MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

SIXTH SEMESTER B.TECH (INSTRUMENTATION AND CONTROL ENGG)
END SEMESTER EXAMINATION JANUARY 2021

Industrial Automation [ICE 3201]
05-01-2021

TIME: 3 HOURS   MAX. MARKS: 50

Instructions to candidates :*Answer ALL questions and missing data may be suitably assumed.*

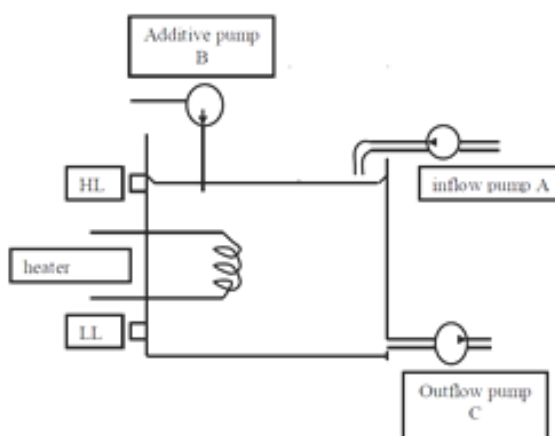1A.   Write a ladder logic and timing diagram for the process shown in Fig. 1.A.

Fig. 1A

The problem statement is described below
Step 1: Filling the liquid in a tank
The tank is filled with liquid from pump A until the high level switch is reached, then a small amount of liquid is added by running additive pump B for 10 seconds. The mixture is heated to 60℃ before being drawn off (step 2) as required. Pump C is used to drawn off the mixture from the tank.
Step 2: Draining the liquid from tank
While draining the tank, all the actuators like pump A, pump B and heater should be off and pump C should be on until level reaches to low level. When the level of tank reaches to low level then control of program need to go to step 1. This cycle repeats continuously.
Use a start button to start the process and stop button to stop the process. Strictly follow the sequence as mentioned in the problem statement.

1B.   Describe supervisory control and differentiate it with direct digital control

                                                                                          (5+5)

2A   Explain the following Allen Bradley instructions
       i) ACS
       ii) SQR
       iii) LIM
       iv) CPT
       v) ASN
       vi) XPY

2B   With neat diagrams, explain different types of redundant techniques for DCS and mention their advantages.

2C   Draw the scan cycle of PLC and explain each step in a scan cycle.

                                (3+4+3)

3A   Analog PLC system contains 6 different analog sensors (S1, S2, S3, S4, S5 and S6) as inputs to the system. Using analog PLC Operation, evaluate the following expression

$$Q=S1+S2 \% (S3 \div S4)-S5 \times S6$$

Sensor output voltages are S1=1.8V, S2=1.2V, S3=3V, S4=1.5V, S5=2V, S6=2V.
All sensor output voltage ranges are 1V to 5V.

3B   Draw the ladder logic and digital logic for the following expression

$$(A+B+C+D+E)^3.$$

Note i: Do not use X power Y Instruction.
      ii: For digital logic use AND/ OR gates only.

                                (5+5)

4A   With neat diagrams, explain advanced Siemens PLC PID Controller block.

4B   Write ladder logic to control a motor with two switches: GO and STOP. The GO switch is used to start the motor and the STOP switch is used to stop it. If the motor is on and the GO switch is pushed, the motor should stop. If the STOP switch is used to stop the motor, the GO switch must be push twice to start the motor. When the motor is running, a light should be turned on.

4C   Describe the need of PLCs in process control industries with a suitable example.

                                (3+4+3)

5A   Illustrate the benefits of HART Protocol.

5B   Give the technical specifications of following protocols
       i) Modbus
       ii) Profibus
       iii) Ethernet/IP

5C   Design digital circuit and ladder logic for the multiplexer shown in Fig. 5C
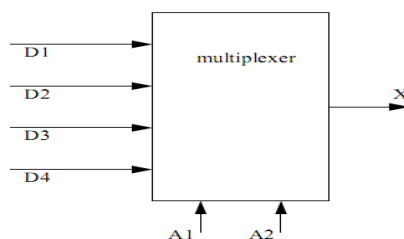
                                (4+3+3)

Fig. 5C

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