SULIT

KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN ELEKTRIKAL

PEPERIKSAAN AKHIR

SESI I : 2023/2024

DEJ40033: PROGRMMABLE LOGIC CONTROLLER & AUTOMATION

PERATURAN PERMARKAHAN

PENYELARAS
POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

SULIT

	MARK/NOTES
SECTION A **STRUCTURE QUESTION** **QUESTION 1 (a)** A logical sensor can be used with sourcing (PNP) or sinking (NPN) techniques for output wiring. Based on Figure A1(a), explain the operation of a sensor using the sourcing (PNP) technique in terms of the sensor's active and inactivated states. **[CLO1 / C2]**	

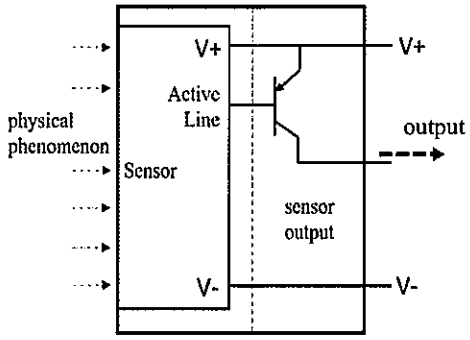


Figure A1(a)

Answer	**Max 5 marks**
When the sensor is active:	
When the sensor is active, it will make the active line high. The current will flow	1
to the terminal base transistor, then turn on the transistor and effectively close	1
the switch. This will allow current to flow from V+ through the sensor to the	
output (hence sourcing). That means the voltage on the PNP output will be pulled	1
up to V+, and the current will flow out to the output.	
When the sensor is inactive:	
The sensor is inactive (nothing detected), then the active line is low, and the	1
transistor is off, like an open switch. That means the PNP output will have no	1
current in/out.	

MARK/NOTES

QUESTION 1 (b)

The type of relays can be determined by their Pole (P) and Throw(T). By using the aid of the symbol for Double Pole Double Throw (DPDT) relay, explain the meaning of pole and throw.

[CLO1 / C2]

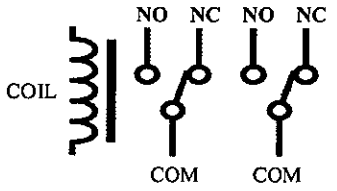
Answer

Max 5 marks

Pole refers to a number of switch contact sets. The relay has two poles or two commons, which means it can control two separate circuits. 1.5

Throw refers to the number of different positions, meaning the relay has both Normally Closed (NC) and Normally Open (NO) contacts. 1.5

The symbol:



2

QUESTION 1 (c)

Two push buttons (PB) are used to start and stop the operation of two indicator lights, Lamp 1 and Lamp 2. Lamp 1 will turn ON after 5 seconds when the start button is pressed. After that, Lamp 2 will only turn ON after the limit switch (LS) has been activated four times. By referring to the timing diagram in Figure A1(c), draw the Relay Ladder Logic (RLL) control circuit for the system.

[CLO1 / C3]

