KUMARAGURU
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B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

Fifth Semester

MECHATRONICS ENGINEERING

U18MCI5203: Programmable Logic Controllers

COURSE OUTCOMES

CO1: Outline the importance of PLC, DCS, and SCADA in industrial automation

CO2: Describe the architecture of PLCs with the analogy of relay logic components

CO3: Develop ladder logic program for applications

CO4: Integrate PLCs with electromechanical systems

CO5: Classify the communication protocols

CO6: Design SCADA system for industrial applications

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions: -
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	Define low-cost automation. Enumerate any four applications of low-cost automation.	CO1	[K_2]
2.	Interpret the USA principle for automation.	CO1	[K_2]
3.	List out the advantages of using PLCs over electro-magnetic relays.	CO2	[K_2]
4.	Differentiate between retentive and non-retentive timers.	CO2	[K_2]
5.	Enlist any four program control instructions used in PLC.	CO3	[K_2]
6.	What is the purpose of OSR instruction? Where it can be used?	CO4	[K_2]
7.	Define Communication protocol. Enlist some industrial communication protocols.	CO5	[K_2]
8.	Differentiate Profinet and Profibus protocols.	CO5	[K_2]
9.	Enumerate the five SCADA system layers with its hierarchical order.	CO6	[K_2]
10.	Interpret the reasons behind the usage of RTU over PLCs in remote area process stations.	CO6	[K_2]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11.	a)	Enumerate and explain the ten strategic principles of automation.	10	CO1	[K_2]
	b)	Outline the importance of PLC, DCS, and SCADA in industrial automation	6	CO1	[K_2]

12.	a)	Explain the architecture of PLC with neat sketch and describe the various components used in PLC.	10	CO2	[K$_2$]
	b)	Illustrate in detail about the sourcing and sinking input/output interfacing with PLCs.	6	CO2	[K$_2$]

13.		Design a PLC Ladder diagram to control and implement the process automation illustrated below and shown in Figure – 1.	16	CO3	[K$_3$]

Two different sized particles are being moved on the conveyor belt. To pack these particles, two different boxes are used separately. These products must not be packed in the same box. Separation of these particles is to be controlled.

- Small parts do not need to be detected as it has a straight conveyor path.
  Big parts are to be diverted to the adjacent conveyor which is connected with the main conveyor as shown in diagram above.
- Detection of big particles has to be done to divert the path of such particles.
- To detect big parts, Proximity Limit switch is used.
- Conveyor has a fixed speed; hence timer is to be set to 2 seconds to energize Gate Solenoid which diverts big parts to the adjacent conveyor.
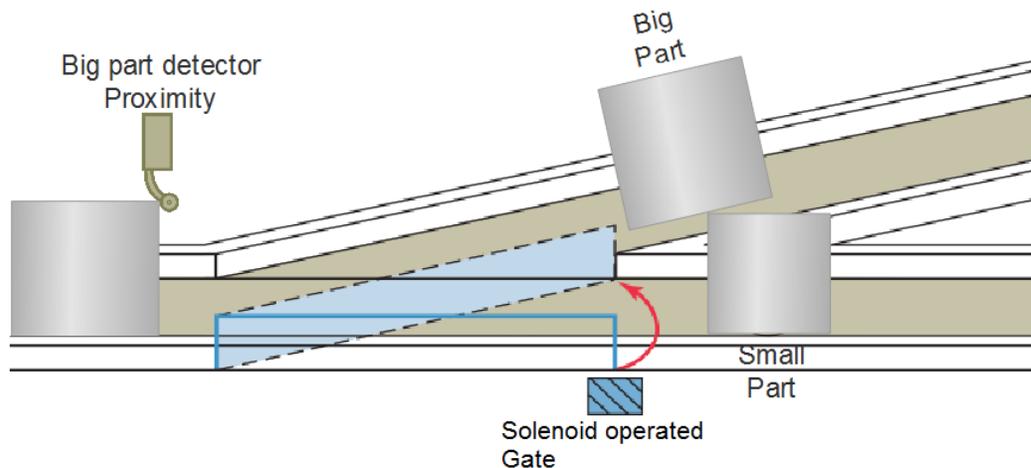

Figure - 1

List of Inputs and Outputs

• I:1/14 = Start	• O:2/0 = Master Coil
• I:1/15 = Stop	• O:2/1 = Gate solenoid coil
• I:1/0 = Sensor to detect big parts	• T4:0 = Timer to operate gate

14. Design a PLC Ladder diagram to control and implement the process automation   16   CO4   [K₃]

illustrated below and shown in Figure – 2.

