

Instrumentation.

20

T.E (CHEM) / VI / CBGS / 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
- ± 0.5% of full scale value
 - ± 0.75% of span
 - ± 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?

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

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?

- b) Write short notes on
- Relief valve
 - Thermistors
 - Electro-magnetic flowmeter

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

- b) A diaphragm has an effective area of 25 cm². If the pressure difference across the diaphragm is 5 psi, what force is exerted on the diaphragm?

[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 $50 \text{ cm}^3/\text{s}$ and a minimum of $2 \text{ cm}^3/\text{s}$. 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 $40 \text{ cm}^3/\text{s}$, 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)	$\frac{1}{4}$	$\frac{1}{2}$	1	$1\frac{1}{2}$	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