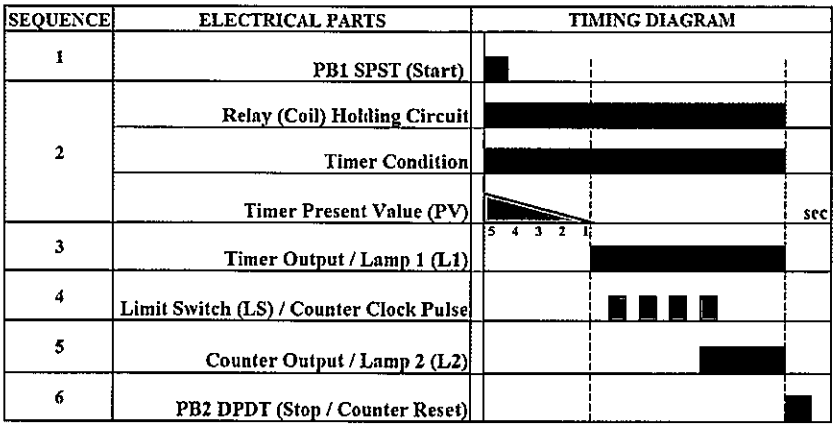
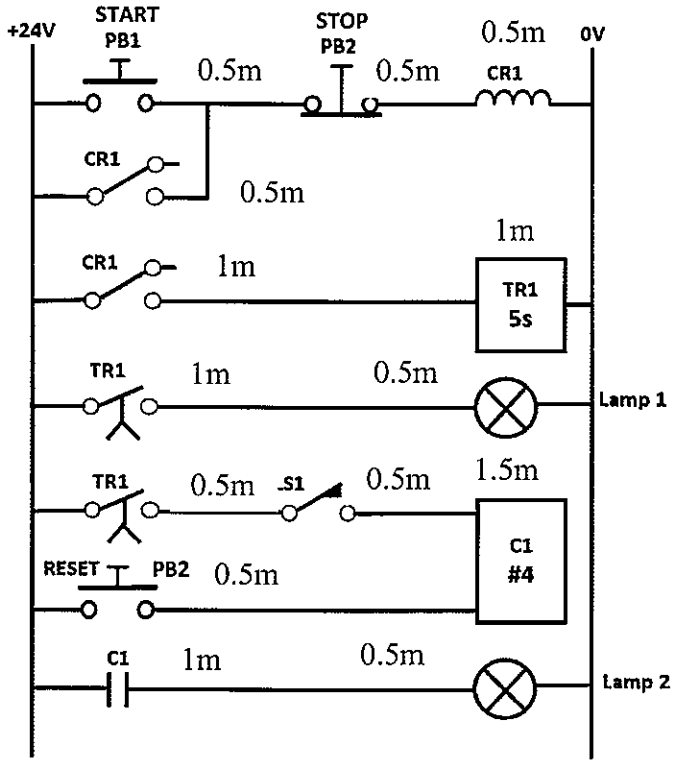


Figure A1(c)

MARK/NOTES

Answer

Total 10 marks



2

2

1.5

3

1.5

QUESTION 2 (a)

Categorise the types of photo optics sensors and proximity sensors based on the characteristics listed in Table A2(a).

[CLO1 / C2]

Table A2(a)

Characteristic	Type of sensor Answer:
i. A sensor needs a mirror on the other side to reflect the light to the receiver. The object is detected if it blocks the path of the beam.	**Retro reflective Sensor**
ii. A sensor sends a beam from the emitter to the receiver. The object is detected if it blocks the path of the beam.	**Through-beam Sensor**
iii. A sensor uses a coil to generate a high-frequency magnetic field. If there is a metal object near the changing magnetic field, current will flow in the metal object.	**Inductive Proximity Sensor**
iv. A sensor generates an electrostatic field capable of sensing both metal and non-metallic materials like paper, glass, liquids, and cloth.	**Capacitive Proximity Sensor**

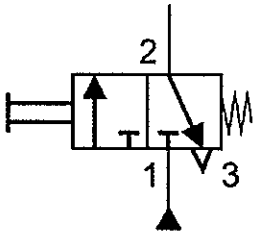
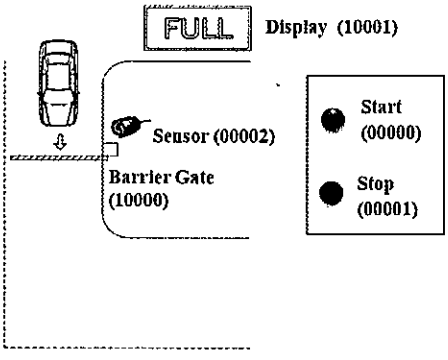
Max 5 marks

