Faculty/School:	**Faculty of Engineering/School of Electrical Engineering**
Course Name : **Specialized 3rd Year Laboratory (PBL)** Course Code : SEEM 3742	Review: 5 Release Date : 2023 Last Amendment: 2022 Prosedure No:

SEEM3742

FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MALAYSIA
SKUDAI CAMPUS
JOHOR

MECHATRONICS LABORATORY
STUDENT PACK

ELECTRO-PNEUMATICS (SMC)

Prepared By :	Verified by : Director
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Signature : Official Stamp :	Signature : Official Stamp :
Date : 26 March 2023	Date : 26 March 2023

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Problem/Project Guide:

Electro-hydraulic (electro-pneumatic) term is defined from words of electro, which mean electrical and hydraulic (pneumatic) which mean hydro/liquid (air) pressure. The electro-hydraulic (electro-pneumatic) equipment and system is an integration of electrical and mechanical components with compressed liquid (air) source. This lab requires the students to work through Task 1,2 and/or 3 and are expected to understand the basic operation of the electro-hydraulic (electro-pneumatic) control circuit. Based on the exercises given, students should be able to solve the problem given and finally provide a technical report with simulation of the activities carried out throughout the investigation. For this lab, students will be exposed to both electro-hydraulics and electro-pneumatics system but only one problem will be chosen and solved.

(a) Problem-objectives

Electro-hydraulics-Students are expected to be able to design and implement an electro-hydraulic circuit which behaves as an elevator.

Electro-pneumatics-Students are expected to be able to design and install an electro-pneumatic circuit using multiple cylinders with sequence motion

(b) Milestone

By the end of	Descriptions
Week 1	- Group members introduction and task distributions (Electro-hydraulics or Electro Pneumatics) - Working on Task 1, Task 2 and/or Task 3 - Completion of Individual Report
Week 2	- Working on experiments planning (equipment / list of materials in the simulation software) - Circuit design - Simulation - Completion of design proposal which include (2 pages)
Week 3	- Troubleshooting - Simulation result and video demonstration of experiments/ works Completion and Submission of Group Report

(c) Project timeline

Activities	Week 1	Week 2	Week 3
1. Understanding/ identify problem/			
2. Experiments/ testing/ design proposal			
3. Analysis/ simulation & application			

(d) Report Writing

Your report may include the information here. For example,

Other than the general guide specified by the Laboratory Coordinator, your report for this laboratory must also include

- ✦ Introduction, review and circuit diagrams
- ✦ Photographs of the simulation / actual circuit construction
- ✦ Photographs of your group members
- ✦ Videos submission for recording evidence of group progress and project's demonstration/ application.

Discussion are mandatory for all the results obtained.

(e) **Resources Software & Hardware:** Examples as follows

- Microsoft office
- FluidSim Software/ Automation Studio
- SMC Electro-Pneumatics System
- Bosch Electro-Hydraulics System
- Electro-hydraulics and Pneumatics Theory (available in Mechatronics website) • Materials related to the problem/project- technical papers, links to websites etc.

