Course Title: Microprocessor Based Process Control

Course Code: EE413

Answer The following Questions Stating the DI , AI , DO , sensors & actuator types

Q1-In the system shown in figure 1, the measured states are Level (L), critical Level (LCR), and Temp (T) & critical Temp (TCR) .The control outputs is heater (H) & Pump (P). A high of either input or output indicates true condition. Construct a flow chart for the system. The states are defined as:

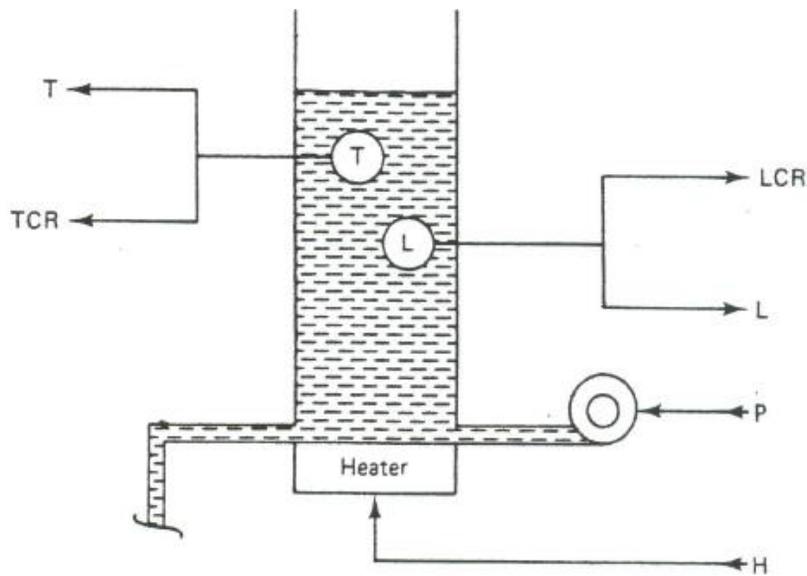| State	Condition	Control	Delay
S1	L	P (off)	1 min
S2	LCR	P (off)	None
S3	T	H (off)	2 min
S4	TCR	H (off)	None

Figure 1

Q2- In figure 2 shows a system for controlling liquids in a tank separated by a motorized gate. Inputs are analogue variables Level (L1 & L2) & pressure (P1& P2) . Outputs are Input Valves (V1 & V2) & output valves (VO1 & VO2) operating as on and off.

The left tank should be at a level of 300 cm or above & a pressure of 0.5 Bar. The right tank pressure should be 1 bar & the level is <=150 cm.

If the pressure in any tank is greater than the 1.5 bar, a lamp will be on & the process is terminated.

Then the gate should open to 50% wide hence the two liquids will be mixed together as long as the pressure is less than 1.5 bar. If the mixture pressure is less than 1.25 bar, then the gate is to be opened to 100%, once the gate is either 50% or 100% VO2 is open for 10 seconds to discharge, otherwise terminate.

Termination procedure is the input valve V1&2 closes and gate is completely shut off. Construct the system flow chart.
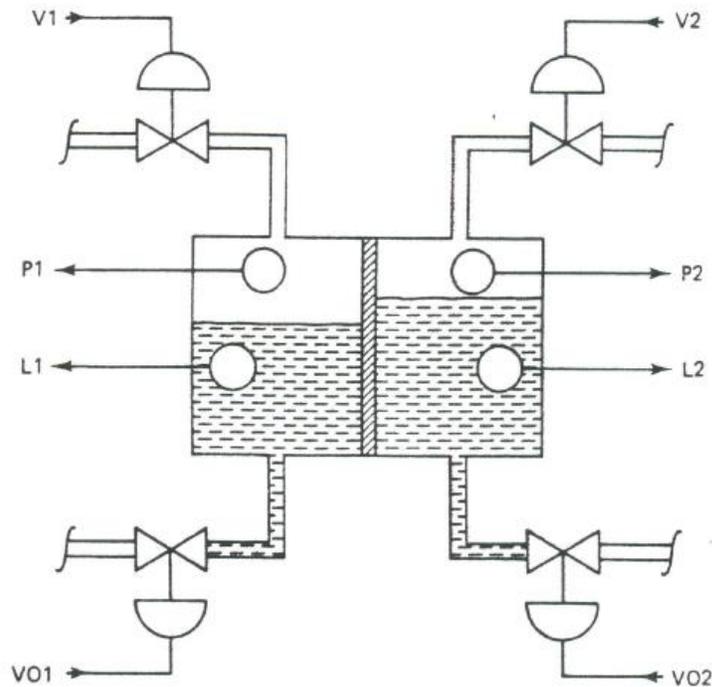

Figure 2

Q3- In problem 2, Add components, switches , sensors or actuators & implement an algorithm to handle pressure & level unexpected rising that might occur in the right tank (flashing alarm & input valve closing) .

