Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech**
Sub_Code: REI5C003

5th Semester Regular/Back Examination: 2024-25
SUBJECT: Instrumentation Devices & Systems
BRANCH(S): AEIE, EIE
Time: 3 Hours
Max Marks: 100
Q.Code: R071

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) How can we define the terms repeatability and precision?
b) A force sensor has an output range of 1 to 5 V corresponding to an input range of 0 to 2×10^5 N. Find the equation of the ideal straight line.
c) Define Gauge Factor. A strain gauge with gauge factor 5 and resistance of 200 ohms has change in resistance of 0.15 ohm after force applied, then calculate the strain.
d) Draw the circuit diagram of a L.V.D.T. and draw its DC characteristics.
e) State working principle of Hall Sensor.
f) What is Seebeck effect.
g) Explain the basic principle of RVDT.
h) State and differentiate laminar and turbulent flow.
i) Define the gain of an inverting amplifier.
j) What are the sources of noise in measuring instruments.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Discuss the static characteristic of instrumentation systems.
b) The resistance R(θ) of a thermistor at temperature θ K is given by $R(\theta) = \alpha \exp(\beta/\theta)$. Given that the resistance at the ice point (θ = 273.15 K) is 9.00 KΩ and the resistance at the steam point is 0.50 KΩ, find the resistance at 25 °C.
c) Design a reactive deflection bridge.
d) How displacement is being sensed by LVDT by suitable characteristic curve, explain briefly.
e) Discuss the working principle of Venturi meter.
f) Distinguish bellows and diaphragm.
g) Explain the working principle of doppler shift flow meter.

h) Discuss the step response of a second order system and explain the output characteristic curve.

i) Explain the working of strain gauge connected differential amplifier and derive its output expression.

j) Discuss the quantization process and quantization error.

k) Explain the working principle of elastic type pressure sensing element.

l) A copper resistance sensor is to be used to measure temperatures ranging from 0 to 150 °C. Given that the resistance R_T (Ω) at T (°C) is expressed as: $R_T = R_0(1 + \alpha T + \beta T^2)$ and $R_0 = 50.0\ \Omega$, $R_{75} = 62.25\ \Omega$, $R_{150} = 76.80\ \Omega$, calculate:

I. the values of α and β;

II. the non-linearity at 75 °C as a percentage of full-scale deflection.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Explain dynamic characteristics of an instrument. Hence explain various dynamic compensation techniques in detail. **(16)**

Q4 Explain the working of a thermocouple and calculate following (a and b) if a thermocouple used between 0 and 500°C has the following input-output characteristics: **(16)**

Input T in °C	0	100	200	300	500
Output E in μV	0	5200	10 800	16 200	27 000

a) Derive the equation of the ideal straight line representing the thermocouple's characteristics.

b) Calculate the non-linearity at 100 °C and 300 °C in μV and express it as a percentage of the full-scale deflection.

Q5 Explain the working principle of Instrumentation amplifier. Also differentiate between differential amplifier and instrumentation amplifier. **(16)**

Q6 Explain the working mechanism of various types of differential pressure flow meters in detail. **(16)**