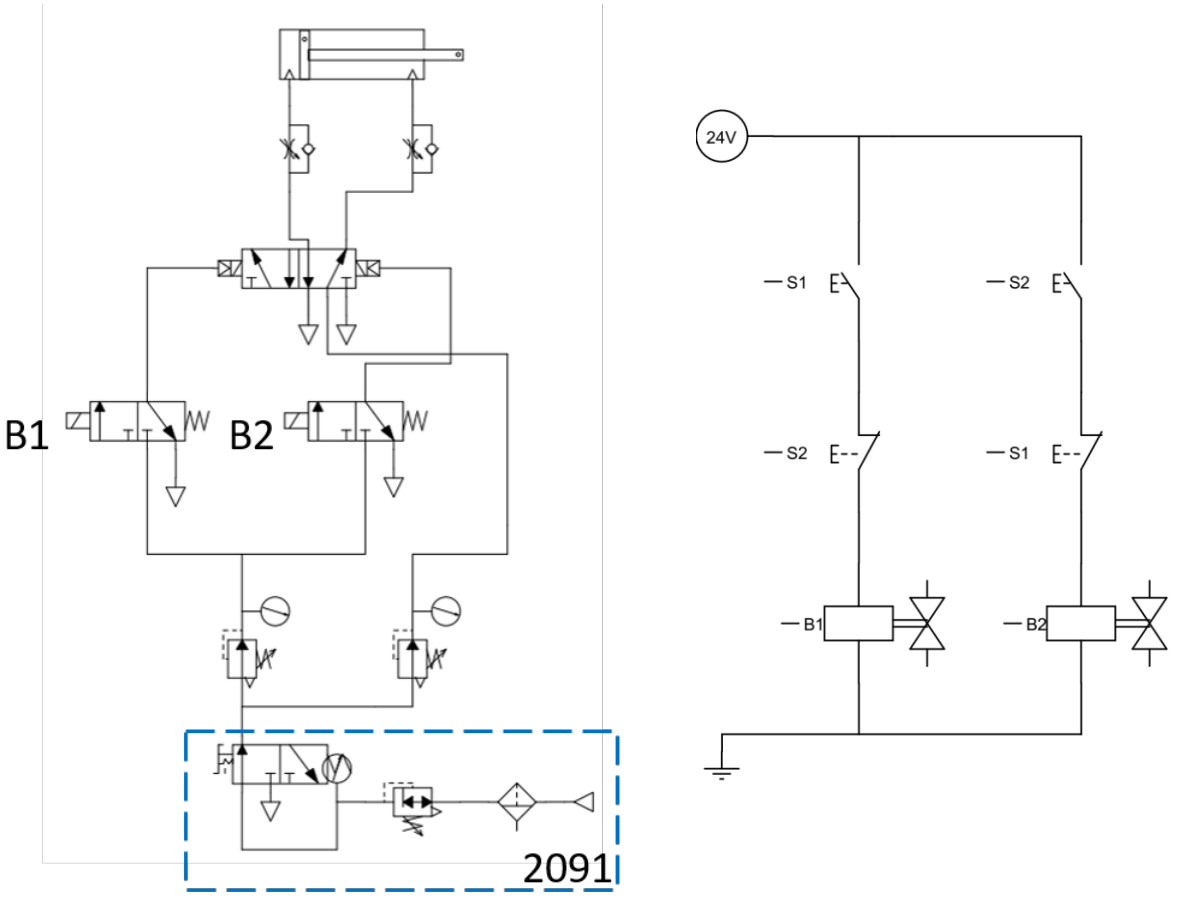
Task 1: Actuation of the 5/2 Way Directional Control Valve (DCV)

Practice Objective

After working through this practice, students are expected to understand the basic operation of the electro-pneumatic control circuit using a double-acting cylinder.

Procedure

1. Connect the pneumatic circuit as shown in **Figure 1.1(a)**. Use directional valve 5/2 way (2024) and directional valve 3/2 way (2050 or 2052).
2. Connect the electric circuit as shown in **Figure 1.1(b)**.
3. Validate the pneumatic circuit and electric circuit for any misconnection.
4. Turn the pneumatic power unit ON. Adjust the pressure to 2 to 5 bars at the pressure-limiting valve.
5. Turn the electrical power unit ON.
6. Press S1 and verify if the piston rod of the pneumatic cylinder extends.
7. Press S2 and verify if the piston rod of the pneumatic cylinder retracts.
8. After you complete the experiment, turn OFF of the pneumatic power unit and electric power unit.



(a) Pneumatic circuit (b) Electrical circuit

Figure 1.1: Circuit drawing of pneumatic and electrical circuits for Task 1

Assignment

Based on your observation, fill **Table 1.1**.

Table 1.1: Truth table for Task 1

S1	S2	Double-Acting Cylinder (Extend/Retract/No change)
Not pressed	Not pressed	
Not pressed	Pressed	
Pressed	Not pressed	
Pressed	Pressed	

Based on your understanding, describes the expected result if both solenoids (B1 and B2) in **Figure 1.3(b)** are swapped.

