|ESCUELA SUPERIOR POLITÉCNICA DEL LITORAL
Faculty of Electrical and Computer Engineering
COURSE SYLLABUS
Electrical Industrial Controls

1. CODE AND NUMBER OF CREDITS

CODE	FIEC00273	
NUMBER OF CREDITS: 4	**Theoretical: 4**	**Practical: 0**

2. COURSE DESCRIPTION

The course will provide the methods and techniques to design and interpret electrical control systems that enable the protection, command and control motors (starts, stopping, braking, direction of rotation, speed, operation sequences and time delays) or electrical equipment by contactors, regulation applications process or general industrial field.

During the course the student designs control systems interactively with the teacher and their peers in the classroom, supplemented this with tasks outside of class, focusing on the designs criteria of economy and simplicity.

It is a specialization course at the end of the career of Power Engineering specialization in electricity, which gives a vision of future automation engineer electrical with both the industrial applications or general field use and management of electricity.

3. PRE-REQUISITES AND CO-REQUISITES

PRE-REQUISITES	FIEC00166 ELECTRICAL MACHINES II
CO-REQUISITES	Not applied

4. CORE TEXT AND OTHER REQUIRED REFERENCES FOR THE TEACHING OF THE COURSE

CORE TEXT	1. Stephen L. Herman, Industrial Motor Control, Fifth Edition, 2005, Thomson Delmar Learning
REFERENCES	1. José Roldan Viloria, Motores Eléctricos. Automatismos de Control, 9a ed., 2a reimp., Dic. 2008, International Thomson Paraninfo. 2. Maloney Timothy J., Electrónica Industrial Moderna, 5a ed., 2005, Pearson. 3. Gilberto Enríquez Harper, Control de Motores Eléctricos, 1a ed., 2006, Limusa. 4. Gilberto Enríquez Harper, Fundamentos de Control de Motores Eléctricos en la Industria, 1a ed. 1999, 2005, Limusa. 5. Charles S. Siskind, Sistemas de Control Eléctrico en la Industria, 1963, McGraw-Hill. 6. R. L. MacIntyre, Control de Motores Eléctricos, 3a ed., 1982, Marcombo 7. Y. L, Kosow, Control de Máquinas Eléctricas, 1982, Editorial Reverté.

5. COURSE LEARNING OUTCOMES

At the end of the course, the student will be able to:

1. Designing electrical control systems to govern, by contactors and manual or automatic pilot devices, motor running or electrical equipment in industrial processes or general.
2. Recognize the elements of power and control and its symbolism.
3. Understanding and interpreting circuit diagrams electrical power and control of industrial processes.
4. Use and combine the control elements to perform control functions.
5. Designing power and control circuits that protect and govern their electric motors control functions such as start, stop, speed, change of rotation, feed and brake gradually.
6. Calculate the starting currents of spin inversion and braking DC motors and C.A..
7. Draw current characteristic curves and engine torque during periods of startup, turning and braking investment.
8. Select the most appropriate starter according to the characteristics of the engine.
9. Convert relay logic circuits to static logic.

10. Understand the Programmable Logic Controllers (PLC).

6. COURSE PROGRAM

I.   Introduction to Electrical Engineering Controls. (6 sessions - 12 hours).

- Policies and course objectives.
- Fundamentals of electrical control systems (ECS): Definitions, characteristics and types of design requirements.
- Elements and symbols of control systems and circuit diagrams.
- Basic control circuits.

II. Starters automatic, acceleration, braking and turning inversion cc engine (5 sessions - 10 hours).

- Starters for acceleration or automatic.
- starting or acceleration devices with current limitation armor.
- EMF Starts with relays and relays in series with the armature.
- Starting apparatus with acceleration of time.
- Start with electronic time relays.
- Braking: Countercurrent and dynamic.

III. Methods ac motor starter, automatic starters and load. (7 sessions - 14 hours).

- Induction motor Features. or induction motor behavior to restart (or direct to rated voltage).
- Starts at reduced voltage or by resistors stator, stator reactance, autotransformer, start static (thyristors).
- Modification Starts with motor impedance: Sequence Y-Delta, partial windings, rotor resistance.
- Advantages and disadvantages of starting methods.

IV. Calculation and selection of starters for AC motors (1 session - two hours).

- Calculation of reduced voltage starters and modification of impedance.
- starter selection criteria.

V.   Other motor control functions A.C. (2 sessions - 4 hours).

- Inversion of rotation.
- Gradual Progress
- Braking: Countercurrent and dynamic.
- Synchronous Motor: Operating Characteristics and boot.
- Starting the motor or synchronous.
- synchronous motor dynamic braking.

VI. Protection Devices. (1 session - two hours).

- Types of anomalies.
- Causes of elevation or temperature.
- Overload Protection: Thermal overload relay, overload relay instant shooting thermomagnetic overload relay, thermistor overload relay.
- Short-circuit Protection.
- Protection against inadvertent or.
- Protection against failure or field.
- Protection against phase loss.
- Under Voltage Protection.

