



**A) COURSE**

| Course Id: | Course                   |
|------------|--------------------------|
| 5714       | <b>ELECTROPNEUMATICS</b> |

| Class Hours per Week | Lab hours per week | Complementary practices | Credits | Total hour course |
|----------------------|--------------------|-------------------------|---------|-------------------|
| 3                    | 2                  | 3                       | 8       | 48                |

**B) GENERAL COURSE INFORMATION:**

|  | EE<br>(IEA)                                  | ME<br>(IM) | MME<br>(IMA) | EME<br>(IME) | MTE<br>(IMT)                            |
|--|--|------------|--------------|--------------|---|
| <b>Level:</b>                              | VI   |            |              |              | VI                                      |
| <b>Course Type<br/>(Required/Elective)</b> | Required                                     |            |              |              | Required                                |
| <b>Prerequisite<br/>Course:</b>            | Industrial<br>Instrumentation<br>180 Credits |            |              |              | Control<br>Engineering I<br>180 Credits |
| <b>CACEI<br/>Classification:</b>           | IA   |            |              |              | IA                                      |

**C) COURSE OBJECTIVE**

|   |
|---|
| <b>At the end of the course, the student will be capable of:</b>              |
| Designing electro-pneumatic systems applied to industrial process automation. |

**D) TOPICS (CONTENTS AND METHODOLOGY)**

|                                     |   |                |
|-------------------------------------|---|----------------|
| <b>1.- INTRODUCTION</b>             |   | <b>3 Hours</b> |
| <b>Specific Objective:</b>          | Study the main laws governing the fluid power.  |                |
|                                     | 1.1 Basics of fluid mechanics.<br>1.2 Fundamental Laws<br>1.2.1 Ideal Gas Law<br>1.2.2 Principle of Pascal<br>1.2.3 Bernoulli equation<br>1.2.4 Applications of the principle of Pascal |                |
| <b>Readings and other resources</b> | ESPOSITO ANTHONY<br>Fluid Power with applications. Editorial Prentice Hall, 2003<br>GUILLÉN SALVADOR ANTONIO<br>Introducción a la Neumática. Editorial Alfaomega Marcombo, 1999.        |                |
| <b>Teaching Methodologies</b>       | Exposure of theoretical concepts.   |                |
| <b>Learning Activities</b>          | Homeworks and projects.<br>Analysis of real problems.   |                |



| 2.- GENERATION AND PREPARATION OF COMPRESSED AIR |  | 4 hours |
|--|--|---------|
| <b>Specific Objective:</b>                       | Identify the characteristics of the elements of a pneumatic system.  |         |
|  | 2.1. Compressor<br>2.2. Accumulator<br>2.3. Air dryers.<br>2.4. FRL unit.<br>2.5. Air distribution, direct air supplying of pneumatic devices<br>2.6 Example of dimensioning an air supplying network for pneumatic devices<br>2.7 Calculation of compressed air consumption in various devices. |         |
| <b>Readings and other resources</b>              | CARULLA MIGUEL / LLADONOSA VICENT<br>Circuitos Básicos de Neumática. Editorial Alfaomega Marcombo, 1995.<br>DEPERT W. / STOLL K.,<br>Dispositivos neumáticos. Editorial Alfaomega Marcombo, 1991.  |         |
| <b>Teaching Methodologies</b>                    | Exposure of theoretical concepts.  |         |
| <b>Learning Activities</b>                       | Homeworks and projects.<br>Analysis of real problems.<br>Problem solving and exercises.  |         |

| 3.- ELECTROPNEUMATIC SYSTEMS        |   | 3 hours |
|-------------------------------------|---|---------|
| <b>Specific Objective:</b>          | Identify the operating characteristics of electro-pneumatic systems.  |         |
|                                     | 3.1 Structure of an electro-pneumatic system<br>3.2 Areas of application of electro-pneumatics<br>3.3 Advantages of electro-pneumatic systems.<br>3.4 Safety in electro-pneumatic circuits. |         |
| <b>Readings and other resources</b> | LLADONOSA V.<br>Circuitos Básicos de Electroneumática. Editorial Alfaomega Marcombo, 1991.<br>CREUS SOLÉ A.,<br>Neumática e Hidráulica. Editorial Alfaomega Marcombo, 2007.                 |         |
| <b>Teaching Methodologies</b>       | Exposure of theoretical concepts.   |         |
| <b>Learning Activities</b>          | Homeworks and projects.<br>Analysis of real problems.<br>Problem solving and exercises.   |         |