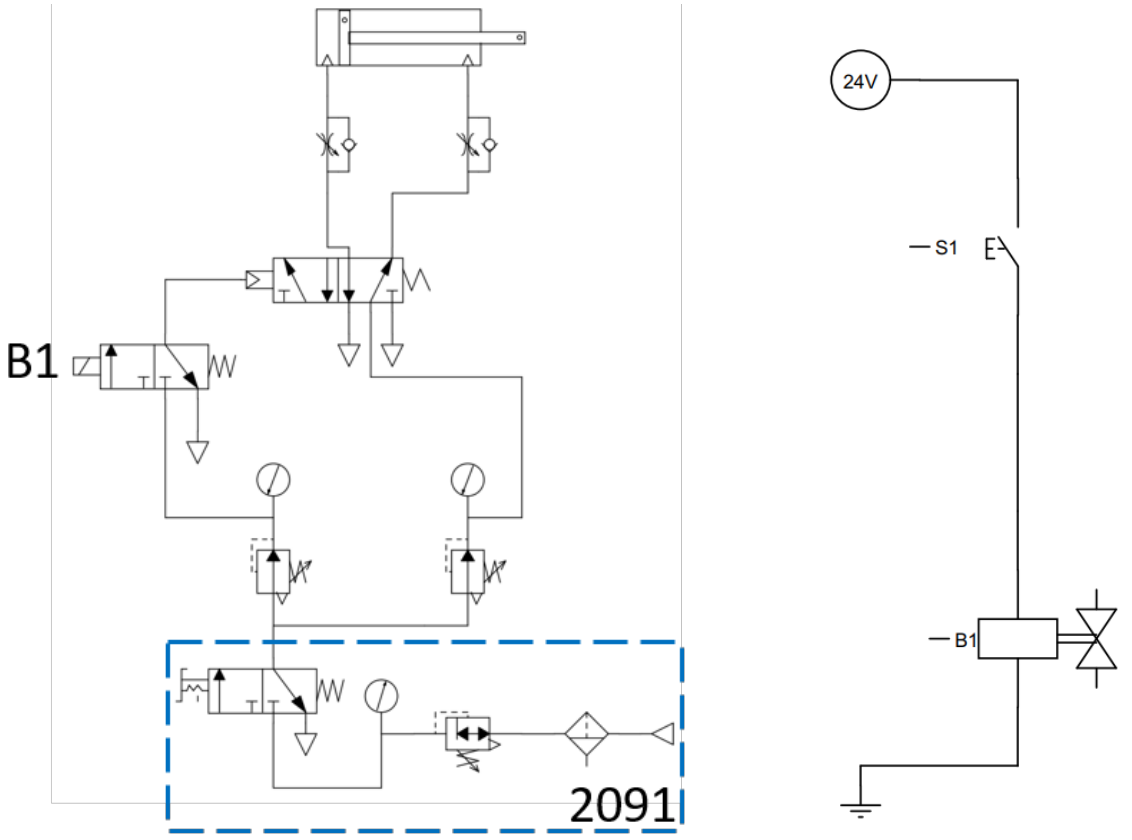
Task 2: Self-holding (Memory) Electro-Pneumatic Circuit Using Relay.

Practice Objective

After working through this practice, students are expected to understand the self-holding concept in the electro-pneumatic control system.

Procedure

1. Connect the pneumatic circuit and electric circuit as shown in **Figure 2.1(a)** and **(b)**. Use directional valve 5/2 way (2023) and directional valve 3/2 way (2050 or 2052).
2. Validate the pneumatic circuit and electric circuit for any misconnection.
3. Turn the pneumatic power unit ON. Adjust the pressure to 2 to 5 bars at the pressure-limiting valve.
4. Turn the electrical power unit ON.
5. Press and hold S1. Verify if the piston rod of the pneumatic cylinder extends.
6. Release S1. Verify if the piston rod of the pneumatic cylinder extends.
7. Record your observation.
8. Replace the current electric circuit to the electrical circuit shown in **Figure 2.2**. Repeat procedure #3 to #7.
9. Press the switch S2 and verify if the piston rod of the pneumatic cylinder retracts.
10. Based on your observation, explain the differences observed between these two electrical circuits.
11. After you complete the experiment, turn OFF of the pneumatic power unit and electrical power unit.



