Pilar Merchán García	D1.10	pmerchan@unex.es	eii.unex.es
Subject Area	Systems Engineering and Automation		
Department	Electrical, Electronic and Automatic Engineering		
Coordinating Lecturer[5] (Ifmore than one)			

Competencies[6] (see tableat 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"
CB1		CG1	X	CT1	X	CEFB1		CECRI1		CETE1		CETE11	X
CB2		CG2	X	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		CETE6		CETE16	
		CG7	X	CT7	X			CECRI7		CETE7	X	CETE17	
		CG8	X	CT8	X			CECRI8		CETE8	X	CETE18	
		CG9	X	CT9	X			CECRI9		CETE9		CETE19	
		CG10	X	CT10	X			CECRI10		CETE10		CETE20	
		CG11	X					CECRI11				CETFG	
		CG12						CECRI12					

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[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]
Sequential and concurrent automatisms. Programmable controllers.
Course syllabus
Name of lesson 1: **Introduction to Industrial Automation** (1 hour) Contents of lesson 1: Presentation of the contents of the subject. Relationship with previous subjects (Introduction to Automation). New functions and elements of IA.
Name of lesson 2: **Programmable Logic Controllers (PLC). Internal architecture and Setting.** (2 hours) Contents of lesson 2: Introduction. Internal architecture. Operating principle. Characteristics. Programming.
Name of lesson 3: **Operating cycle and Real-Time Control.** (2 hours) Contents of lesson 3: Introduction. Modes of operation. Operating cycle. Real-time control and execution time. Fast process elements. Description of the practical activities of lesson 3: **Practice 1** - Description and configuration of an industrial automation system. CPU memory, data types and addressing. (1 hour)
Name of lesson 4: **Input / output interfaces.** (1 hour) Contents of lesson 4: Introduction. Types of I/O interfaces. Digital Inputs / Outputs. Analog inputs / outputs. Specific interfaces. Description of the practical activities of lesson 4: **Practice 2** - Introduction to programming software STEP 7 and programming languages. Logical operations. (2 hours)
Name of lesson 5: **Industrial sensors and actuators.** (3 hours) Contents of lesson 5: Introduction. Characteristics of industrial sensors. Input characteristics of industrial sensors. Electrical, mechanical, operational, dynamic and environmental characteristics. Industrial sensors of general application. Actuators: Classification. Electric actuators. Hydraulic and pneumatic actuators. Description of the practical activities of lesson 5: **Practice 3** - Memory operations. (2 hours)
Name of lesson 6: **Programming the automation** (4 hours) Contents of lesson 6: Instructions for PLCs. Programming languages. IEC 1131-3 standard programmable controller programming system. Basic operations. Description of the practical activities of lesson 6: **Practice 4** - Timing operations, counters and comparisons. (4 hours)
Name of lesson 7: **Control systems implemented with PLCs.** (6 hours) Contents of lesson 7: Introduction. Programming Sequential Function Charts (SFCs): Implementing SFCs on PLCs. Description of the practical activities of lesson 7: **Practice 5** - Programming SFCs (case study 1). (2 hours) **Practice 6** - Programming SFCs (case study 2). (2 hours)

Name of lesson 8: **Structured programming.** (4 hours)
Contents of lesson 8: Hierarchy. Structured programming. Organisation of the user program. Programming of modular tasks.

Description of the practical activities of lesson 8:
Practice 7 – Programming SFCs (case study 3). (3.5 hours)

Name of lesson 9: **Complementary and system operations.** (2 hours)
Contents of lesson 9: Mathematical functions. Displacement. Conversion.

Name of lesson 10: **Advanced programming of PLC** (4 hours)
Contents of lesson 10: Analog signals processing. PID regulation loops. High-speed counters (HSC).

Description of the practical activities of lesson 10:
Practice 8 - Analog signals processing: Temperature Measurement (2 hours)
Practice 9 - Programming a PID control loop. (2 hours)
Practice 10 - Programming High-speed counters. (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	3,5	1						2.5
2	7	2						5
3	8	2		1				5
4	8	1		2				5
5	14,5	3		2			1,5	8
6	18	4		4				10
7	26	4		4				15
8	18,5	4		3,5				14
9	7,5	2					1,5	4
10	26	4		6				16
Assessment[8]								
Final Assessm.	13	3						10
TOTAL	150	30		22,5			3	94,5

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	X

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proposed exercises.	
3. Exposition of related topics by students.	X
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]

To know the elements, techniques and strategies used in industrial automation systems. To familiarize the student with programmable controllers and their programming. To undertake simple Industrial Automation tasks. To tackle more complex and sophisticated automation tasks.