| 4.- PNEUMATIC DEVICES               |  | 6 hours |
|-------------------------------------|--|---------|
| <b>Specific Objective:</b>          | Successfully integrate the operation of valves, actuators and measuring components in a pneumatic control system.  |         |
|                                     | 4.1 Distribution valves.<br>4.2. Types of actuators in distribution valves.<br>4.3. Control Valves.<br>4.4. Power actuators.<br>4.5. Additional devices. |         |
| <b>Readings and other resources</b> | DEPERT W. / STOLL K.,<br>Dispositivos neumáticos. Editorial Alfaomega Marcombo, 1991.  |         |
| <b>Teaching Methodologies</b>       | Exposure of theoretical concepts.  |         |
| <b>Learning Activities</b>          | Homeworks and projects.<br>Analysis of real problems.<br>Problem solving and exercises.  |         |



| 5.- ELECTRICAL DEVICES IN ELECTRO- PNEUMATICS |  | 3 hours |
|---|--|---------|
| <b>Specific Objective:</b>                    | Identify the operating characteristics of the elements comprising an electro-pneumatic control system.   |         |
|   | 5.1. Electrical components in electro-pneumatics.<br>5.2. Calculating energy consumption in electro-pneumatic circuits.<br>5.3. Electrical symbols used in electro-pneumatics.<br>5.4. Control elements.<br>5.5. Connections identification. |         |
| <b>Readings and other resources</b>           | MILLAN TEJA SALVADOR<br>Automatización Neumática y Electroneumática, Editorial Alfaomega, 1996.  |         |
| <b>Teaching Methodologies</b>                 | Exposure of theoretical concepts.  |         |
| <b>Learning Activities</b>                    | Homeworks and projects.<br>Analysis of real problems.<br>Problem solving and exercises.  |         |

| 6.- RULES AND CHARACTERISTICS OF ELECTRO- PNEUMATIC DIAGRAMS |  | 5 hours |
|--|--|---------|
| <b>Specific Objective:</b>                                   | Analyze the structured design rules for developing electro-pneumatic diagrams.   |         |
|  | 6.1. Pneumatic diagram of an electro-pneumatic circuit.<br>6.2. Rules for designing pneumatic control circuit.<br>6.3. Control chains.<br>6.4. Designation of components.<br>6.5. Component codes.<br>6.6. Initial conditions of a pneumatic control diagram.<br>6.7. Electrical diagram of an electro-pneumatic circuit.<br>6.8. Rules for designing electrical control circuits.<br>6.9. Identification of components in an electro-pneumatic control circuit. |         |
| <b>Readings and other resources</b>                          | MILLAN TEJA SALVADOR<br>Automatización Neumática y Electroneumática, Editorial Alfaomega, 1996.  |         |
| <b>Teaching Methodologies</b>                                | Exposure of theoretical concepts.  |         |
| <b>Learning Activities</b>                                   | Homeworks and projects.<br>Analysis of real problems.<br>Problem solving and exercises.  |         |

| 7.- DESIGN OF BASIC ELECTRO-PNEUMATIC CIRCUITS |   | 12 hours |
|--|---|----------|
| <b>Specific Objective:</b>                     | Analyze basic electro-pneumatic designs applied to simple mechanisms.   |          |
|  | 7.1. Logic functions.<br>7.2. Basic logic circuits with relays.<br>7.3. Basic circuits with programmers.<br>7.4. Application examples.<br>7.5. Electro-pneumatic circuits simulation. |          |
| <b>Readings and other resources</b>            |   |          |
| <b>Teaching Methodologies</b>                  | Exposure of theoretical concepts.   |          |
| <b>Learning Activities</b>                     | Homeworks and projects.<br>Analysis of real problems.<br>Problem solving and exercises.   |          |