(a) Pneumatic circuit (b) Electrical circuit

Figure 2.1: Circuit drawing of pneumatic and electrical circuits for

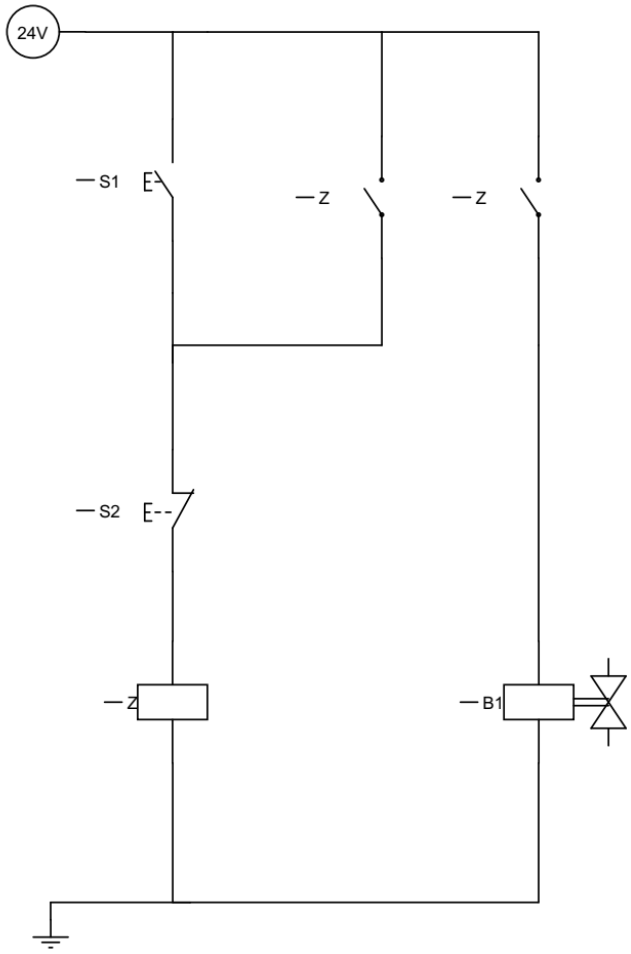


Figure 2.2: Self-holding electrical circuit

Task 3: Implementing Basic Logic Functions in Electro-Pneumatic Circuit.

Practice Objective

After working through this practice, students are expected to be able to relate the installation of parallel and serial electric circuit with the basic logic functions (OR/AND/NOT).

Assignment

By using the previous pneumatic circuit as shown in **Figure 2.1 (a)**, try out different electrical circuits as shown in **Figure 3.1(a)** to **Figure 3.1(c)**.