1.5

1.5

1

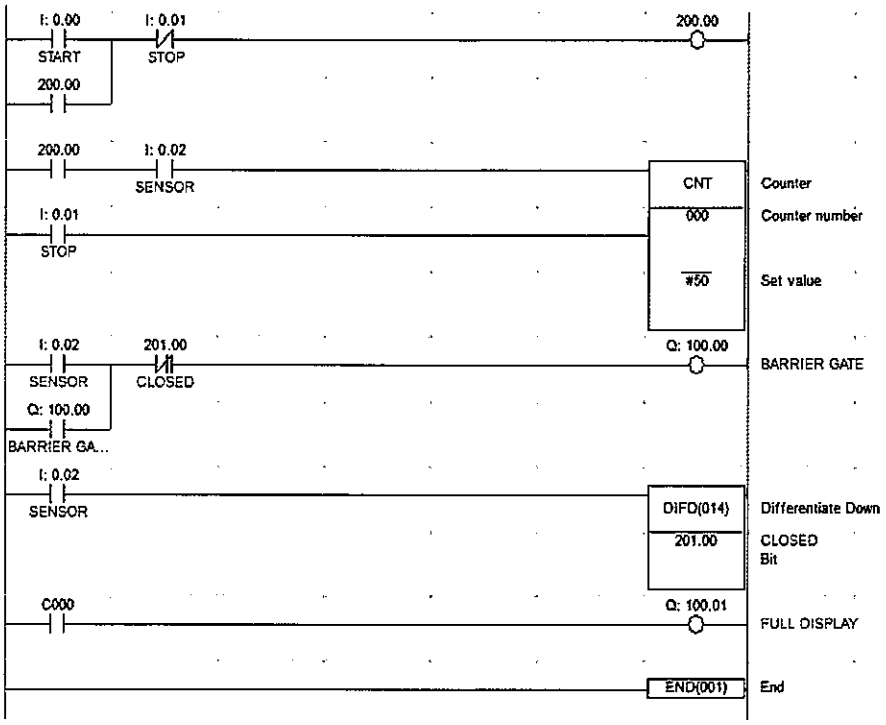
1

	MARK/NOTES
QUESTION 2 (b) A single-acting cylinder can be directly controlled by a 3/2-way solenoid valve with spring return. By using the aid of a symbol diagram for the solenoid valve, explain the function of each port in a 3/2-way solenoid valve operation. **[CLO1 / C2]**	
Answer	**Max 5 marks**
The symbol  	2
Function each port	
Port 1: The inlet port where compressed air enters the valve.	1
Port 2: The outlet port is connected to the single-acting cylinder.	1
Port 3: The functions as the exhaust port through which the air is released from the single-acting cylinder.	1
QUESTION 2 (c) Figure A2(c) shows a simple car park control system that allows only 50 cars in a parking space area. The system can only start after pressing the start button. The sensor will detect every time a car is near the barrier gate. Once detected, the barrier gate will open to allow the car to enter the car park. The barrier gate will close again after the car has passed through the barrier. When the sensor detects 50 cars, the sign board will show "FULL". A reset push button is used to reset the system. Draw the PLC ladder diagram for the system using a DIFD instruction to close the barrier gate. **[CLO1 / C3]**	
 Figure A2(c)	

MARK/NOTES

Max 10 marks

Answer



2

2.5

2.5

1

1

1

QUESTION 3 (a)

Figure A3(a) shows the PLC block diagram. Briefly explain the function of the Power Supply, CPU, Memory, Input Module, and Output Module.

[CLO1 / C2]

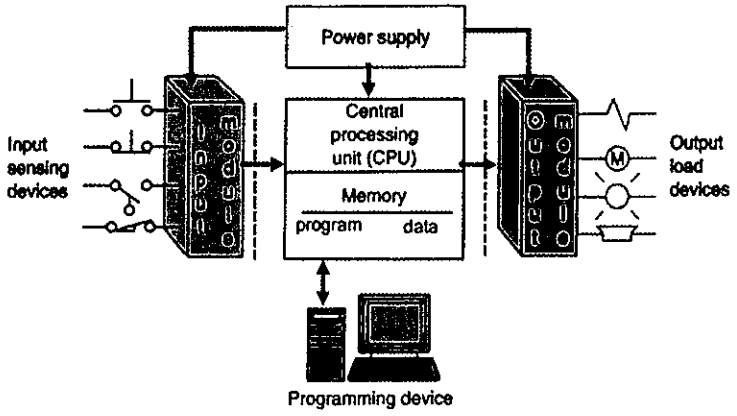


Figure A3(a)

