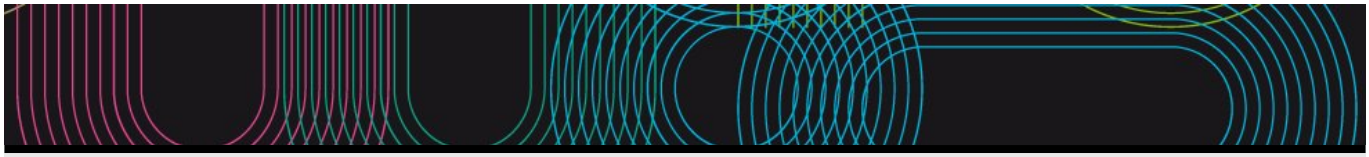

IDENTIFYING DATA				
(*)Fundamentos de automática				
Subject	(*)Fundamentos de automática			
Code	V12G380V01403			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	Espada Seoane, Angel Manuel			
Lecturers	Espada Seoane, Angel Manuel Fernández Silva, María López Fernández, Joaquín Rajoy González, José Antonio			
E-mail	aespada@uvigo.es			
Web				
General description	This subject introduces the basic concepts about industrial automation and control methods. The PLC will be considered the central element for industrial automation while the industrial regulator will be the central element for the control methods.			

Competencies	
Code	
A3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
A25	RI6 Know the fundamentals of automation and control methods.
B3	CT3 Oral and written proficiency in the own language.
B6	CT6 Application of computer science in the field of study.
B9	CS1 Apply knowledge.
B16	CP2 Critical thinking.
B17	CP3 Working as a team.
B20	CP6 Ability to communicate with people not expert in the field.

Learning aims	
Expected results from this subject	Training and Learning Results
(*)Coñecementos sobre os fundamentos de automatismos e métodos de control.	A25
(*)Coñecemento en materias básicas tecnolóxicas.	A3
(*)Comunicación oral e escrita de coñecementos en lingua propia.	B3
(*)Aplicación da informática no ámbito de estudo.	B6
(*)Aplicar coñecementos.	B9
(*)Razoamento crítico.	B16
(*)Traballo en equipo.	B17
(*)Capacidade para comunicarse con persoas non expertas na materia.	B20

Contents
Topic

1.-Introduction to industrial automation	1.1 Introduction to task automation. 1.2 Types of control. 1.3 The programmable Logic Controller (PLC). 1.4 Bloc Diagram. PLC Elements. 1.5 PLC Operating Cycle. Cycle time. 1.6 Operation modes.
2. . Introduction to PLC programming.	2.1 Binary, octal, hexadecimal and BCD systems. Real numbers. 2.2 Addressing and peripheral access. 2.3 Instructions, variables and operands. 2.4 Programming languages. 2.5 Types of program modules. 2.6 Lineal and structured programming.
3. PLC programming with I/O.	3.1 Binary variables. Inputs, outputs and memory. 3.2 Binary combinations. 3.3 Assignation operations. 3.4 Creating a simple program. 3.5 Timers and counters. 3.6 Arithmetic operations. 3.7 Examples.
4. System modeling for PLC programming.	4.1 Basic principles. Modeling techniques. 4.2 Modeling using Petri Nets. 4.2.1 Steps and transitions definitions. Evolution rules. 4.2.2 Conditional selection among several alternatives. 4.2.3 Simultaneous sequences. Concurrency. Resource sharing. 4.3 Petri net implementation. 4.3.1 Direct implementation. 4.3.2 Normalized implementation (Grafcet). 4.4 Examples.
5. Basic concepts on automatic regulation. Continuous systems representation and modeling.	5.1 Open loop and closed loop control systems. 5.2 Typical regulation loop. Nomenclature and definitions. 5.3 Physical systems and mathematical models. 5.3.1 Mechanical systems. 5.3.2 Electrical systems. 5.3.3 Others. 5.4 State space modeling. 5.5 Transfer function modeling. Laplace transform. Properties. Examples.
6. Dynamic systems analysis.	6.1 Stability. 6.2 Transient response. Transient modes. 6.2.1 First order systems. Differential equations and transfer function. Examples. 6.2.2 Second order systems. Differential equations and transfer function. Examples. 6.2.3 Studing the effect of adding poles and zeros. 6.3 Reduction of higher order systems. 6.4 Steady-state response. 6.4.1 Steady-state errors. 6.4.2 Input signals and type of a system. 6.4.3 Error constants.
7. Controllers.	7.1 Control basic actions. Proportional, integral and derivative actions. 7.2 PID controller. 7.3 Tuning industrial PID controllers. 7.3.1 Open loop PID tuning: Ziegler-Nichols et al. 7.3.2 Closed loop PID tuning: Ziegler-Nichols et al. 7.4 State space controller design. Effects of adding poles to the transfer function.
P1. Introduction to STEP7.	Introduction to the STEP7 program to create and edit automation programs. PLCs Siemens series S7-300 e S7-400.
P2. Programming in STEP7.	Modeling a simple automation problem. Implementation in STEP7 using binary instructions.
P3. Implementing Petri Nets in STEP7.	PN model for a simple automation problem. Implementation in STEP7.
P4. PN modeling and its implementation using STEP7.	PN model of a more complex automation problem. Implementation in STEP7.
P5. Modeling sequential systems using GRAFCET. Implementation of this model using S7-Graph.	PN normalized modeling systems and its implementation using S7-Graph.
P6. Control systems analysis using MATLAB.	Introduction to MATLAB control specific functions.
P7. Introduction to SIMULINK.	Introduction to the SIMULINK program, MATLAB extension to simulate dynamic systems.
P8. Systems modeling using SIMULINK.	Control system modeling and simulation using SIMULINK.

