

## Applications of Pneumatics in Logic Circuits and Control Systems (An Interactive, Computer-Based, E-Learning and Virtual Lab Course)

### Introduction:

Pneumatic systems are concerned with using compressed air to do predefined & controllable mech. work. Pneumatics is extensively used in industry, where factories are commonly plumbed with compressed air which is very cheap. This is because (as in fig.) a centrally-located and electrically-powered compressor that powers cylinders and other pneumatic actuators through directional solenoid valves is able to provide motive power in cheaper, safer, more flexible & more reliable way than large number of electric motors & actuators. Separate Pneumatic circuits also have different applications in dentistry, construction & mining areas. Pneumatic logic circuits (e.g., AND, OR, NAND, NOR..etc) are also used in many industrial facilities.

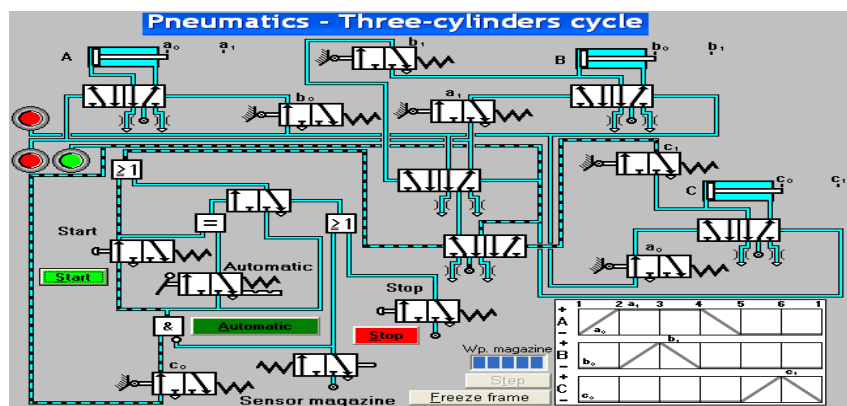
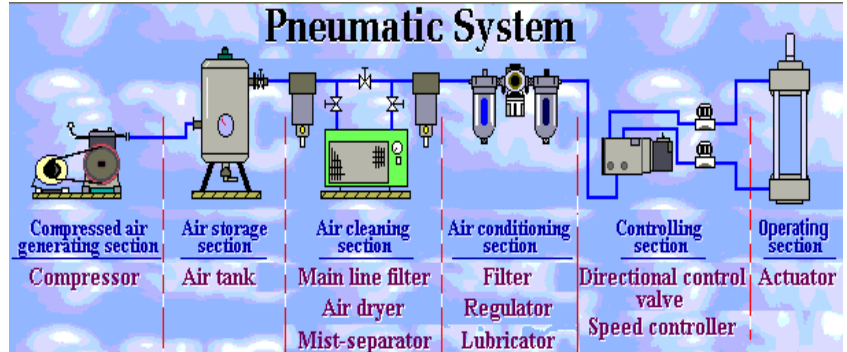
Design of, selection and understanding basics of pneumatic circuits/components and operation and maintenance procedures are very important practices of many engineers & technicians.

Availability, efficiency and extended reliable performance of power plants, and air handling stations are greatly influenced by accurate design, selection, efficient operation and proper maintenance of pneumatic systems and the associated components.

### Course Objectives:

This is an interactive, computer-based, e-Learning and virtual lab course. It has been designed to give participants a broad understanding of the most important pneumatic circuit's concepts. Upon completion of the course, they should understand various physics laws apply to pneumatics, as well as essential symbols & read and understand circuit's schematics and system design. Participants study various components in typical pneumatic system and find how the components function and interact with each other. Each lecture will be followed by a very comprehensive interactive and computer based virtual and multi-media training lab and software. Each lab will also include animations, 3-D models and on-line training quizzes. This Course will give the participants a wide range of knowledge & practical skills to:

- Understand basic components of pneumatic circuits and pneumatic control system.
- Understand and examine how compressed air is prepared, stored and conditioned for use in pneumatic circuits.
- Understand and examine various types of pneumatic actuators (cylinders, motors and semi-rotating motors).
- Understand and examine various types of valves used to control (pressure, direction, flow rate and check valves). This includes functions, materials, sizes, geometry considerations and essential characteristics.
- Understand various types of accessories used in pneumatic circuits (e.g., filters, flow meters, pressure gauges, heat exchangers and pressure switches..etc).
- Understand Symbols & reading pneumatic schematics and identify system components & design function as well.
- Practical training for basic pneumatic system design and how to build, analyze and operate pneumatic circuits.
- Understand and examine International Reference Standards related to pneumatic Symbols and system/circuit design.
- Understand some maintenance and troubleshooting requirements for pneumatic circuits





## **The ILO's (Intended Learning Outcomes) of the Course:**

### **a- Knowledge and Understanding:**

This course has been designed to give the participants a broad based understanding of the most important Pneumatic concepts. Upon completion of this course, they should have the ability to:

- ✓ Understand and apply knowledge of basic physics laws and fluid mechanics concepts as they apply to Pneumatics and to optimum solution of automatic control problems using Pneumatic systems.
- ✓ Understand and apply knowledge of thermo-fluid characteristics of standard Air and various types of gas conducting methods and the proper materials used for each one.
- ✓ Understand and apply knowledge of Principles of Pneumatic System design including types of air-pumps, pneumatic actuators, various control valves and accessory components in a typical pneumatic system.
- ✓ Understand reading pneumatic schematics and identify system components and design function as well.
- ✓ Understand and apply knowledge of Maintenance & Troubleshooting of Pneumatic Control Systems.
- ✓ Understand current engineering technologies related to Pneumatic Automatic Control Systems.

