

071605T4MCT

MECHATRONICS TECHNOLOGY LEVEL 5

ENG/OS/MC/CR/06/5

Operate Programmable Logic Control (PLC) Systems

July/August 2025



**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION
COUNCIL (TVET CDACC)**

PRACTICAL ASSESSMENT

Tim RS

INSTRUCTIONS TO CANDIDATE:

- i. DO NOT write on the question paper.
- ii. DO NOT switch ON power without the assessor's permission.
- iii. The assessor will assess your performance at critical points and may record your performance using audio-visual means.
- iv. You are required to have a name tag.

System Functioning Overview:

You are tasked with installing, configuring, testing, diagnosing, and maintaining a PLC-controlled conveyor belt system that automatically sorts metallic and non-metallic (plastic) objects in a plastic manufacturing company.

The system functions as follows:

- a) A Start and stop push button are included for manual control. A green indicator lamp turns ON when the system is started, and a red lamp lights up when the system is stopped. A pre-written PLC program is provided in Figure 2.
- b) A capacitive sensor detects plastic objects:
 - i. The motor (assumed to drive the conveyor) runs continuously, allowing the object to pass.
 - ii. The pneumatic cylinder remains retracted.
 - iii. The alarm remains OFF.
- c) Inductive sensor detects metallic objects:
 - i. The motor stops (conveyor halt
 - ii. The pneumatic cylinder extend d to eject the metal).
 - iii. An alarm is activated.

You are required to perform the following tasks:

Task 1: Preparation

1. Perform lockout/tagout as necessary. Observe all PLC and electrical safety rules in accordance with OSHA before starting any work.
2. Select and prepare all required tools and materials (e.g., hand tools, multimeter, air supply, wiring accessories) based on the provided checklist.

Task 2: Installation

3. Mount and label the PLC, I/O modules, inductive and capacitive sensors, motor (conveyor drive), pneumatic cylinder (object ejector), alarm, Start/Stop push buttons, and indicator lamps on the working board and control panel.
4. Wire the PLC inputs and outputs as per the provided wiring diagram in Figure 1. Ensure correct power supply connections for all I/O devices as per standard electrical practices.

5. Ensure proper grounding of the PLC system and connect the power supply to the PLC according to recommended installation standards.
6. Connect to the PLC using the provided appropriate software. Enter the given program in Figure 2 using **correct addressing as per your wiring** and download it to the PLC. Confirm the program is correctly downloaded.

Task 3: System Testing

7. Test the Start push button:
 - i. Pressing Start should initialize system operation.
 - ii. The green lamp should turn ON to indicate system is running.
8. Test with a plastic object:
 - i. The capacitive sensor should detect the plastic.
 - ii. The motor should continue running (conveyor active).
 - iii. The pneumatic cylinder remains retracted.
 - iv. No alarm should sound.
9. Test with a metallic object:
 - i. The inductive sensor should detect metal.
 - ii. The motor should stop (conveyor stop).
 - iii. The pneumatic cylinder should extend (eject the object).
 - iv. The alarm should be activated.
10. Repeat tasks 7 and 8 to confirm proper repeatable functionality:
 - i. Plastic detection: Motor runs, cylinder retracted, alarm off.
 - ii. Metal detection: Motor stops, cylinder extends, alarm sounds.
11. Test the Stop push button:
 - i. Pressing Stop should immediately halt all system operations.
 - ii. The green lamp should go OFF, and the red lamp should turn ON to indicate the system is stopped.
 - iii. Pressing Start again should resume system operation.

Task 4: Troubleshooting

12. Diagnose faults if any abnormal behavior is observed. Perform appropriate maintenance.

You are provided with the following resources for the practical:

1. Computer with PLC programming software
2. Push button switch, NO (Green)
3. Push button switch, NO (Red)
4. Capacitive proximity sensor (24V DC)
5. Inductive proximity sensor (24V DC)
6. Single phase motor
7. Contactors (24V DC coil)
8. Indicator lights, 24V DC (Green)
9. Indicator lights, 24V DC (Red)
10. Single-strand control wires (1.5mm²)
11. 3 core flex cable 1.5mm² (Power)
12. PLC communication cable
13. Double pole MCB
14. Single pole MCB
15. Connectors and terminals
16. Cable lugs, 1.5mm²
17. Siren alarm, 24V DC
18. 3/2 solenoid directional control valve
19. Single acting cylinder piston
20. Compressor
21. Pneumatic pipes
22. Pressure gauge
23. 24V DC power supply
24. AC power source
25. Multimeter
26. Wire cutter
27. Wire stripper
28. Crimping tool
29. Screwdrivers (flat and Phillips head)
30. Labeling stickers
31. LOTO tag
32. Plastic object
33. Metallic object