Assessment systems[6]

Assessment criteria:
CE1. Proficiency in the theoretical contents of the subject.
Related to the competences CB1, CB5, CG3, CT1, CETE7, CETE8, CETE11.
CE2. Knowledge of the practical procedures related to the subject.
Related to the competences CB2, CB5, CG4, CT2, CETE7, CETE8, CETE11.
CE3. Ability to apply the acquired knowledge in the resolution of practical issues.
Related to the competences CB3, CB5, CT4, CETE8, CETE11.
CE4. Command of computer and laboratory tools related to the subject.
Related to the competences CB5, CT5, CETE8, CETE11.
CE5. Ability to communicate and transfer knowledge in an appropriate technical language, oral and written, within the field of industrial automation.
Related to the competences CB4, CB5, CT3, CT7, CETE8, CETE11.
CE6. Acquisition of skills related to the development of a project based on a real case.
Related to the competences CB2, CB5, CG1, CG2, CG4-CG11, CT6, CT8-CT10, CETE8, CETE11.

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%	60%	60%	70%
2. Practical activities in: classroom, lab, computers room, visits, etc	0%–50%	30%	30%	30%
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:
Continuous assessment students:

Assessment activity 1:
The student must take a final written exam that will consist of the resolution of theoretical questions and problems of the subject. The weight assigned to this evaluation test is 60% of the final grade. This activity is classified as RECOVERABLE.

Assessment activity 2:
Attendance and participation in the practical sessions are mandatory. The weight assigned to this activity is 30% of the final grade.
This activity is classified as NOT RECOVERABLE, that is, it can only be done in the ordinary call, although it scores with the same percentage also in the extraordinary call.

Assessment activity 3:
Completion of tasks, problems and online questionnaires proposed throughout the course. The weight for this activity represents 10% of the final grade. This activity is classified as NOT RECOVERABLE.

Observations:
1. Any assessment activity will be scored out of 10 and the indicated weighting will be applied afterwards.
2. In order to calculate the final grade, the student must obtain at least a 5 in both the final exam and the practical activities. In those cases in which this minimum grade is not achieved and nevertheless the total computation of the grade exceeds 5, the final grade that will appear in the minutes will be 4.

Global assessment students:
The global assessment will take place on the same day assigned to the final exam of each call by the Subdirección de Ordenación Académica de la E.II.II. It will consist of the following tests:

- A final written exam that will consist of the resolution of technical questions and/or problems of the subject. The grade of this evaluation test will be 70% of the final grade.
- A practical activities exam whose grade will be 30% of the final grade.

Bibliography (basic and complementary)

Basic Bibliography:
- YUSTE, R. y GUERRERO, V., "Autómatas Programables SIEMENS Grafcet y Guía Gemma con TIA Portal", Ed. Marcombo, 2017.
- MANDADO y otros, "AUTÓMATAS PROGRAMABLES Y SISTEMAS DE AUTOMATIZACIÓN, Ed. Marcombo. 2009".

Complementary Bibliography:
- BALCELLS, J., ROMERAL, J.L., "Autómatas Programables", Ed. Marcombo. 1997.
- MANDADO y otros, "AUTÓMATAS PROGRAMABLES: ENTORNO Y APLICACIONES", Ed. THOMSON. 2005.

- PIEDRAFITA, R, "INGENIERÍA DE LA AUTOMATIZACIÓN INDUSTRIAL", Ed. Ra-Ma, 2004

Other resources and complementary educational materials

O1. Virtual Campus of the University of Extremadura:
   http://campusvirtual.unex.es/portal/
O2. Programmable Logic Controllers manufacturer's web page:
   http://support.automation.siemens.com
O3. Website of the Spanish Association of Robotics and Automation of Production Technologies:
   http://www.aeratp.com/