COURSE SYLLABUS

Academic Year: 2020/2021

Identification and characteristics of the course				
Code	501103	ECTS Credits		6
Course title (English)	Automation I			
Course title (Spanish)	Automatización I			
Degree programs	Degree in Electronic and Automatic Engineering (Industrial Branch) ; Materials Engineering Degree (optional)			
Faculty/School	School of Industrial Engineering			
Semester	6	Course type (compulsory/optional)	compulsory	
Module	Specific Technology: Industrial and Automatic Electronics			
Subject matter	Automation and control			
Lecturer/s				
Name	Room	E-mail		Web page
Jesús Lozano Rogado	D1.14	jesuslozano@unex.es		eii.unex.es
José Miguel Prieto Ballester	D1.18	josemiguelpb@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)	Jesús Lozano Rogado			

Competencies*

Basic Competences	Mark With an " X"	General Competences	Mark With an " X"	Trasversal 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	X
		CG8	X	CT8	X			CECRI8		CETE8	X
		CG9	X	CT9	X			CECRI9		CETE9	
		CG10	X	CT10	X			CECRI10		CETE10	
		CG11	X					CECRI11		CETE11	X
		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*
Sequential and concurrent automatisms. Programmable automatons.
Course contents
Title of unit 1: Introduction to Automation I (1 hour) Contents of unit 1: Presentation of the contents of the subject. Relationship with previous subjects (Introduction to Automation). New functions and elements of industrial automation.
Title of unit 2: Programmable Logic Controllers (PLC). Internal architecture and Setting. (2 hours) Contents of unit 2: Introduction. Historical background. Internal architecture. Operating principle. Characteristics of the PLC. Configuration of the PLC
Title of unit 3: Cycle of operation of the PLC and Real-Time Control. (2 hours) Contents of unit 3: Introduction. Modes of operation. Operating cycle. Real-time control and execution time. Fast process elements. Description of practical activities for unit 3: Practice 1 - Description and configuring an industrial automation system. CPU memory, data types and addressing. (1 hour)
Title of unit 4: Input / output interfaces. (1 hour) Contents of unit 4: Introduction. Types of I/O interfaces. Digital Inputs / Outputs. Analog inputs / outputs. Specific interfaces. Description of practical activities for unit 4: Practice 2 - Introduction to programming software STEP 7 and programming languages. Logical operations. (1.5 hours)
Title of unit 5: Industrial sensors and actuators. (2 hours) 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. Description of practical activities for unit 5: Practice 3 - memory operations. (4 hours)
Title of unit 6: Programming the PLC (3 hours) Contents of unit 6: Instructions for PLCs. Programming languages. IEC 1131-3 standard programmable controller programming system. Basic operations. Description of practical activities for unit 6: Practice 4 - Timer counters and comparison (I). (2 hours) Practice 5 - Timing operations, counters and comparison (II). (2 hours)
Title of unit 7: Control systems implemented with PLCs. (7 hours) Contents of unit 7: Programming of the Sequential Function Charts (SFCs): Implementation of the SFCs on PLCs. Description of practical activities for unit 7: Practice 6 - Programming the SFC (I). (2 hours) Practice 7 - Programming of the SFC (II). (2 hours) Practice 8 - Programming of the SFC (III). (2 hours)
Title of unit 8: Structured programming. (5 hours) Contents of unit 8: Structured programming. Subroutines and interruption routines. Description of practical activities for unit 8: Practice 9 - Treatment of analog signals. Temperature Measurement (2 hours)
Title of unit 9: Complementary and system operations. (2 hours) Contents of unit 9: Arithmetic, comparison and other system operations. Description of practical activities for unit 9: Practice 10 - Programming a PID control loop. (2 hours)
Title of unit 10: Advanced programming of programmable robots. (5 hours)

Contents of unit 10: Analog I / O treatment. PID regulation loops. Quick counters. Description of practical activities for unit 19: Practice 11 - Programming speed counters. (2 hours)

Educational activities *

Student workload (hours per lesson)		Lectures	Practical sessions				Monitoring activity	Homework
Lesson	**Total**	**L**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
1	1,5	1						0,5
2	8	2						6
3	6	1		1				4
Exam Units 1 - 3	5	1						4
4	7,5	1		1,5				5
5	14,5	1		4			1,5	8
Exam Units 4 - 5	5	1						4
6	21	3		4				14
7	25	7		6				12
8	13	5		2				6
9	11,5	2		2			1,5	6
10	8	1		2				6
Exam Units 6 - 10	12	1						11
Assessment **								
TOTAL ECTS								

L: Lectures (100 students)
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

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

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%	70%	70%	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%	0	0	0
4. Active participation in class.	0%–10%	0	0	0
5. Attendance at classroom activities.	0%–10%	0	0	0

AE1. 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 70% of the final score. This activity is classified as **RECOVERABLE**. Three partial exams will be taken during class time after the completion of topics 3, 5 and 10 of the subject matter. The weighting of each midterm is proportional to the number of lectures hours. This part of the subject may be passed definitively if the grade obtained in each partial exam is higher than a 5. If not, the student must take the final exam with the parts to be passed.

AE2. LABORATORY PRACTICES.

The attendance and participation in the practices is compulsory. Weighting over the final mark: 30%. This activity is classified as **NON RECOVERABLE**, that is, it can only be done in the ordinary call, although it scores with the same percentage also in the extraordinary call.

AE3. FOLLOW-UP TASKS

Carrying out work and problems proposed throughout the course. Up to 10% of the final grade. This activity is classified as **NON RECOVERABLE** although it scores the same weighting also in the extraordinary call.

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 qualification.
- 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 in each of the parts of the final exam a **minimum score of 5**. In those cases in which this minimum score is not obtained and nevertheless the total computation of the grade exceeds 5, the final score 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 asociation of Robotics and Automation: http://www.aeratp.com/