	MARK/NOTES
Answer	**Max 5 marks**
i. **Power Supply**: Provides power to the CPU, Input Unit, and Output Unit	1
ii. **CPU**: The CPU is the brain of the PLC. Responsible for reading inputs, executing the control program, and updating outputs.	1
iii. **Memory**: To save the data, the program will be used by PLC.	1
iv. **Input Module**: A medium that connects the external input devices such as sensor, switch, and limit switch into the CPU within PLC	1
v. **Output Module**: A medium that connects the external output devices such as motor, solenoid, and lamp from the CPU within PLC.	1

QUESTION 3 (b)

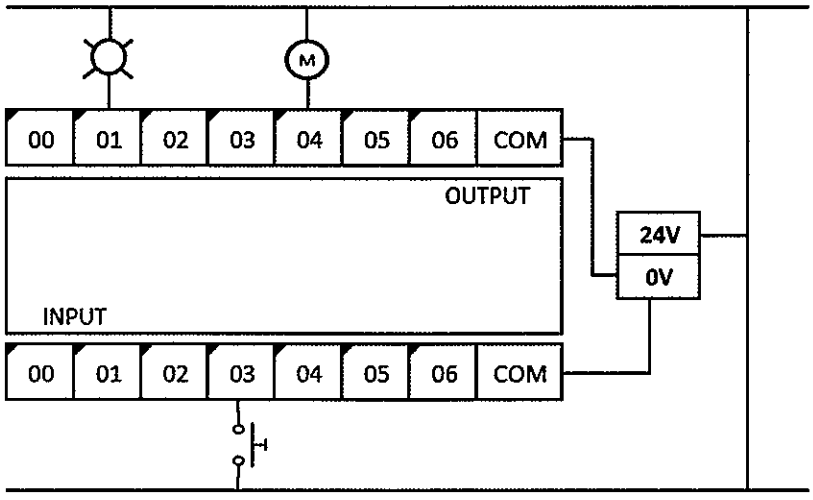
By referring to Table A3(b), match the input device and output device in the PLC wiring using the sinking (NPN) technique, as shown in Figure A3(b).

[CLO1 / C2]

Table A3(b)

Devices	Data
Push Button (NO)	00003
Lamp	10001
Servo Motor	10004

Answer — **Max 5 marks**



Sinking Wiring
2 marks

Each Device
1 mark each
(3 x 1 mark)

	MARK/NOTES
QUESTION 3 (c) As the person in charge of PLC maintenance, you are required to carry out preventive maintenance for the PLC system. Write **FIVE (5)** preventive maintenance methods to ensure the PLC will not be damaged during the operation. **[CLO1 / C3]**	
Answer	**Max 10 marks**
i. Any filters installed in enclosures should be cleaned or replaced to ensure that clear air circulation is inside the enclosure. ii. Check temperature, humidity, and other environmental factors to ensure your PLC operates within the proper conditions. Also, ensure good airflow in the cabinet by cleaning filters in the enclosure. iii. Dust or dirt accumulated on PLC circuit boards should be cleaned. If dust is allowed to build up on heat sinks and electronic circuitry, an obstruction of heat dissipation could occur and cause circuit malfunction. iv. Connections to the I/O modules should be checked for tightness to ensure that all plugs, sockets, terminal strips, and module connections are making connections and that the module is installed securely. v. Periodically check the connections to the I/O modules to ensure all plugs, sockets, terminal strips, and modules have good connections. vi. Check the power and battery LED indicators. If the power LED indicator is off or flickering or the battery LED indicator is on, this may be a preliminary sign of a low battery or potential power issues. vii. Keep any items such as drawings, installation manuals, or other materials away from the PLC system. Leaving these items on top of the CPU rack or other enclosures can obstruct airflow and create hot spots, ultimately causing a system malfunction. viii. Keep a stock of replacement parts on hand to minimize downtime resulting from component failure. ix. Ensure that heavy, noise-generating equipment is not too close to the PLC. x. Save a copy of your PLC program during routine maintenance to ensure an up-to-date backup.	2 marks each (5 x 2 marks)