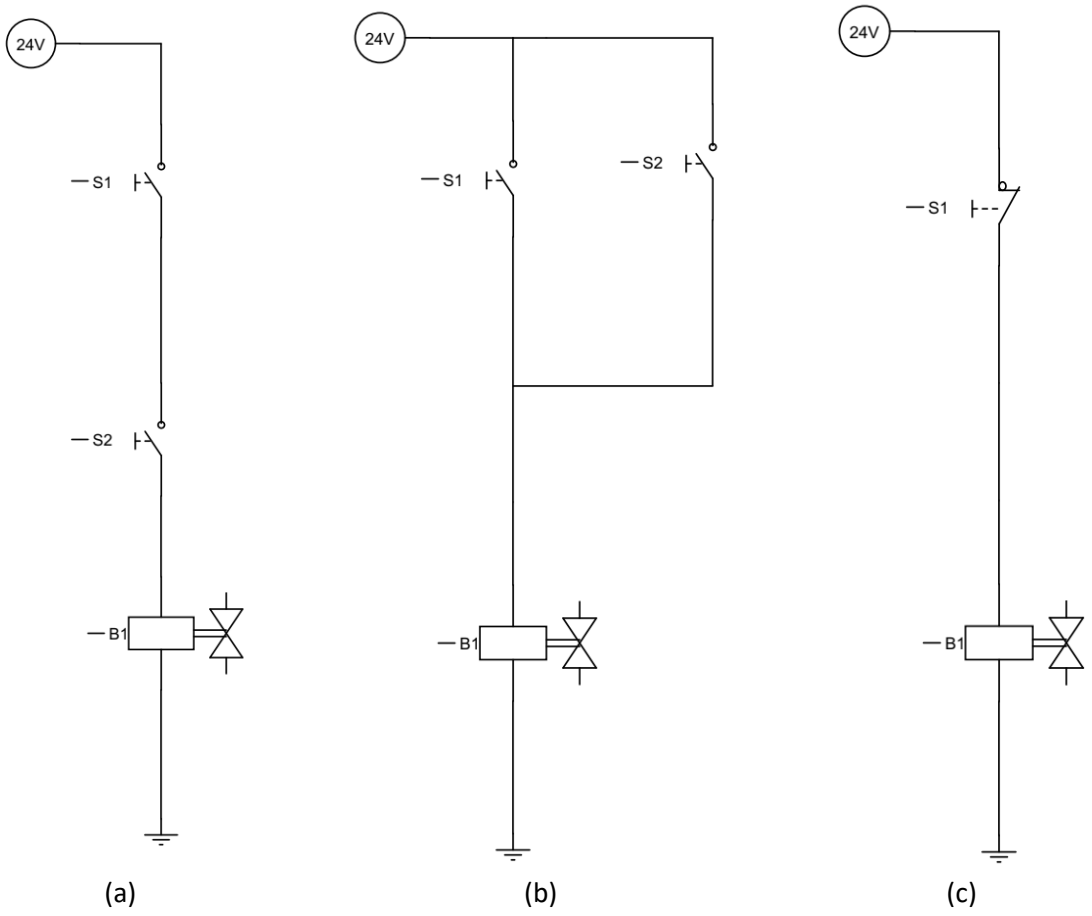


Figure 3.1: Electrical Circuits for Task 3

For each scenario (**Figure 3.1(a)** to **Figure 3.1(c)**), you are required to:

1. Write down the truth table of the observed result.
2. Formulate the logic equation based on the truth table.
3. Identify which logic function is used.

Based on what you have learned in the previous section, design an electro-pneumatic circuit that fulfill the following truth table (refer **Table 3.1**).

Table 3.1: Truth Table for Task 3

S1	S2	d
0	0	0
0	1	1
1	0	1
1	1	0
Note: For S1 & S2: 0 = Not press & 1 = Press For d: 0 = Retract & 1 = Extend		

You are required to:

1. Formulate the logic equations based on the truth table.
2. Design the electro-pneumatic circuit you had designed.
3. Validate the design with the experiment observation.
4. Identify which logic function that has the same truth table as Table **3.1**

PROBLEMS

Electro-Pneumatics: Material transportation using bidirectional conveyor

Practice Objective

After working through this practice, students are expected to design and install an electro-pneumatic circuit material transportation.

Assignment

Consider a pneumatic transferring station shown in **Figure P.1**, where a cylinder is used to transfer detected objects to a conveyor. A sequence of operation for the station can be described as follows:

Step 1 : When a product detected, a cylinder will extend to transfer the object to the conveyor at position Y (the pushing cylinder at control panel used to simulate the process).

Step 2 : When a metal object is detected at Y (to other station), the conveyor transports the metal object toward Z. Meanwhile, when a non-metal object is detected at Y, the conveyor transports the metal object toward X (to other station).

Step 3 : After the object was transported to other station, the conveyor will stop moving

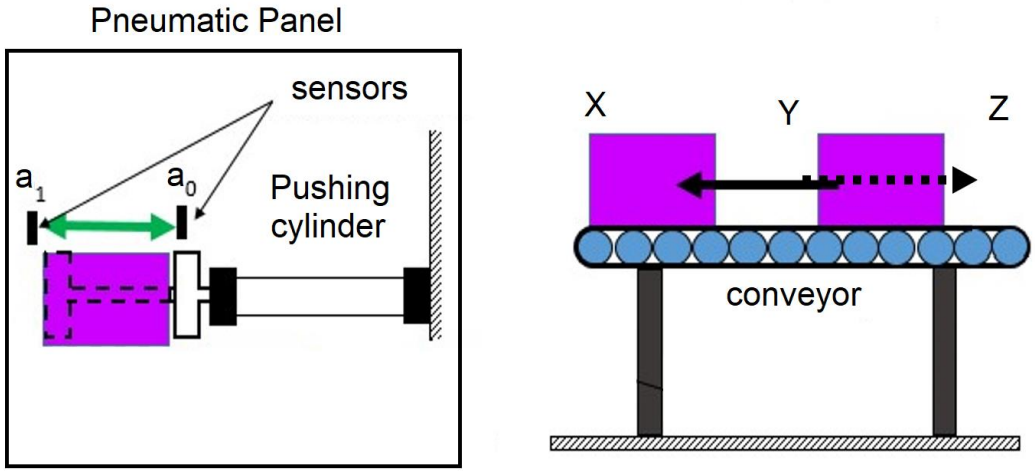


Figure P.1: Transfer Station

In your report, please include (but not limited to) the following information:

1. The truth table of the expected result.
2. The logic equations based on the truth table.
3. The pneumatic and electrical circuits that you had designed.