VII. Speed control of DC motors and C. A. (2 sessions - 4 hours).

- Principles of DC motor speed
- Principles of engine speed C. A.
- Speed control voltage supply.
- Speed control by frequency.
- Speed control by changing the number of poles.

VIII. Auxiliary Devices, Drivers and Transducers. (2 sessions - 4 hours).

- Limit switches, liquid level, temperature and pressure.
- Potentiometers.
- Variation Linear Differential Transformer.
- Pressure Transducer.
- Thermocouples, thermistors and temperature sensors Resistors [RTD].
- Photocells and Photoelectric Devices, optical coupling.

- Tachometers [Speed Transducers] magnitude and frequency.
IX. Static Control and Introduction to Programmable Logic Controllers (PLC). (2 sessions - 4 hours).

- Logical functions, memory function, definition and representation in logic relays and solid state logic.
- Converting relay logic circuits to static logic circuits. Interfaces input and output, converter and amplifier. Block diagram.
- Logical equations: Equations of activation and deactivation equations.
- Introduction to PLC: Component parts of a block diagram PLC, input and output addresses in a PLC, the bit address, the byte and word. Concepts of programming languages.

7. WORKLOAD: THEORY/PRACTICE

Number of sessions per week: 2
Number of hours per session: 2
Total number of class hours theoretical 4

8. CONTRIBUTION OF THE COURSE TO THE EDUCATION OF THE STUDENT

The course contributes to the formation in the area of design in Electrical Engineering, specifically the design of automation systems in low voltage electric.

BASIC TRAINING	PROFESSIONAL TRAINING	SOCIAL SKILLS DEVELOPMENT
	X	

9. THE RELATIONSHIP BETWEEN THE LEARNING OUTCOMES OF THE COURSE AND THE LEARNING OUTCOMES OF THE DEGREE PROGRAM

LEARNING OUTCOMES OF THE DEGREE PROGRAM*	CONTRIBUTION (High, Medium, Low)	LEARNING OUTCOMES OF THE COURSE**	THE STUDENT MUST:
a) An ability to apply knowledge of mathematics, science and engineering.	High	6,7,8	Perform calculations starters parameters, impedance, starting current, starting torque, voltage and current operation of DC motors and AC.
b) An ability to design and conduct experiments, and to analyze and interpret data			
c) An ability to design a system, component or process to satisfy realistic constraints.	High	1,4,5,8	Designing and selecting starters for DC motors and C. A. Designing power and control circuits for motors and electrical equipment, according to specifications of automation.
d) An ability to function on multidisciplinary teams.	Low	1,5,6,7,8	Working in groups to solve design problems
e) An ability to identify, formulate and solve engineering problems.	Medium	1,3,4,5,6,7,8,9	Apply knowledge to solve problems that arise in automation through contactors.
f) An understanding of ethical and professional responsibility.			
g) An ability to communicate effectively.	Low	1	Review design problems, suggests alternative solutions verbally.
h) A broad education necessary to understand	Medium	1	Perform economic technical designs to compete in the field of engineering.

	the impact of engineering solutions in a social, environmental, economic and global context.			
i)	A recognition of the need for, and an ability to engage in life-long learning.	Low	1	Find and read current information sources.
j)	A knowledge of contemporary issues.			
k)	An ability to use the techniques, skills, and modern tools necessary for engineering practice.	Medium	1,4,5,6,7,8,9	Apply the design and selection techniques to understand, analyze and interpret drawings and designs elaborate whether technical catalogs on automation equipment.
l)	Capacity to lead, manage and undertake projects.			

10. EVALUATION IN THE COURSE

Evaluation activities	
Exams	X
Tests	X
Homework/tasks	X
Projects	
Laboratory/Experiments	
Class participation	
Visits	
Other	

11. PERSON RESPONSIBLE FOR THE CREATION OF THE SYLLABUS AND THE DATE OF ITS CREATION

Created by	Otto Alvarado Moereno
Date	05 / Sept / 2013

12. APPROVAL

ACADEMIC SECRETARY OF THE ACADEMIC DEPARTMENT	DIRECTOR OF TECHNICAL ACADEMIC SECRETARY
NAME: Mrs.Leonor Caicedo G. SIGNATURE: Date of approval by the Directive Council: 2013-537 2013-10-7	NAME: Eng.Marcos Mendoza SIGNATURE: ESCUELA SUPERIOR POLITÉCNICA DEL LITORAL Ing. Marcos Mendoza V. DIRECTOR DE LA SECRETARIA TÉCNICA ACADÉMICA

13. VALIDITY OF THE SYLLABUS

RESOLUTION OF THE POLYTECHNIC BOARD:	13-12-343
DATE:	2013-12-12