Lib. T.E - VI Sem - Chem. Instrumentation.

20

TE/CHEM/VI/CBSGS/INST

QP Code: **6281**

[Total Marks: 80]

(3 Hours)

N.B.: (1) Question No. 1 is compulsory.
(2) Solve any three questions out of remaining five questions.
(3) Assume suitable data if required.

1. a) A temperature sensor can measure temperatures from 32 °F to 212 °F. A measurement results in a value of 78 °F. Calculate the error if the accuracy is 6
   i) ± 0.5% of full scale value
   ii) ± 0.75% of span
   iii) ± 0.8% of reading.
   What are the possible temperatures in each case?

   b) A stepper motor has a 20-teeth gear which moves by 1 tooth in 2 steps. For a desired rotational speed of 300 rpm, what input pulse rate (in pulses per second) is required? What is the angle of turn per step? 6

   c) Write a short note on control valve characteristics. 8

2. a) A piezoelectric sensor is made up of quartz. The voltage sensitivity for quartz is about 0.075 V/(m.Pa). How much pressure in bars should be applied, to create a potential difference of 15 V, if the thickness of the material is 4 cm? 5

   b) Write short notes on 15
   i) Relief valve
   ii) Thermistors
   iii) Electro-magnetic flowmeter

3. a) Design a Programmable Logic Control (PLC) for turning an electric motor ON/OFF using a START/STOP switch. 5

   b) A diaphragm has an effective area of 25 cm^2. If the pressure difference across the diaphragm is 5 psi, what force is exerted on the diaphragm? 5

[P.T.O.]

c) Write short notes on 10

i) SIL classification

ii) Layers of protection analysis (LOPA) methods

4. a) An equal percentage valve has a maximum flow of 50 cm^3/s and a minimum of 2 cm^3/s. If the full stem travel is 2 cm, what is the flow rate (in lit/hr) at a 7.5 mm opening? If the flow rate is 40 cm^3/s, determine the stem travel from fully open position. 6

b) Write a short note on calibration of pressure sensors using dead weight piston gauge. 6

c) A DAQ card of 8 bit resolution and 10-50 mA analog current loop is used to record temperatures above 30 °C. The least count for temperature measurement is 1 °C. What is the maximum temperature that can be measured? What is the analog input in mA for a measured value of 150 °C? 8

5. a) Select the appropriate valve size for the following application:- 10

Process fluid: Liquid Propane

Specific gravity: 0.5

Volumetric flow rate: 3028 lpm

Pressure drop: 1.7 bar

Piping geometry factor: 0.9

N_1	Flow unit	Pressure Unit
0.0865	m^3/hr	kPa
0.865	m^3/hr	bar
1.0	GPM	psi

C_v	0.3	3	14	35	55	108	174
Valve size (inches)	¼	½	1	1½	2	3	4

[P.T.O.]

b) Explain how a capacitive sensing element can be used to measure the level of liquid in a container. 5

c) Suggest a sensor that could be used to determine the difference in levels between liquids in two containers. 5

6. Write short notes on (any four) 20

a) Signal conditioning

b) Static characteristics of an instrument

c) Hot wire anemometer

d) Linear variable differential transformer (LVDT)

e) Diaphragm pressure gauge