| 8.- DESIGN OF SEQUENTIAL ELECTRO-PNEUMATIC CIRCUITS |   | 12 hours |
|---|---|----------|
| <b>Specific Objective:</b>                          | To design sequential electro-pneumatic systems using structured techniques.   |          |
|   | 8.1. Classification of control systems.<br>8.2. Sequential control systems.<br>8.3. Phase space diagram.<br>8.4. Space-time diagram.<br>8.5. Memorizing signals.<br>8.6. Simulation of electro pneumatic sequential circuits. |          |
| <b>Readings and other resources</b>                 | MILLAN TEJA SALVADOR<br>Automatización Neumática y Electroneumática, Editorial Alfaomega, 1996.   |          |
| <b>Teaching Methodologies</b>                       | Exposure of theoretical concepts.   |          |
| <b>Learning Activities</b>                          | Homeworks and projects.<br>Analysis of real problems.<br>Problem solving and exercises.   |          |

**E) TEACHING AND LEARNING METHODOLOGIES**

Traditional exposition, supported by the suggested literature, using simulation programs, videos presentations. Presentation of cases for analysis and debate. Industrial visits that include in their application processes of electro-pneumatics.

**F) EVALUATION CRITERIA:**

| Evaluation:         | Schedule              | Suggested Form of Evaluation and weighing | Topics              |
|---------------------|-----------------------|---|---------------------|
| 1st Term            | Session 16            | Exam 85%, Homework 15%,                   | Units 1, 2, 3 and 4 |
| 2nd Term            | Session 32            | Exam 85%, Homework 15%,                   | Units 5, 6 and 7    |
| 3rd Term            | Session 48            | Exam 85%, Homework 15%,                   | Unit 8              |
| Final evaluation    |                       | 100% (Average of the partial evaluations) |                     |
| Other activity:     |                       |   |                     |
| Extraordinary Exam  | According to schedule | 100% Exam                                 | 100% of topics      |
| Title Exam          | According to schedule | 100% Exam                                 | 100% of topics      |
| Regularization Exam | According to schedule | 100% Exam                                 | 100% of topics      |

**G) BIBLIOGRAPHY AND ELECTRONIC RESOURCES**

**Main Books**

- a) MILLAN TEJA SALVADOR  
Automatización Neumática y Electroneumática, Editorial Alfaomega, 1996.



- b) ESPOSITO ANTHONY  
Fluid Power with applications  
Editorial Prentice Hall, 2003
- c) GUILLÉN SALVADOR ANTONIO Introducción a la Neumática  
Editorial Alfaomega Marcombo, 1999.
- d) CARULLA MIGUEL / LLADONOSA VICENT Circuitos Básicos de Neumática  
Editorial Alfaomega Marcombo, 1995.
- e) DEPERT W. / STOLL K., Dispositivos neumáticos,  
Editorial Alfaomega Marcombo, 1991.
- f) LLADONOSA V.  
Circuitos Básicos de Electroneumática. Editorial Alfaomega Marcombo, 1991.
- g) CREUS SOLÉ A., Neumática e Hidráulica  
Editorial Alfaomega Marcombo, 2007.

#### **Complementary Books**

- a) INTERNATIONAL STANDAR ISO-1219-1  
Fluid Power system and components, graphic symbols and circuit diagrams; Part 1, graphic symbols.  
First Edition
- b) INTERNATIONAL STANDAR ISO-1219-2  
Fluid Power system and components, graphic symbols and circuit diagrams; Part 2, circuit diagrams  
First Edition
- c) ANDREW PARR  
Hydraulics and Pneumatics, A Technical and Engineer's guide. Editorial Elsevier Butterworth  
Heinemann, 1998.
- d) ROLDÁN VITORIA JOSÉ  
Neumática, Hidráulica y Electricidad Aplicada, Editorial Thomson-Paraninfo, 10ª Edición, 2004.
- e) Neumática Nivel básico TP 101. Manual de estudio FESTO DIDACTIC.

#### **Internet Links**

<http://www.millerfluidpower.com/>  
<http://www.lenzinc.com/>  
<http://www.parker.com/>  
<http://www.festo.com/>  
<http://www.hydraulic-supply.com/>  
<http://www.sauer-danfoss.com/>