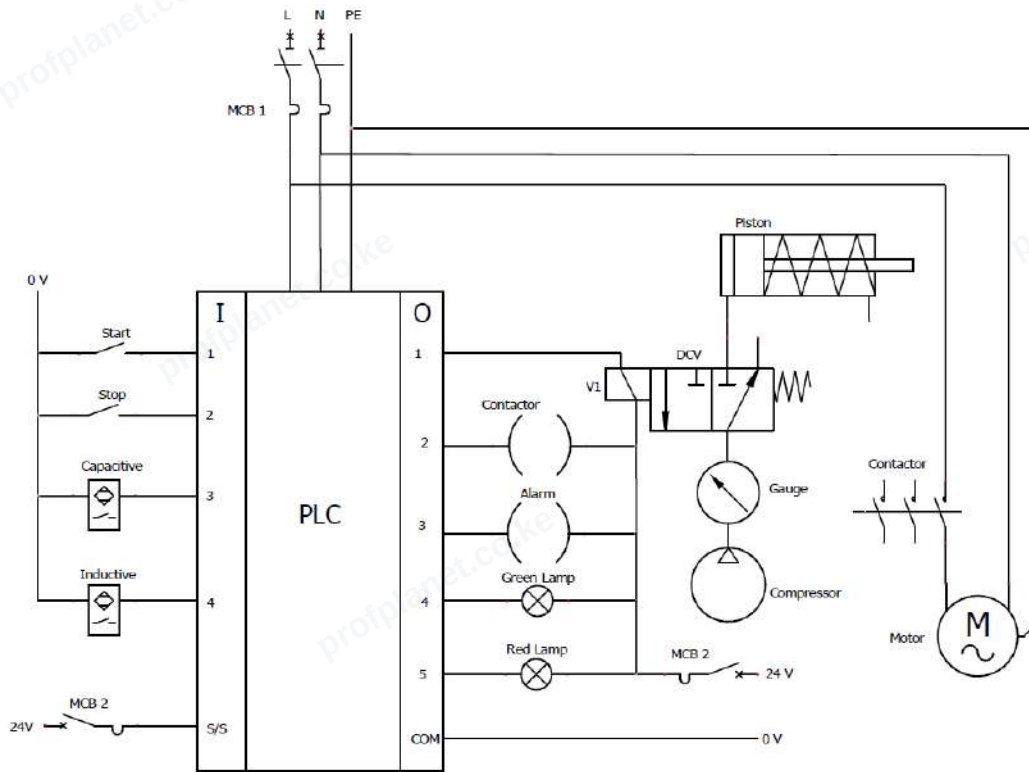


Figure 1: PLC and Pneumati Circuit

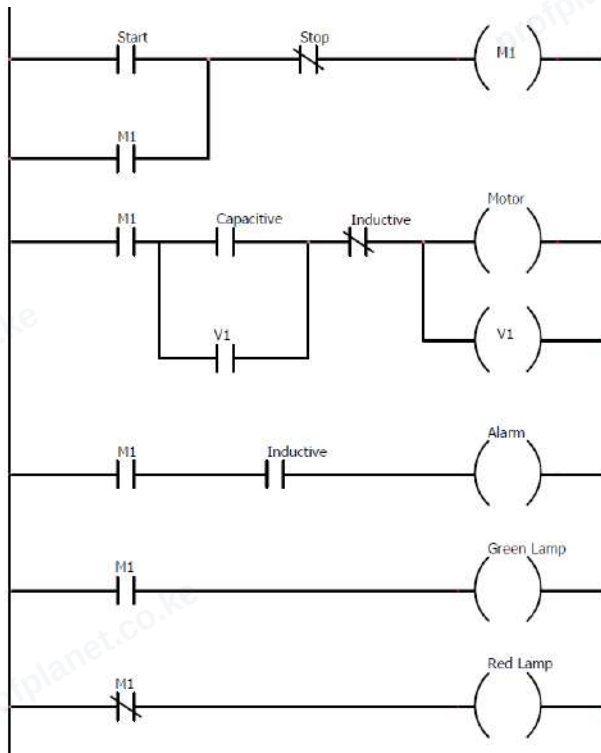


Figure 2: PLC Program