A) COURSE

Course Id:	Course
5610	Industrial automation

Class Hours per Week	Lab hours per week	Complementary practices	Credits	Total hour course
3	2	3	8	48 theory 32 practice

B) GENERAL COURSE INFORMATION

	EE (IEA)	ME (IM)	MME (IMA)	EME (IME)	MTE (IMT)
Level:				IX	
Course Type (Required/Elective)				Required	
Prerequisite Course:				Hydraulic and pneumatic circuits	
CACEI Classification:				IA	

C) COURSE OBJECTIVE

At the end of the course, the student will be capable of:
The student will be able to analyze and design automation systems used in modern facilities of manufacturing, using programmable logic controllers and electro pneumatic systems.

D) TOPICS (CONTENTS AND METHODOLOGY)

1.- Introduction to industrial automation		**3 hours**
Specific Objective:	That the student analyzed different types of technologies to implement an automated process.	
1.1.- Automation concepts. 1.2.- Elements that conform an automatic system. 1.3.- Control systems. 1.4.- Control strategies. 1.5.- Analog and digital automation. 1.6.- Wired logic. 1.7.- Programmed logic. 1.8.- PLC in the automation.		
Readings and other resources	Resources needed for teaching and learning specifically on this topic, where appropriate.	
Teaching methods	Specific activities on this topic made by the teacher, such as presentation, conducting discussions, practice management, etc.	

Learning activities	Specific activities on this topic made by the students, such as lab practices where will apply the knowledge and develop the abilities to manage both software and hardware, in the automation of systems.

2.- Overview of the programmable logic controllers.		**3 hours**
Specific Objective:	That the student understand the role that play a programmable logic controller, like control system in an automation system, as well as their main operating characteristics.	
2.1.- History backgrounds and PLC definition. 2.2.- Application fields and PLC advantages. 2.3.- Elements that shape a control system with PLC. 2.4.- External structure. 2.4.1.- Compact structure. 2.4.2. Modular structure. 2.5.- Internal structure of PLC 2.5.1.- Central process unit (CPU) 2.5.2.- Memory types. 2.5.3.- Source supply. 2.6.- Input and output interphases (E/S)		
Readings and other resources	Resources needed for teaching and learning specifically on this topic, where appropriate.	
Teaching methods	Specific activities on this topic made by the teacher, such as presentation, conducting discussions, practice management, etc.	
Learning activities	Specific activities on this topic made by the students, such as lab practices where will apply the knowledge and develop the abilities to manage both software and hardware, in the automation of systems.	

3.- Sensors and actuators.		**9 hours**
Specific Objective:	That the student understand operating principle, the classification and characteristics of sensors and actuators as well as their interaction, connection and installation modules of input and output of the PLCs.	
3.1.- All/nothing inputs. 3.1.1.- Classification. 3.1.2.- Principle of operation. 3.1.3.- Connection to PLC. 3.2.- Analog inputs. 3.2.1.- Classification. 3.2.2.- Principle of operation. 3.2.3.- Connection to PLC. 3.3.- Outputs. 3.3.1.- All/nothing output. 3.3.2.- Analog outputs.		
Readings and other resources	Resources needed for teaching and learning specifically on this topic, where appropriate.	
Teaching methods	Specific activities on this topic made by the teacher, such as presentation, conducting discussions, practice management, etc.	
Learning activities	Specific activities on this topic made by the students, such as lab practices where will apply the knowledge and develop the abilities to manage both software and hardware, in the automation of systems.	

4.- Language types and PLC programming.		**12 hours**
Specific Objective:	That the student develops programming of the different languages.	

4.1.- Variables directioning. 4.2.- Programming language using ladder diagrams or contact (KOP). 4.2.1.- Defining the elements of a ladder diagram. 4.2.2.- Contact types. 4.2.3.- Timers. 4.2.4.- Accountants. 4.2.5.- Comparators. 4.2.6.- Program implementation. 4.2.7.- Subroutines. 4.2.8.- Pre-programming considerations in KOP. 4.2.9.- Logic and arithmetic operations. 4.2.10.- Programs. 4.3.- Programming language by instruction list (AWL). 4.3.1.- Timers. 4.3.2.- Accountants. 4.3.3.- Comparators. 4.3.4.- Programs. 4.4.- Programming by function diagrams (FUP). 4.4.1.- Representation of constants and connection bornes. 4.4.2.- Basic functions. 4.4.3.- Special functions. 4.4.4.- Programs. 4.5. - Overview of the SOFTWARE to PLC's.	
Readings and other resources	Resources needed for teaching and learning specifically on this topic, where appropriate.
Teaching methods	Specific activities on this topic made by the teacher, such as presentation, conducting discussions, practice management, etc.
Learning activities	Specific activities of this topic that the students will perform, such as practices, readings, homework, exercises in class, etc.