MARK/NOTES

SECTION B

ESSAY QUESTION

QUESTION 1

Timer and counter instructions are fundamental components of PLC programming for continuous operation. By referring to Figure B1, transfer the timing diagram into a PLC ladder diagram and next to the mnemonic code by using a timer and counter instructions to implement it.

[CLO1 / C3]

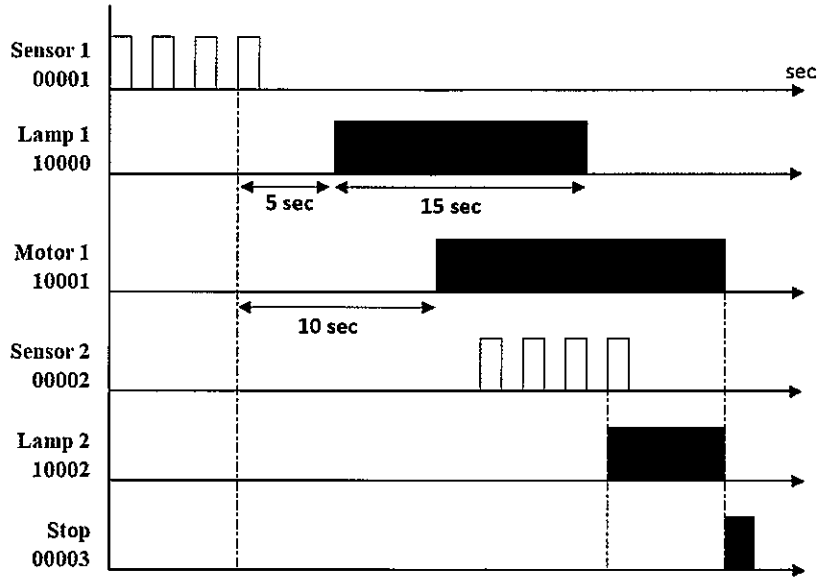
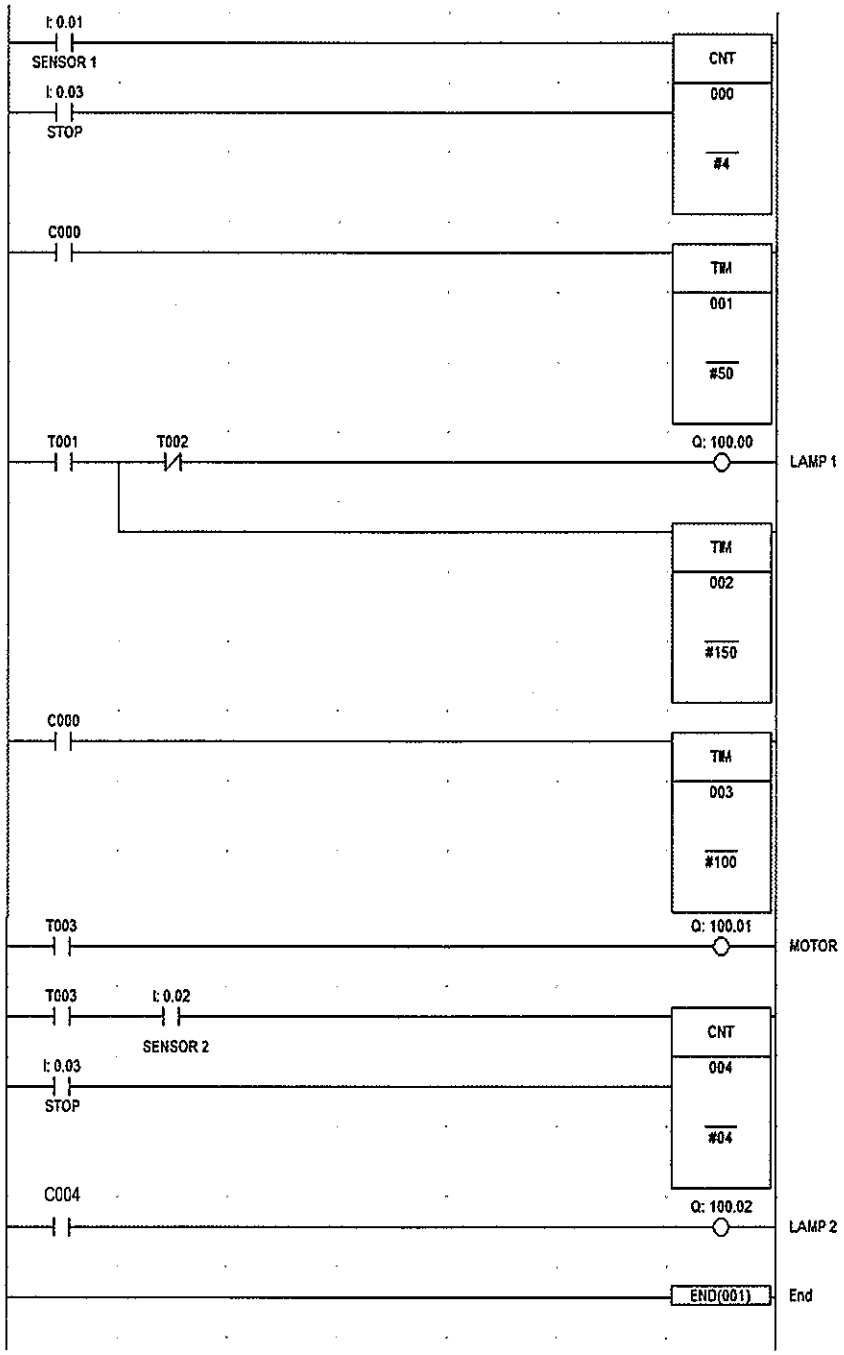


