

COURSE SYLLABUS

Academic Year: 2020/2021

Identification and characteristics of the course			
Code	501103	ECTS Credits	6
Course title (English)	INDUSTRIAL AUTOMATION		
Course title (Spanish)	AUTOMATIZACIÓN INDUSTRIAL		
Degree programs	Degree in Electrical Engineering (Industrial Branch) Degree in Mechanical Engineering (optional) Degree in Materials Engineering (optional)		
Faculty/School	School of Industrial Engineering		
Semester	6	Course type (compulsory/optional)	Compulsory
Module	Specific Technology: Electricity		
Subject matter	Power Electronics and Industrial Automation (GIE), Diversification in Electricity (GIM, GIMat)		
Lecturer/s			
Name	Room	E-mail	Web page
Pilar Merchán García	D1.10	pmerchan@unex.es	eii.unex.es
Subject Area	Systems and Automation Engineering		
Department	Electrical, Electronic and Automatic Engineering		
Coordinator (Only if there is more than one lecturer)			

Competencies *											
Basic Competences	Mark With an "X"	General Competences	Mark With an "X"	Transversal Competences	Mark With an "X"	Specific Competences	Mark With an "X"	Specific Competences	Mark With an "X"	Specific Competences	Mark With an "X"
CB1	X	CG1	X	CT1	X	CEFB1		CECRI1		CETE1	
CB2	X	CG2	X	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		CETE6	
		CG7	X	CT7	X			CECRI7		CETE7	
		CG8	X	CT8	X			CECRI8		CETE8	X
		CG9	X	CT9	X			CECRI9		CETE9	
		CG10	X	CT10	X			CECRI10		CETE10	
		CG11	X					CECRI11		CETE11	
		CG12						CECRI12		CETFG	

* The sections concerning competencies, course outline, teaching activities, teaching methodology, learning outcomes and assessment methods must conform to those included in the ANECA verified document of the degree program.

Contents
Course outline*
Logical automatisms, sensors, actuators. Structure and programming of PLCs.
Course contents
<p>Title of unit 1: Introduction to Industrial Automation (1 hour)</p> <p>Contents of unit 1: Presentation of the contents of the subject. Relationship with previous subjects (Introduction to Automation). New functions and elements of IA.</p>
<p>Title of unit 2: Programmable Logic Controllers (PLC). Internal architecture and Setting. (2 hours)</p> <p>Contents of unit 2: Introduction. Internal architecture. Operating principle. Characteristics of the PLC. Configuration of the PLC.</p>
<p>Title of unit 3: Cycle of operation of the PLC and Real-Time Control. (2 hours)</p> <p>Contents of unit 3: Introduction. Modes of operation. Operating cycle. Real-time control and execution time. Fast process elements.</p> <p>Description of practical activities for unit 3: Practice 1 - Description and configuring an industrial automation system. CPU memory, data types and addressing. (1 hour)</p>
<p>Title of unit 4: Input / output interfaces. (1 hour)</p> <p>Contents of unit 4: Introduction. Types of I/O interfaces. Digital Inputs / Outputs. Analog inputs / outputs. Specific interfaces.</p> <p>Description of practical activities for unit 4: Practice 2 - Introduction to programming software STEP 7 and programming languages. Logical operations. (2 hours)</p>
<p>Title of unit 5: Industrial sensors and actuators. (3 hours)</p> <p>Contents of unit 5: Introduction. Characteristics of industrial sensors. Input characteristics of industrial sensors. Electrical characteristics, mechanical, operational, dynamic and environmental. Industrial sensors general application. Drives: Classification. Electric drives. Hydraulic and pneumatic drives.</p> <p>Description of practical activities for unit 5: Practice 3 - Memory operations. (2 hours)</p>
<p>Title of unit 6: Programming the automation (4 hours)</p> <p>Contents of unit 6: Instructions for PLCs. Programming languages. IEC 1131-3 standard programmable controller programming system. Basic operations.</p> <p>Description of practical activities for unit 6: Practice 4 - Timing operations, counters and comparison. (4 hours)</p>