### **b- Intellectual Skills:**

This course helps the participants to acquire the ability to:

- ✓ Identify, select, describe, and draw the main various components in typical Pneumatic schematics and to recognize and comprehend how these components function and interact with each other.
- ✓ Follow and participate in a comprehensive interactive & computer-based virtual and multi-media training labs which include system animations, 3-D models and on-line multiple choices quizzes.
- ✓ Identify, formulate and solve main basic automatic control problems using Pneumatic power.
- ✓ Design Pneumatic circuit, component & schematics to meet required needs within realistic constraints.
- ✓ Select appropriate components for modeling and analyzing typical Pneumatic Control problems.
- ✓ Select appropriate solutions for various multiple choices quiz problems based on analytical thinking.
- ✓ Assess and evaluate the characteristics and performance of Air-pumps, pneumatic actuators, various control valves and accessory components in a typical pneumatic system and process control design.
- ✓ Use virtual lab tools & software packages pertaining to pneumatic systems & process control design.

### **c- Practical and Professional Skills:**

This course helps the students to acquire the ability to:

- ✓ Integrate knowledge of basic physics laws, fluid mechanics concepts, information technology, design, and engineering practice to solve engineering problems of Pneumatic Control Systems.
- ✓ Employ drawing & professional skills to design, analyse schematics of pneumatic systems & control circuits.
- ✓ Use a wide range of computer applications, technical tools, and techniques including virtual labs software.
- ✓ Implement comprehensive knowledge, understanding, and intellectual skills in solving on-line virtual training labs, exercises, and MCQ problems.
- ✓ Prepare and present technical reports and schematics of pneumatic circuits and control systems.

### **d-General and Transferable Skills:**

This course helps the students to acquire the ability to:

- ✓ Collaborate & Communicate effectively within a lab group/team.
- ✓ Work in stressful class and lab environment and within time constraints.
- ✓ Demonstrate efficient IT capabilities.
- ✓ Manage tasks and lab resources efficiently.
- ✓ Search for information and adopt self learning.
- ✓ Refer to relevant literature effectively

### **Who Should Attend:**

Engineers and Field Personnel involved with design, maintenance, operation, selection installation and maintenance as well as plant reliability, condition monitoring and for the day to day servicing and operational efficiency. Also plant and maintenance engineers, process engineers and maintenance managers. It is also be invaluable to supervisors who are involved in pump and compressor maintenance activities.



### **The Instructor:**

Dr. Mohsen Soliman is an Associate professor of fluid mechanics group in Mechanical Power Engineering Department – Cairo university. He has a Ph.D. degree, 1987 from university of California, Irvine and has a long teaching and research experience in the area of fluid flow, turbo machines, and gas dynamics and has many research papers published at international conferences and journals. Dr. Soliman has had many years' experience in organizing and lecturing training courses for engineers inside and outside Egypt. The courses cover design pipe lines, valve technology, water hammer and fire fighting systems. Currently, Dr. Soliman is the manager of the Automatic Control Lab, ACC, and the administrator of the Automatic Control Post Graduate Diploma at Mech. Power Engineering Dept. FECU. See the ACC site: [www.acc-vlab.cu.edu.eg](http://www.acc-vlab.cu.edu.eg)

### **Daily Course Program**

#### **Day one:**

9:00 – 9:30	Registration	
9:30 – 11:00	Lecture 1	Introduction & ILO's of the course
11:00 – 11:30	Coffee break	
11:30 – 13:00	Lecture 2	Overview for Using Virtual Labs for Automatic Control Systems+ movie.
13:00 – 13:30	Lunch break	
13:30 – 15:00	Lecture 3	Compressed Air Power Physics: basic physics laws & thermo-fluid concepts.

#### **Day Two:**

9:00 – 10:30	Lecture 4	Types of Compressors used in Pneumatic circuits. Air Preparation Process.
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 5	Pneumatic Actuators (cylinders, motors and semi-rotating motors).
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 6	Pneumatic Pressure Control Valves.

#### **Day Three:**

9:00 – 10:30	Lecture 7	Pneumatic Directional Control Valves.
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 8	Pneumatic Flow Control Valves.
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 9	Pneumatic Air Conditioning (filters, heat exchangers and air tanks).

#### **Day Four:**

9:00 – 10:30	Lecture 10	Check Valves and Accessory Components.
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 11	Compressed Air Conductors and Piping System.
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 12	Understanding Symbols and Reading Pneumatic Circuits Schematics.

#### **Day Five:**

9:00 – 10:30	Lecture 13	Practices Basic System Design. Build, Analyze & Operate Pneumatic Circuits.
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 14	International Reference Standards related to Pneumatic Symbols & Systems.
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 15	Maintenance and Troubleshooting. Course Review and Course Evaluation.

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أ.م/ محسن سيد سليمان  
مدير معمل التحكم ACC ومسئول إدارة دبلوم التحكم الأوتوماتيكي  
مدير وحدة ضمان الجودة سابقاً ومرشداً أكاديمي د.ع في قسم ميكانيكا قوى