Figure B1

Answer:

PLC ladder diagram



"If the working method is different from the solution given, make an appropriate adjustment to the marking scheme with approval from the Program Leader."

MARK/NOTES

Max 20 marks

2

1.5

3

2.5

4

1

MARK/NOTES

Mnemonic Code

Address	Instruction	Data	
0000	LD	00001	
0001	LD	00003	1
0002	CNT	000	
		#04	
0003	LD	CNT000	
0004	TIM	001	1
		#50	
0005	LD	TIM001	
0006	OUT	TR0	
0007	AND NOT	TIM002	
0008	OUT	10000	1.5
0009	LD	TR0	
0010	TIM	002	
		#150	
0011	LD	CNT000	
0012	TIM	003	0.5
		#100	
0013	LD	TIM003	
0014	OUT	10001	
0015	LD	TIM003	
0016	AND	00002	1.5
0017	LD	00003	
0018	CNT	004	
		#04	
0019	LD	CNT004	
0020	OUT	10002	0.5
0021	FUN(01)		

The answer refers to the ladder diagram built by the students.

MARK/NOTES

QUESTION 2

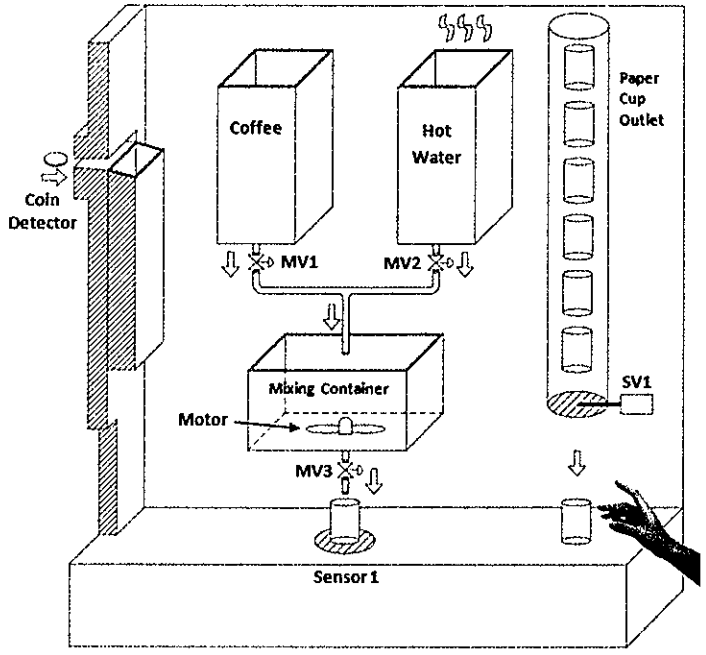


Figure B2

Figure B2 shows an automatic coffee maker system. By referring to the sequence explanation, propose to complete an I/O wiring and PLC ladder diagram for the system.

i. When a 50-cent coin is inserted (only one coin at a time), the solenoid valve (SV1) opens to allow a paper cup to drop down from the outlet. Then, SV1 automatically closes after 2 seconds to ensure that only one paper cup is dispensed at a time.

ii. Simultaneously, after the coin is inserted, MV1 and MV2 open for 5 seconds to dispense a certain amount of coffee and hot water into the mixing container.

iii. After that, MV1 and MV2 will close again, and the motor starts brewing the coffee mixture for 10 seconds.

iv. Once the brewing is complete, the motor stops, and MV3 is activated to drain the prepared coffee into the paper cup for 5 seconds.

v. MV3 will only open if it detects a paper cup at Sensor 1.

vi. The automatic coffee maker system stops and waits for the next activation through coin insertion.