<p>Title of unit 7: Control systems implemented with PLCs. (6 hours)</p> <p>Contents of unit 7: Introduction. Programming of the Sequential Function Charts (SFCs): Implementation of the SFCs on PLCs.</p> <p>Description of practical activities for unit 7: Practice 5 - Programming the SFC (I). (2 hours) Practice 6 - Programming of the SFC (II). (2 hours)</p>
<p>Title of unit 8: Structured programming. (2 hours)</p> <p>Contents of unit 8: Structured programming. Organisation of the user program. Programming of modular tasks.</p> <p>Description of practical activities for unit 8: Practice 7 – Programming of the SFC (III). (3.5 hours)</p>
<p>Title of unit 9: Complementary and system operations. (2 hours)</p> <p>Contents of unit 9: Arithmetic, comparison and other system operations.</p>
<p>Title of unit 10: Advanced programming of PLC (4 hours)</p> <p>Contents of unit 10: Analog I / O treatment. PID regulation loops. Quick counters.</p> <p>Description of practical activities for unit 19: Practice 8 - Treatment of analog signals: Temperature Measurement (2 hours) Practice 9 - Programming a PID control loop. (2 hours) Practice 10 - Programming speed counters. (2 hours)</p>

Educational activities *								
Student workload (hours per lesson)		Lectures	Practical sessions				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	28	6		4				18
8	16,5	2		3,5				11
9	7,5	2					1,5	4
10	26	4		6				16
Assessment **	13	3						10
TOTAL ECTS	150	30	0	22,5	0	0	3	94,5

L: Lectures (100 students)

** Insert as many rows as necessary. For instance, you can include one row for a partial exam and another for the final exam.

HI: Hospital internships (7 students)
 LAB: Lab sessions or field practice (15 students)
 COM: Computer room or language laboratory practice (30 students)
 SEM: Problem-solving classes, 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 Methodology*

Among the teaching methodologies included in the curriculum of the degree, the following are used in this course:

Teaching methodologies	Those used are indicated with an "X"
1. Explanation and discussion of the theoretical contents	X
2. Resolution, analysis and discussion of previously proposed examples of support or problems	X
3. Exhibition of work previously commissioned from students	X
4. Development in laboratory, computer classroom, field, etc., of case studies	X
5. Resolution of specific doubts in small groups, to detect possible problems in the teaching-learning process and guidance in the student's work, practice and study	X
6. Search for information prior to the development of the theme or complementary information once activities have been carried out on it	X
7. Elaboration of works, individually or in groups	X
8. Study of each topic, which may consist of: content studies, preparation of problems or cases, preparation of the exam, etc.	X
9. Technical visits to facilities	

Lectures: Classes of a theoretical nature: These will establish the fundamental concepts. For the development of the program, the master class will be used as the main methodological resource. In these classes the theoretical part of the subject will be developed and problems will be solved that clarify the explained concepts.

Practical sessions: The practices of the subject have as a priority the consolidation of the concepts explained in theory. Before the corresponding session, the student will be given a statement and the objectives that are intended to be obtained with its development will be explained. The practices will be developed in the laboratory that the Area of Systems Engineering and Automation has assigned for this purpose (C1.5). The practices will consist of solving problems related to the subject matter taught. For this purpose, a PLC programming software package will be used. This software package will be used for the configuration and programming of industrial PLCs. Different practical cases will be dealt with in order to familiarize the student with the resolution of real practical cases by means of PLCs.

Learning outcomes *

- Know the elements, techniques and strategies used in the automation systems applied in the industry.
- Familiarize the student with the programmable automatons and their programming.
- Undertake simple Industrial Automation tasks.
- Address other, more complex and sophisticated automation tasks.