5.- Handling and installation of automated systems.		**9 hours**
Specific Objective:	That the student acquires the concepts and important aspects to considere for handling and installation of automation systems.	
5.1.- Organization chart of using the PLC. 5.2.- Start up. 5.3.- Programming. 5.3.1.- Operation modes of a PLC. 5.3.2.- Service functions of a PLC. 5.4.- Information storage. 5.5.- Input and output installation in the PLC. 5.6.- Installation, commissioning and maintenance of an automated system. 5.6.1.- Environmental conditions. 5.6.2.- Distribution of components in the control panel. 5.6.3.- Cabling. 5.6.4.- Power supply. 5.6.5.- Fine tunning and in service. 5.6.6.- Maintenance. 5.7.- Security in automated systems.		
Readings and other resources	Resources needed for teaching and learning specifically on this topic, where appropriate.	
Teaching methods	Specific activities on this topic made by the teacher, such as presentation, conducting discussions, practice management, etc.	

Learning activities	Specific activities on this topic made by the students, such as lab practices where will apply the knowledge and develop the abilities to manage both software and hardware, in the automation of systems.

6.- Integrated systems of industrial automation.		**12 hours**
Specific Objective:	That the student gets abilities needed to integration of industrial automation systems.	
6.1.- Industrial automation with electro-pneumatic systems. 6.2.- Industrial automation with pneumatic purely. 6.3.- Industrial automation with electro-hydraulic systems. 6.4.- Industrial automation with purely hydraulic systems. 6.5.- Industrial automation with electro-mechanical systems.		
Readings and other resources	Resources needed for teaching and learning specifically on this topic, where appropriate.	
Teaching methods	Specific activities on this topic made by the teacher, such as presentation, conducting discussions, practice management, etc.	
Learning activities	Specific activities on this topic made by the students, such as lab practices where will apply the knowledge and develop the abilities to manage both software and hardware, in the automation of systems.	

E) Teaching and learning methodologies

- In class will develop in team and individual, exercises of the topics to promote the abstract and analytical reasoning.
- The use of teaching techniques will be promoted to encourage meaningful learning in some of the topics of the course are used.
- Management, search and interpreting of information related to the topics will be promoted.
- The use of ICTs will be promoted through homework or projects.

F) Evaluation Criteria

Suggested Form of Evaluation and weighing	**Schedule**	**Include**	**Weighing**
First partial exam Written exam: 80% Homeworks, simulations, didactic techniques: 20% Total 100%	Session 16	Topics 1, 2 y 3	33 %
Second partial exam Written exam: 80% Homeworks, simulations, didactic techniques: 20% Total 100%	Session 32	Topics 4	33%
Third partial exam Written exam: 80% Homeworks, projects: 20% Total 100%	Session 48	Topics 5 y 6	33 %
Total	16 weeks (48 sessions)		
Ordinary exam		The final grade will be the sum of the following stakes: 30% exams, 30% lab practices and 40%	

	project.
Lab	Prove necessary to pass the course.
Extraordinary exam	Written theoretical exam of all units 100%
Title exam	Written theoretical exam of all units 100%
Regularization exam	Written theoretical exam of all units 100%

G) BIBLIOGRAPHY AND ELECTRONIC RESOURCES

Main Books

- MANDADO PÉREZ ENRIQUE, Marcos Acevedo J. Fernández Silva C. Arnesto Quiroga J. I., (2009). Autómatas Programables y Sistemas de Automatización, Marcombo S.A., ISBN-13: 978-84267-1575-3.
- GARCÍA MORENO EMILIO, (2000). Automatización de Procesos Industriales, Alfaomega, ISBN: 970-15-0658-8, 380 pp.
- PALLÁS ARENY RAMÓN, (2005). Sensores y Acondicionadores de Señal, 4ª Ed., Marcombo S.A., ISBN: 8426713440.
- BALCELLS JOSEPH, ROMERAL JOSÉ LUÍS, (2000). Autómatas Programables, 1ª Ed., Marcombo, S.A., ISBN: 8426710891, 450 pp.
- WEBB JOHN W., REIS RONALD A., (2003). Programmable Logic Controllers, Principles and Applications, 5th Ed., Prentice Hall.
- PIEDRAFITA MORENO RAMÓN, (2004). Ingeniería de la Automatización Industrial,2ª Ed., Ra-Ma, 712 pp.
- PORRAS CRIADO ALEJANDRO, (2002). Autómatas programables, fundamentos, manejo, instalación y prácticas, Mc Graw Hill.
- BOLTON, WILLIAM, (2010). Mecatrónica: Sistemas de control electrónico en la ingeniería mecánica y eléctrica, 4ª. ed., Alfaomega, ISBN 9786077854326. 608 pp.
- CREUS SOLÉ, ANTONIO, (2007). Neumática e hidráulica, Alfaomega. ISBN: 9789701509036.
- CREUS SOLÉ, ANTONIO, (2010). Instrumentación industrial, Marcombo, 8a. ed., ISBN 978-8426716682.
- DORANTES GONZÁLEZ, et al. (2004). Automatización y control, prácticas de laboratorio, McGraw-Hill Interamericana. ISBN 9789701047941.
- GUTIÉRREZ, DE LA MORA, GALVÁN, CÁRDENAS, (2006). Introducción a la automatización, - Amate.
- JOSÉ ROLDAN, VILORIA (2008). Automatismos Industriales, Paraninfo. ISBN: 9788497325790, 423 pp.

Internet Links

http://www.festo.com/
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