Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2023

Subject Code:3150504 Date:20-12-2023

Subject Name: Instrumentation and Process Control

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	**(a)**	Define Time Constant.	**03**
	(b)	Discuss the importance of process control in industry.	**04**
	(c)	Solve following differential equation using Laplace Transform $\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 3x = 1 \qquad given \;\; x(0) = x'(0) = 0$	**07**
Q.2	**(a)**	Give the Laplace Transform of following functions. i. $e^{-2t}\sin t$ ii. $\delta(t)$ iii. t^2e^t	**03**
	(b)	Explain the significance of deviation variables.	**04**
	(c)	Derive transfer function for a mercury in glass thermometer. What is the value of process gain for the mercury in glass thermometer?	**07**
		OR	
	(c)	A thermometer with time constant 10 sec showing a steady temperature 35^{O}C is suddenly immersed in heated oil bath at 200^{O} C. Find: i. Time required for temperature reading of 150^{o} C. ii. Temperature reading on the thermometer after 25 sec.	**07**
Q.3	**(a)**	Define a first order system.	**03**
	(b)	Explain negative and positive feedback control systems	**04**
	(c)	Explain the merits and demerits of Proportional, Integral and Derivative action in a feedback controller.	**07**
		OR	
Q.3	**(a)**	What is open loop control system?	**03**
	(b)	Discuss the significance of the damping coefficient.	**04**
	(c)	Discuss the characteristics of an underdamped second order response.	**07**
Q.4	**(a)**	What is controller gain?	**03**
	(b)	Explain gain margin and phase margin.	**04**
	(c)	Obtain the overall transfer function of a servo mechanism negative feedback control system.	**07**
		OR	
Q.4	**(a)**	Define stability for a control system.	**03**
	(b)	Explain controller tuning using Ziegler-Nichols method	**04**
	(c)	Determine the stability of the control system having the open loop transfer function: $G(s) = \frac{K_c}{s(s+1)(s+2)}$	**07**
Q.5	**(a)**	Define: Drift, hysteresis and speed of response	**03**
	(b)	Explain advantages and disadvantages of Distributed Control System.	**04**
	(c)	Describe the principle, construction and working of optical pyrometer.	**07**

OR

Q.5	**(a)**	Define: Accuracy, precision and reproducibility	**03**
	(b)	Explain SCADA system	**04**
	(c)	Describe the principle, construction working and applications of the bourdon tube pressure gauge.	**07**

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