Material A and Material B are collected in a tank. These products are to be mixed
and heated till it reaches set point temperature value.

- To detect Material A and Material B levels, two separate level switches are
  used, and to detect low level, one more level switch is used at the bottom of the
  tank. These give output in digital terms that is when corresponding levels are
  detected.
- To control level of this system, Single Acting Piston valve can be used which
  has two states, either fully open or fully close.
- To control mixing, agitator is used which is connected with Motor shaft.
- Heater is installed inside the tank and temperature sensor such as RTD or
  Thermocouple is used to detect the temperature of liquid in the tank.
- This mixer is mixed until set point temperature is achieved.
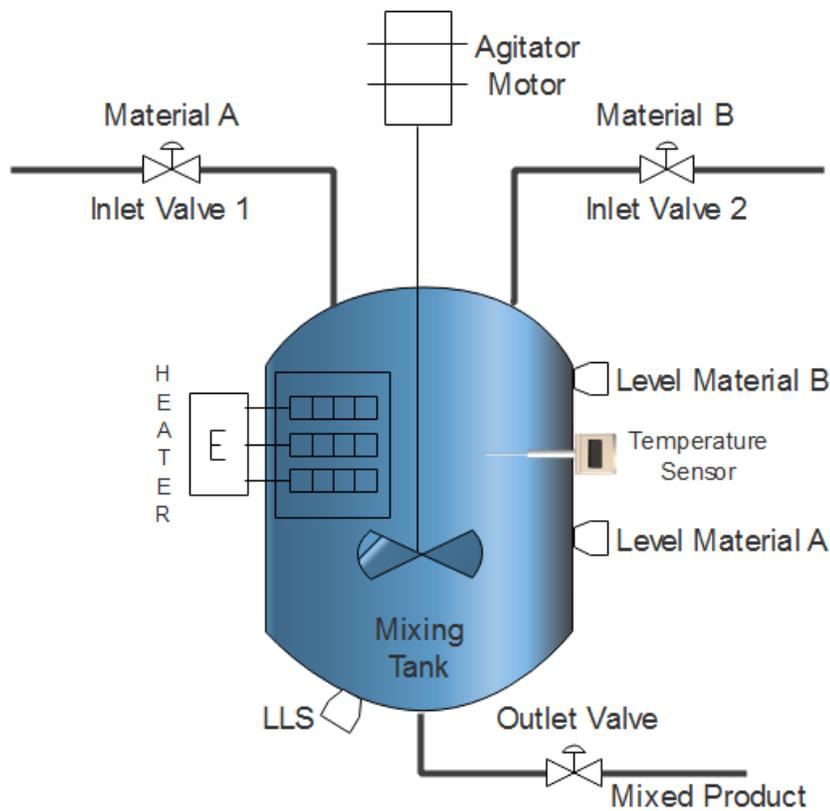- Outlet valve is then operated to drain the mixed product.

Figure - 2

List of Inputs and Outputs

I:1/14 = Start	O:2/0 = Inlet Valve 1
I:1/15 = Stop	(Material A Feed)
B3:0/0= Master Coil Bit	O:2/1 = Inlet Valve 2
I:1/0 = Level of Material B	(Material B Feed)
I:1/1 = Level of Material A	O:2/2 = Agitator Motor (Mixing)
I:1/2 = Low Level Switch	O:2/3 = Heater
(empty tank)	O:2/4 = Outlet valve to drain the product

15. a) Explain the OSI model layers with hierarchy levels and explain about each layer with neat sketch.   10   CO5   [K$_2$]

   b) Illustrate any one master-slave communication protocol used in industry to interface PLCs, RTUs, HMIs with SCADA system.   6   CO5   [K$_2$]

16. Design a SCADA system for water treatment plant and explain the various components and its functions in the SCADA system.   16   CO6   [K$_3$]

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