Q4- The system shown in figure 3 moves material into right & left bin using right motor (RM) & left motor (LM). Suggest a sensor to calculate the motor speed. The sequence of the process is as following:

1. Push button to start sequence .
2. Fill the right tank for 1 min Then hold
3. The labor should add chemical catalyst , then press the continue push button (VS)
4. The process continues & the machine fills the left tank for 3 minutes .
5. Labor should press the stop state button within 10 seconds if not , the system will loop .

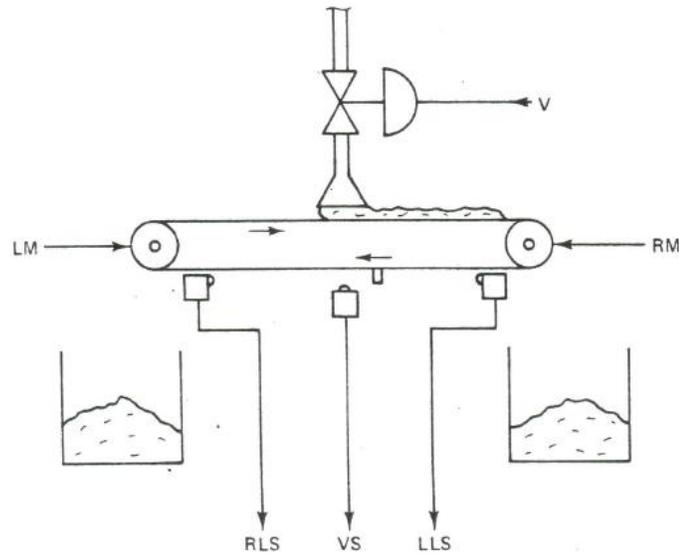Develop a flowchart to provide the sequence for the system .

Figure 3

Q5- In the system shown in figure 4, the process is mixing algorithm , It's assumed that tanks are empty at startup . The process is as shown:

Startup:
    a) Fill A& B
    b) Heat A 12 min while heating
        B 15 min
    c) Empty A& B into C

Phase I:
    d) Stir & heat C to reach Tsp
    e) Then turn off ,stir & heat
    f) Pump out C

While in Phase 1:
    g) Fill A & B
    h) Heat A 12 min while heating
        B 15 min

Phase II :
    i) Empty A & B into C
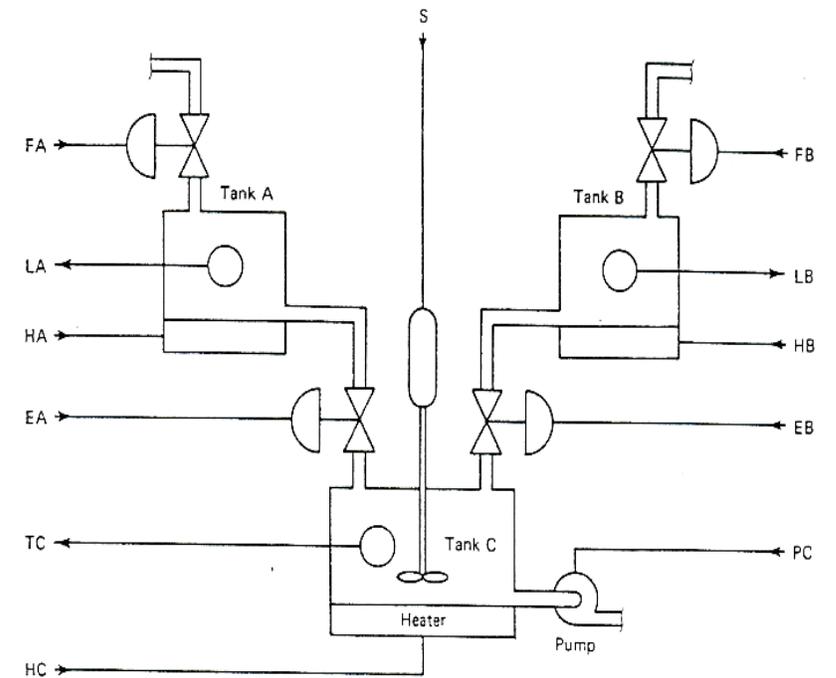   j) Return to phase I & continue
Prepare a flowchart for the system .

