Pre-competition Activity
Mechatronics Competition
Task Descriptions

TASK A: Pneumatic sequence

Weighting (points out of total): 30 / 100

Maximum time allowed, t_{max}: 60 minutes

Problem:
Use Festo TP101 equipment set to design, assemble and commission a pneumatic circuit with the sequence of

$$\left[A-, B-, \begin{pmatrix} A+ \\ 4.0bar \end{pmatrix}, 2s,\ B+ \right]$$

Circuit requirements:

1. Adjust the supply pressure to 5.0 bars.
2. Cylinders A and B are to be double acting cylinders with cushioned end stops.
3. The cycle is to be initiated by a normally closed 3/2 way valve with a selector switch.
4. Once the cycle is started as described in (3), it will self-repeat until interrupted by the 3/2 way valve with a selector switch.
5. If the cycle is interrupted mid-cycle, it will complete the current cycle fully before it comes to rest.
6. Use appropriate sensors to ensure that cylinders A and B are in their extended positions before the cycle can start. Note that there are two cylinder-attached proximity sensors and two roller lever valves available.
7. Cylinder B will retract at maximum speed.

8. Add speed control element to cylinder B to limit its forward (B+) speed while maintaining maximum force. Full return stroke is to be achieved in 3.0 ±0.5 s.

9. Use a flow restrictor to starve cylinder A when moving forward. Add a pressure gauge to observe the pressure slowly increasing in Cylinder A and trigger Cylinder B return at 4.0 bar after a 2s delay.

10. The choice of directional control valves are left up to the teams to determine but each cylinder must have its own directional control valve.

TASK B: Electro-pneumatic (Hard-wired system)

Weighting (points out of total): 30/ 100

Maximum time allowed, t_{max}: 60 minutes

Problem:

Design, Assemble, and Commission the following sequence using hardwired electro-pneumatic elements.

$$[A+, B+, B-, A-]$$

Circuit requirements:

1. Supply pressure is to be limited to 5.5 bars and Cylinders A and B are double acting cylinders with cushioned end stops.

2. The sequence is to be initiated by a normally open momentary switch and interrupted by another normally open momentary switch.

3. Use one of the relays provided to form a START/STOP latching circuit for step (2).

4. Once the cycle is started as described in (2), it will self-repeat until interrupted by the STOP button.

5. The sequence should only start if cylinder A and B are fully retracted.

6. Cylinder B is to be fitted with proximity sensors onto the cylinder and cylinder A's position is sensed by electrical limit switches.

7. Cylinder B is to be operated by a solenoid actuated, spring return 5/2 way directional control valve (DCV).

8. Cylinder B is to have forward speed control that ensures cylinder's forward stroke is completed within 2.0-2.5 seconds at full force.

9. A 5/2 way double solenoid DCV is to be used for Cylinder A and the solenoids must be indirectly energised through relays.

10. Cylinder B must make a rapid return.

WARNING: DO NOT POWER SOLENOID VALVES DIRECTLY WITH REED SWITCHES.

TASK C: Programing a sequence with a PLC

Weighting (points out of total): 40 / 100

Maximum time allowed, t_{max}: 60 minutes

Problem:

Use Festo TP101 and TP201 equipment set along with your PLC to design, assemble and commission an electro-pneumatic circuit with the following sequence:

$$\left[\left[\begin{pmatrix} A+ \\ B+ \end{pmatrix}, \begin{pmatrix} A- \\ B- \end{pmatrix}\right]^2, 2s, A+, 2s, \left[\begin{pmatrix} A- \\ B+ \end{pmatrix}, \begin{pmatrix} A+ \\ B- \end{pmatrix}\right]^2, 2s, A-\right]$$

Circuit requirements:

1. Adjust the supply pressure to 6.0 bars.

2. Cylinders A and B are to be double acting cylinders with cushioned end stops.

3. The cycle is to be initiated by actuating a normally open momentary push-button switch (START). The cycle is not to self-repeat but must be able to start again by pressing the (START) button on demand without resetting or reloading the programme to your PLC.

4. Use a solenoid actuated and spring return valve for cylinder A and a double solenoid valve for actuating Cylinder B.

5. Cylinder B solenoids are to be controlled indirectly using relay contacts.

6. Each cylinder is to have a sensor to detect its extended and retracted position. These can be any of the sensors available in the equipment set provided.

+++ END OF TASKS +++

Mechatronics

Assessment Summary Marking Criteria

Please note this is an **example** of how marks will be broadly awarded.

National Qualifiers (heats):

Criterion ID	Criterion Description	Max Marks
A	TASK 1: Pneumatic sequence	30
B	TASK 2: Electro-pneumatic (Hard-wired system)	30
C	TASK 3: PLC programming	40
	Total Marks	100

National Final:

Criterion ID	Criterion Description	Max Marks
A	TASK 1: Electro-pneumatic sequence	15
B	TASK 2: PLC Programming - Workstation + IO-Link	20
C	TASK 3: MPS Build + Program : Station 1	30
D	TASK 4: MPS Build + Program : Station 2 + IO-Link	25
E	TASK 5: MPS maintenance/optimisation	10
	Total Marks	100