M.TECH. INSTRUMENTATION AND ELECTRONICS ENGINEERING FIRST YEAR FIRST SEMESTER - 2024

Subject : INSTRUMENTATION AND MEASUREMENTTECHNIQUES

Time: 3 Hours **Full Marks : 100**

Answer ***question 1*** and ***any five*** from remaining.

1. Write short notes on ***any four*** from the following. 4×5=20
   a) Potentiometer as level transducer [CO2, K2, A1, S3]
   b) Strain gauge type weighing machine [CO2, K2, A1, S3]
   c) LVDT as pressure transducer [CO2, K2, A1, S3]
   d) Thermistor as inrush current limiter [CO2, K2, A1, S3]
   e) Feed-forward control scheme [CO3, K2, A1, S3]
   f) On delay timer of PLC [CO3, K2, A1, S3]
   g) Low pass active filter [CO4, K2, A1, S3]

2. a) Define: Relative error, zonal drift, reproducibility, dynamic error, fidelity. [CO1, K1, A1, S1]
   b) Draw and explain functional block diagram of a speed measurement system. [CO1, K2, A1, S3]

   (2×5)+6=16

3. a) State the properties of strain gauge materials. Give example of one adhesive and one backing material. [CO2, K1, A1, S1]
   b) Describe demodulation circuit of LVDT and draw the demodulated characteristics. [CO2, K6, A4, S5]
   c) Describe signal conditioning unit for thermocouple? What do you mean by thermowell? [CO2, K4, A3, S2]

   (3+2)+(4+2)+(3+2)=16

4. a) Draw the signal condition unit for 3-wire RTD and derive the output of the circuit. [CO2, K1, A2, S2]
   b) Draw a leveled diagram of bourdon tube and state its operation. [CO2, K4, A5, S5]
   c) Describe operation of Pirani gauge with necessary circuit diagram. [CO2, K4, A5, S5]

   (4+2)+(2+4)+4=16

5. a) State the Bernoulli's theory and hence compute the expression for liquid flow through a restrictor in pipe line. [CO2, K6, A5, S5]
   b) Describe operation of Doppler flow meter with necessary diagram and calculation. [CO2, K6, A5, S5]
   c) Define proportional band and find its relation with proportional gain. [CO2, K6, A5, S5]

   (2+5)+5+4=16

6. a) Draw the P&I diagram for a temperature control loop?

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[CO3, K2, A1, S2]

b) Draw the block diagram of a close loop control system with controller transfer function $G_c = K_c$, process transfer function $G_p = \frac{K_p}{s\tau_p+1}$ and the disturbance transfer function $G_d = \frac{K_d}{s\tau_p+1}$. Assume TF for final control element and measuring element are unity. Compute the overall close loop gain and time constant. Compute the offset error if any for servo control mode considering a step input.

[CO3, K6, A5, S5]

c) Draw a scheme for anti-reset windup.

[CO3, K5, A4, S5]

5+(2+4+2)+3=16

7. a) Describe operation of ratio control scheme with necessary schematic diagram.

[CO3, K6, A5, S5]

b) Explain operation of complementary valve sequencing with a real time example.

[CO3, K3, A4, S3]

c) Describe operation of cascade control scheme with necessary schematic diagram.

[CO3, K2, A1, S2]

5+6+5=16

8. a) Describe the functional block diagram of the PLC. [CO3, K3, A2, S2]

b) Realize pushbutton switch and XOR logic with PLC ladder diagram. [CO3, K3, A2, S2]

c) Start switch starts motor_1 and motor_2 simultaneously. Stops switch stops motor_1 but motor_2 stops after 10 seconds. Realize the stated problem using PLC ladder diagram.

[CO3, K4, A2, S2]

5+6+5=16

9. a) With necessary circuit diagram, describe operation of AC bride used to measure capacitance.

[CO4, K5, A4, S4]

b) Draw the circuit diagram for instrumentation amplifier and hence find the expression for amplifier gain. [CO4, K5, A4, S4]

c) With a neat sketch, describe how transistor can be used as switch? [CO4, K3, A2, S2]

6+6+4=16

10. a) Design a circuit to generate error signal from set point variable and process variable.

[CO4, K5, A4, S4]

b) Design a current to voltage converter that provides 1-5 V corresponds to input current of 4 - 20 mA. [CO4, K5, A4, S4]

c) Describe the operation of a dual slope ADC with necessary schematic diagram. Mention the disadvantage of this type of ADC? [CO4, K3, A2, S2]

3+6+(6+1)=16