Assessment methods *

Evaluation criteria

- EC1. Mastery of the theoretical contents of the subject.
Related to skills CB1, CB5, CG3, CT1, CETE7, CETE8, CETE11.
- EC2. Knowledge of practical procedures related to the subject.
Related to skills CB2, CB5, CG4, CT2, CETE7, CETE8, CETE11.
- EC3. Ability to apply the knowledge acquired in solving practical questions.
Related to skills CB3, CB5, CT4, CETE8, CETE11.
- EC4. Mastery of computer and laboratory tools related to the subject.
Related to skills CB5, CT5, CETE8, CETE11.
- EC5. Ability to communicate and transmit knowledge in an appropriate technical language, oral and written, within the field of industrial automation.
Related to skills CB4, CB5, CT3, CT7, CETE8, CETE11.
- EC6. Acquisition of skills related to the realization of a project based on a real case.
Related to skills CB2, CB5, CG1, CG2, CG4-CG11, CT6, CT8-CT10, CETE8, CETE11.

Evaluation activities

Among the assessment activities included in the degree program, the following are used in this subject:

	Established range	Ordinary call	Extraordinary call	Overall evaluation
1. Final theoretical/practical examination and/or cumulative and/or eliminatory partial examinations.	0%-80%	50%	50%	70%
2. Use of practical activities carried out in: classroom, laboratory, computer room, field, visits, etc.	0%-50%	30%	30%	30%
3. Resolution and delivery of activities (cases, problems, reports, papers, projects, etc.), individually and/or in groups (GG, SL, ECTS).	0%-50%	20%	20%	
4. Active participation in class.	0%-10%	0	0	
5. Attendance at classroom activities.	0%-10%	0	0	

EA1. WRITTEN TESTS

The student will have to take a final written exam that will consist of solving theoretical questions and/or problems of the subject. The weight assigned to this evaluation test is 50% of the final score. This activity is classified as **RECOVERABLE**. T

EA2. LABORATORY PRACTICES.

The practices will be evaluated by an EXAM at the end of the laboratory sessions. The score for this activity is 30% of the final mark. This activity is classified as **RECOVERABLE**.

EA3. FOLLOW-UP TASKS

Carrying out of assignments, problems and online questionnaires proposed throughout the course. The grade for this activity is 20% of the final mark. This activity is classified as NON RECOVERABLE.

GLOBAL EVALUATION

The overall evaluation will take place on the same day assigned to the final exam of each convocation by the Sub-directorate of Academic Organization of the E.II.II. It will consist of the following tests:

- Written part: written test with theoretical/practical questions and/or problems, with a weight of 70% in the final mark.
- Practice part: assembly and explanation by the student of a laboratory practice, which counts for 30% in the final grade.

Observations:

Any test, as well as the grade of the practices, will be marked out of 10 and then the indicated weighting will be applied.

In order to calculate the final grade, the student must obtain at least a minimum grade of 4 in the final exam and a practice grade of 5 or more. In those cases where this minimum grade is not obtained and yet the total grade is greater than 5, the final grade that will appear in the minutes will be 4.

Bibliography (basic and complementary)

Basic bibliography:

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

Complementary bibliography:

- BALCELLS, J., ROMERAL, J.L., "Autómatas Programables", Ed. Marcombo. 1997.
- MANDADO and others, "AUTÓMATAS PROGRAMABLES: ENTORNO Y APLICACIONES", Ed. THOMSON. 2005.
- PIEDRAFITA, R, "INGENIERÍA DE LA AUTOMATIZACIÓN INDUSTRIAL", Ed. Ra-Ma, 2004

Other resources and complementary materials

O1. Virtual Campus of the University of Extremadura:

<http://campusvirtual.unex.es/portal/>

O2. Webpage of PLC builder:

<http://support.automation.siemens.com>

O3. Webpage of the Spanish Association of Robotics and Automation:

<http://www.aeratp.com/>