Figure 4

3

Q6- The liquid filling system shown in figure 5 consists of a 500cm tank , the process procedure is as following :

The fluid is to be filled if 75<T<110, The Tank Level must be within 300<L<500, Start filling process After finishing, count the no. of bottles.

Initiate Packing Process every 12 bottles by flashing a led with 1 HZ frequency for 5 seconds & setting packing flag to logic one

A- Demonstrate the system analog, digital inputs and outputs in the application.

B- Draw the flow chart algorithm of the system.

C- Choose the appropriate temp. Sensor from the table given , if the ADC is to operate from 0 to 6 Volts & system is far away from the control room .state the reason for this selection.

D- If the digital sensor is to be installed & the voltage level is undetermined, find a solution for this problem.

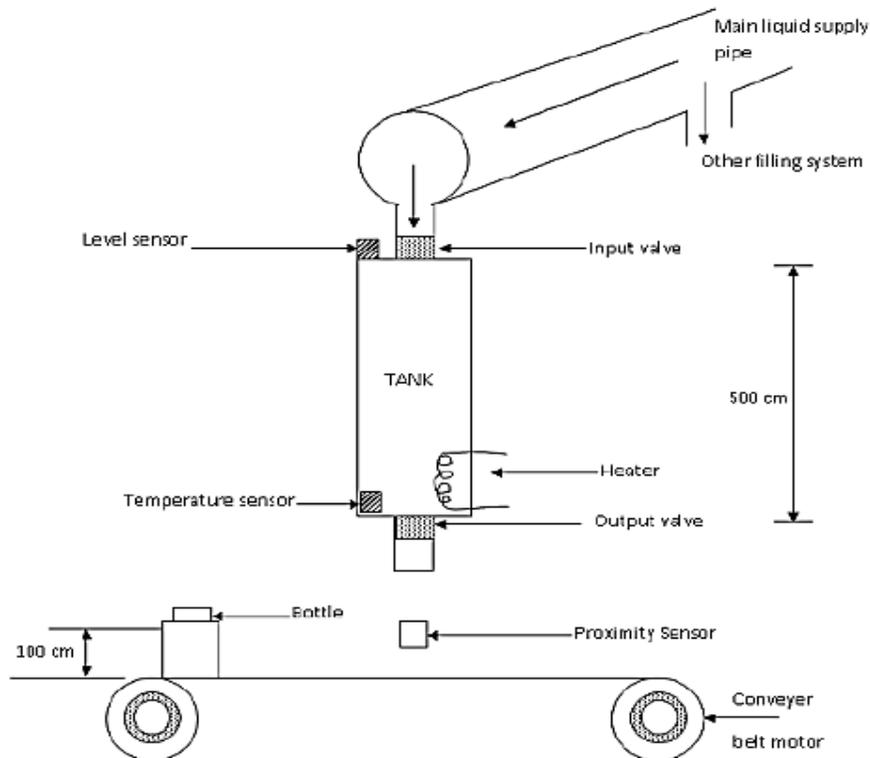| Sensor	Range	Cost	Output
LM35CZ	-40° C to $+110^\circ$ C	9 LE	-1 to 6 V
DS18B20	-55° C to $+125^\circ$ C	105 LE	16-bit
Lm35	-55° C to $+150^\circ$ C	15 LE	-0.55 to 1.5 Volts
LM35DM	0 to 100 C	20 LE	-0.55 to 1.5V
LM35CAZ	-40 to 110 C	55 LE	0 to 6 V

Figure 5

Q7- A motor has the following inputs :

R1 = High , if RPM exceeds a low limit
R2 = High , if RPM exceeds a high limit
L = if the load is high
Outputs to control the motor are :
A1 =High , for armature drive 1
A2 = High , for armature drive 2
C= high to operate clutch & connect load
B= to apply friction brake
The following conditions are to be met for control
A1 : If the speed is below R1 or if the speed is above R1 & the load is low
A2 : If the speed is above R2 or if the speed is below R2& above R1 & the load is low
C : If the speed is above R2 or the speed is above R1 & the load is low
B : If the speed is above R2 & the load is low
Construct the logical equations & the flow chart for the system.