IDENTIFYING DATA

Automation and control fundamentals

Subject	Automation and control fundamentals
Code	V12G363V01304
Study programme	Degree in Industrial Technologies Engineering

Descriptors	ECTS Credits		Choose	Year	Quadmester
	6		Mandatory	2nd	1st

Teaching language	Spanish
Department	
Coordinator	Espada Seoane, Angel Manuel
Lecturers	Espada Seoane, Angel Manuel Rodríguez Diéguez, Amador
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General description	In this matter present the basic concepts of the systems of industrial automation and of the methods of control, considering like central elements of the same the programmable programmable logic controller and the industrial controller, respectively.

Competencies

Code

Learning outcomes

Expected results from this subject	Training and Learning Results

Contents

Topic	
1. Introduction the industrial automation.	1.1 Introduction to automation of tasks. 1.2 Types of control. 1.3 The programmable logic controller. 1.4 Diagram of blocks. Elements of the programmable logic controller. 1.5 Cycle of operation of the programmable logic controller. Time of cycle. 1.6 Ways of operation.
2. Introduction the programming of programmable logic controllers.	2.1 Binary, octal, hexadecimal and BCD systems. Real numbers. 2.2 Addressing and access to periphery. 2.3 Instructions, variables and operands. 2.4 Forms of representation of a program. 2.5 Types of modules of program. 2.6 Linear and structured programming.
3. Programming of programmable logic controllers with I/O.	3.1 Binary variables. Inputs, outputs and memory. 3.2 Binary combinations. 3.3 Operations of allocation. 3.4 Creation of a simple program. 3.5 Timers and counters. 3.6 Arithmetical operations. 3.7 Examples.

4. Modelling of systems for the programming of programmable logic controllers .	4.1 Basic principles. Modelling technics. 4.2 Modelling by means of Petri Networks. 4.2.1 Definition of stages and transitions. Rules of evolution. 4.2.2 Conditional election between several alternatives. 4.2.3 Simultaneous sequences. Concurrence. Resource shared. 4.3 Implementation of Petri Networks. 4.3.1 Direct implementation. 4.3.2 Normalised implementation (Grafcet). 4.4 Examples.
5. Basic concepts of automatic control. Representation and modelling of continuous systems.	5.1 Systems of regulation in open loop and closed loop. 5.2 Control typical 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 Modelling in state space. 5.5 Modelling in transfer function. Laplace transform. Properties. Examples. 5.6 Blocks diagrams.
6. Analysis of dynamic systems.	6.1 Stability. 6.2 Transient response. 6.2.1 First order systems. Differential equation and transfer function. Examples. 6.2.2 Second order systems. Differential equation and transfer function. Examples. 6.2.3 Effect of the addition of poles and zeros. 6.3 Systems reduction. 6.4 Steady-state response. 6.4.1 Steady-state errors. 6.4.2 Input signals and system type. 6.4.3 Error constants.
7. Controllers and parameters tuning.	7.1 Basic control actions. Proportional effects, integral and derivative. 7.2 PID controller. 7.3 Empirical methods of tuning of industrial controllers. 7.3.1 Open loop tuning: Ziegler-Nichols and others. 7.3.2 Closed loop tuning: Ziegler-Nichols and others. 7.4 Controllers design state space. Pole assigment.
P1. Introduction to STEP7.	Introduction to the program STEP7, that allows to create and modify programs for the Siemens PLC S7-300 and S7-400.
P2. Programming in STEP7.	Modelling of simple automation system and implementation in STEP7 using binary operations.
P3. Implementation of PN in STEP7.	Petri Networks modelling of simple automation system and introduction to the implementation of the same in STEP7.
P4. PN Modelling and implementation in STEP7.	Petri Networks modelling of complex automation system and implementation of the same in STEP7.
P5. GRAFCET modelling and implementation with S7-Graph.	Petri Networks normalised modelling and implementation with S7-Graph.
P6. Control systems analysis with MATLAB.	Introduction to the control systems instructions of the program MATLAB.
P7. Introduction to SIMULINK.	Introduction to SIMULINK program, an extension of MATLAB for dynamic systems simulation.
P8. Modelling and transient response in SIMULINK.	Modelling and simulation of control systems with SIMULINK.
P9. Empirical tuning of an industrial controller.	Parameters tuning of a PID controller by the methods studied and implementation of the control calculated in an industrial controller.