P9. Tuning industrial PID controllers.	Obtaining the PID controller parameters using the methods studied in class and its implementation in an industrial PID controller.

Planning			
	Class hours	Hours outside the classroom	Total hours
Laboratory practises	18	27	45
Troubleshooting and / or exercises	0	10	10
Master Session	32.5	32.5	65
Reports / memories of practice	0	8	8
Long answer tests and development	3	19	22

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies	
	Description
Laboratory practises	Different activities aimed to apply the concepts learned during the lectures.
Troubleshooting and / or exercises	The professor is going to solve in class some problems and exercises. The students need to solve similar exercises on their own to obtain the capabilities needed.
Master Session	Include the professor lectures about the contents of the subject.

Personalized attention	
Methodologies	**Description**
Master Session	The teacher will personally attend each student question so that students will get an efficient use of the class. This personalized service regarding the lectures, problems and laboratory clases will take place on a preset schedule.
Laboratory practises	The teacher will personally attend each student question so that students will get an efficient use of the class. This personalized service regarding the lectures, problems and laboratory clases will take place on a preset schedule.
Troubleshooting and / or exercises	The teacher will personally attend each student question so that students will get an efficient use of the class. This personalized service regarding the lectures, problems and laboratory clases will take place on a preset schedule.
Tests	**Description**
Long answer tests and development	The teacher will personally attend each student question so that students will get an efficient use of the class. This personalized service regarding the lectures, problems and laboratory clases will take place on a preset schedule.

Assessment		
	Description	Qualification
Laboratory practises	Every practice is going to be evaluatd between 0 and 10 points, depending on the compliance with the goals set, the student previous work to prepare the practice and the student's attitude. Each practice may have different weight in the final grade.	15
Reports / memories of practice	Memories of the selected practices will be graded in a range between 0 and 10 according to the results obtained in the implementation of the practice, its organization and the quality of the presentation.	5
Long answer tests and development	Final exam regarding the contents of the subject, which may include problems and exercises. the grade will be between 0 and 10.	80

Other comments on the Evaluation

-There will be a continuous eveluación of each student work in the laboratory. If the student fails to pass this assessment it will be a practice exam in the second call.

-The evaluation of practices for students who officially renounce to the continuous evaluation will be done with a practice exam in the two calls.

-It is compulsory to succed in both parts (written and practical test) to pass the course. When the student fails one of the parts, the grade may be scaled so that the final grade will not exceed 4.5.

-In the final exam a threshold score can be set in a set of questions.

-In the second call the student is going to be evaluated only in the failed parts of the first call.

Sources of information

E.MANDADO, J.MARCOS, C. FERNANDEZ, J.I.ARMESTO, **"Autómatas Programables y Sistemas de Automatización"**, 2009,

MANUEL SILVA, **Las Redes de Petri en la Automática y la Informática**,

R. C. DORF, R. H. BISHOP, 2005,

Complementary:

- "Autómatas Programables. Fundamento. Manejo. Instalación y Práctica", PORRAS, A., MONTERO, A.P., Ed. McGraw-Hill, 1990.

- "Automatización. Problemas resueltos con autómatas programables, J. Pedro Romera, J. Antonio Lorite, Sebastián Montoro. Ed. Paraninfo

- Guía usuario Step7 SIEMENS

- Diagrama de funciones (FUP) para S7-300 y S7-400 SIEMENS

- SIMATIC S7-GRAPH para S7-300/400 SIEMENS

- "Control de sistemas continuos. Problemas resueltos", Barrientos, Ed. Mcgraw-Hill.

- "Modern control engineering", Ogata, K., Ed. Prentice-hall.

- "Retroalimentación y sistemas de control", DISTEFANO, J.J., STUBBERUD, A.R., WILLIAMS, I.J., Ed. McGraw-Hill.

Recommendations