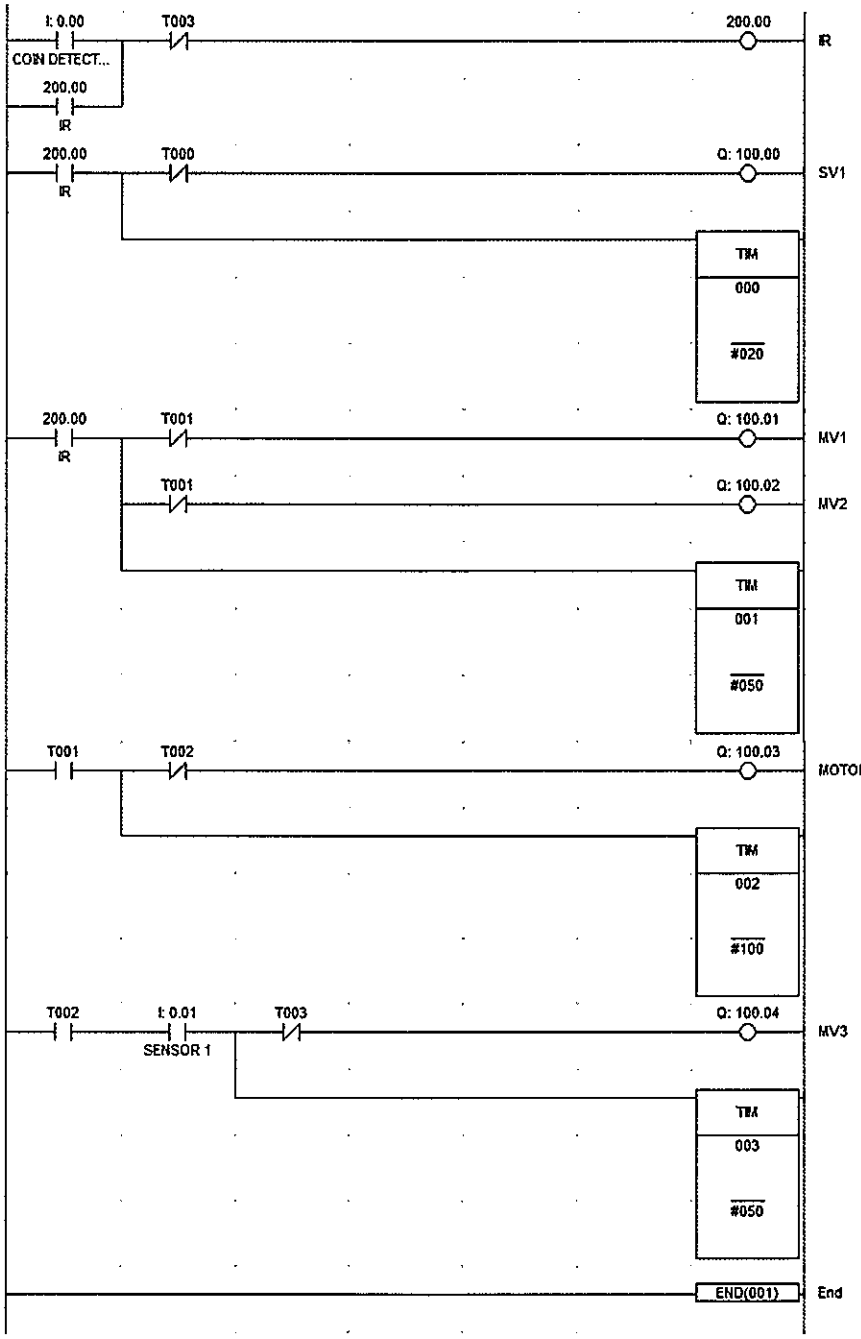
[CLO1 / C5 / DP1, DP3, DP5]

Answer:

PLC Ladder Diagram

MARK/NOTES

Max 20 marks



2

2.5

3.5

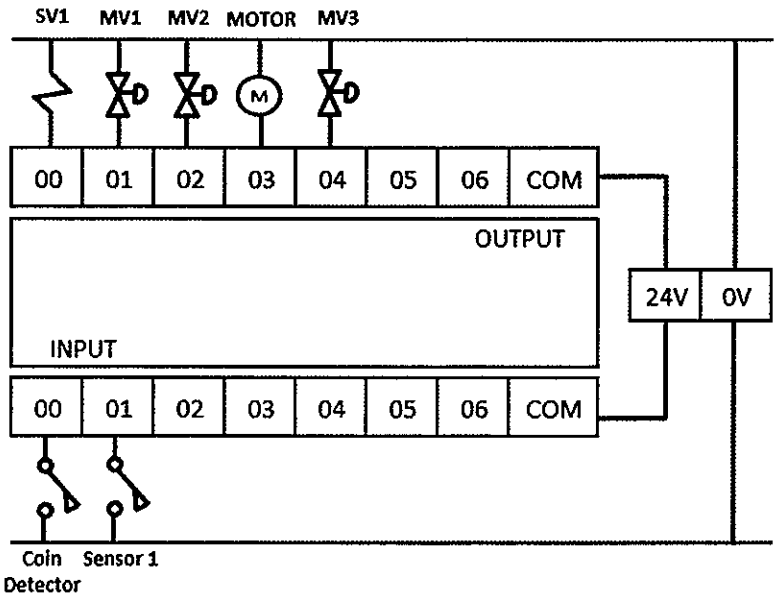
2.5

3.5

1

"If the working method is different from the solution given, make an appropriate adjustment to the marking scheme with approval from the Program Leader."

I/O Diagram



The answer can use the PLC wiring technique of input and output devices for sinking or sourcing techniques.

MARK/NOTES

Each device
0.5 mark
(0.5 m x 7)

Wiring Connection
1.5 marks