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practical	18	30	48
Problem solving	0	15	15
Lecturing	32.5	32.5	65
Essay questions exam	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 practical	Actividades de aplicación de los conocimientos adquiridos en las clases de teoría a situaciones concretas que puedan ser desarrolladas en el laboratorio de la asignatura.
Problem solving	El profesorado resolverá en el aula problemas y ejercicios y el alumnado tendrá que resolver ejercicios similares para adquirir las capacidades necesarias.
Lecturing	Exposición por parte del profesor de los contenidos de la materia.

Personalized assistance

Methodologies	Description
Lecturing	For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed).
Laboratory practical	For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed).
Problem solving	For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed).

Tests	Description
Essay questions exam	For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed).

Assessment

	Description	Qualification Training and Learning Results
Laboratory practical	It will evaluate each practice of laboratory between 0 and 10 points, in function of the fulfillment of the aims fixed in the billed of the same and of the previous preparation and the attitude of the students. Each practical will be able to have distinct weight in the total note.	20
Essay questions exam	Final examination of the contents of the matter, that will be able to include problems and exercises, with a punctuation between 0 and 10 points.	80

Other comments on the Evaluation

<div>- Continous Assesment of student work practices along established laboratory sessions will be held in the semester, with the assistance to them mandatory. In the case of not overcome, a review of practices will take place in the second call.</div><div>
</div><div>- The assesment of the practices for students who officially renounces Continuous Assesment will be carried out in a review of practices in the two calls.</div><div>
</div><div>- It may demand previous requirements to the realisation of each practice in the laboratory, so that they limit the maximum qualification to obtain.</div><div>
</div><div>- It must pass both tests (script and practices) to pass the matter, give the total score at the rate indicated above. In case of no longer than two or one test, scaling may be applied to partial notes that the total does not exceed 4.5.</div><div>
</div><div>- In the final exam may establish a minimum score on a set of issues to overcome.</div><div>
</div><div>- In the second call of the the same course, students should examine the tests (script and/or practices) not passed in the first one, with the same criteria of that.</div><div>
</div><div>- According to the Rule of Continuous Assesment, the subject students to Continuous Assesment that present to some activity evaluable collected in the Teaching Guide of the matter, will be considered like "presented".</div><div>
</div><div>- Ethical commitment: student is expected to present an adequate ethical behavior. If you detect unethical behavior (copying, plagiarism, unauthorized use of electronic devices, and another ones), it follows that the student does not meet the requirements for passing the subject. In this case the global qualification in the present academic course will be of suspense (0.0).</div>

Sources of information

Basic Bibliography

E.MANDADO, J.MARCOS, C. FERNANDEZ, J.I.ARMESTO, **Autómatas Programables y Sistemas de Automatización**, 1ª, Marcombo, 2009

MANUEL SILVA, **Las Redes de Petri en la Automática y la Informática**, 1ª, AC, 1985

R. C. DORF, R. H. BISHOP, **Sistemas de Control Moderno**, 10ª, Prentice Hall, 2005

Complementary Bibliography

PORRAS A., MONTANERO A., **Autómatas programables : fundamento, manejo, instalación y prácticas**, McGraw-Hill, 2003

ROMERA J.P., LORITE J.A., MONTORO S., **Automatización : problemas resueltos con autómatas programables**, 4ª, Paraninfo, 2002

BARRIENTOS, ANTONIO, **Control de sistemas continuos: Problemas resueltos**, 1ª, McGraw-Hill, 1997
OGATA, KATSUIKO, **Ingeniería de Control Moderna**, 5ª, Pearson, 2010

Recommendations

Subjects that continue the syllabus

Product design and communication, and automation of plant elements/V12G380V01931

Subjects that are recommended to be taken simultaneously

Electronic technology/V12G380V01404

Subjects that it is recommended to have taken before

Computer science: Computing for engineering/V12G380V01203
Mathematics: Calculus II and differential equations/V12G380V01204
Fundamentals of electrical engineering/V12G380V01303

Other comments

- Requirements: To enrol in this subject is necessary to had surpassed or well be enrolled of all the subjects of the inferior courses to the course in the that is summoned this subject.