Paper / Subject Code: 31402 / Mechanical Measurements & Control

(3 Hours) [Total marks: 80]

Instructions:
1. **Question 1 compulsory.**
2. **Schematic Diagrams/sketches** carry weightage.
3. Attempt any **three** questions from the remaining **five** questions.
4. Assume suitable data, **if necessary.**

Q1) a) Temperature measurement devices, Enlist contact and non-contact types that are widely used in Industry and social life. Give their merits and demerits based on technology and handling of gazettes w.r.t. applications.   5

b) Differentiate between open and closed loop system with example.   5

c) What is the resolution in degrees of an encoder with 6 tracks? The number of increments per revolution is 2^6.   5

d) Comment on the stability for a given CE of a system $S^6+2+3s^5+6s^3+4s^4+5s^2+3s=0$ 5

Q2) a) Obtain the Transfer function for the Block diagram using Standard Block reduction rules   7
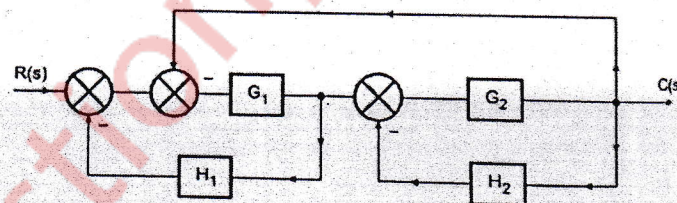
b) A strain gauge has gauge factor of 4. If the strain gauge is attached to a metal bar that stretches from 0.25m to 0.255m when strained, what is the percentage change in resistance? If the unstrained value of gauge is 120 Ω, what is the resistance valve of gauge after application of strain?   5

c) Illustrate the working principle for displacement measurement using "L.V.D.T."   8

Q3) a) Enumerate the types of pressure measurement devices w.r.t. levels i.e. low, medium and high pressures to be measured. State the working principle for each pressure level with example.   10

b) What are the different temperature compensation techniques used in the measurement of strain using strain gauges? Explain any two method's in details.   10

Q4) a) Illustrate a mathematical model for a thermal system given in the **fig: 1** and represent its transfer function. The bath temperature is θ_i and temperature indicated by thermometer is θ_o.   10

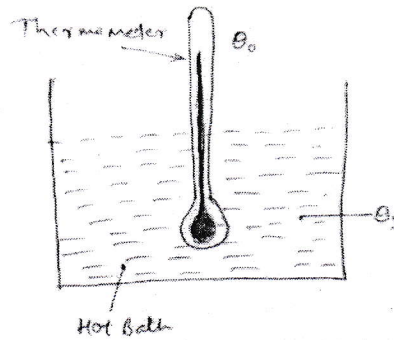58678   **TURN OVER**

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Fig: 1

b) A system is given by differential equation , $\dfrac{d^2y}{dt^2} + 4\dfrac{dy}{dt} + 8y = 8x$,   10

where y = output and x = input. Determine all time domain specifications for unit step input and plot the response curve.

Q5) a) Addition of Zeros in the numerator of a given system G(s) H(s) improves the stability of   10
the system, then If (S + 4) is a zero added to a given system G(s) H(s) = K / s (s² + 2s +2)
(K, in numerator is a constant), Sketch the root locus and comment on its stability.

b) A servomechanism is designed to keep a radar antenna pointed at a flying aeroplane. If the   10
aeroplane is flying with a velocity of 600 km/hr, at a range of 2 km and the maximum
tracking error is to be within 0.1⁰. Determine the required velocity error coefficient.

Q6) a) What do you understand by a State-space modeling of a system? Define state space and   5
state variables.

b) Write a short note on PID controller.   5

c) A feedback system has G(s) H(s) = 100 (s+4) / s (s + 0.5) (s +10). Determine GM, PM, ω_{gc} 10
and ω_{pc}. Draw Bode plot and comment on its stability.

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