Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2024

Subject Code:3150504 Date:17-12-2024

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.**

			Marks
Q.1	**(a)**	Give the Laplace transform for the following 1. Cos kt 2. Sinh kt 3. e^{-at}	**03**
	(b)	State and prove the final value theorem.	**04**
	(c)	Solve the following by using Laplace transforms $\frac{dx}{dt} + x = 1 \qquad x(0) = 0$	**07**
Q.2	**(a)**	Define the following 1. Gain 2. Transportation Lag 3. Time Constant	**03**
	(b)	List the assumption made for derivation of transfer function of mercury thermometer and justify.	**04**
	(c)	Derive the transfer function and step response of mixing process.	**07**
		OR	
	(c)	A Storage tank contains a liquid which is pumped by a centrifugal pump at as steady rate. Liquid enters the tank at volumetric flow rate 200 Liter/hr and liquid level reaches steady-state value of 40 cm. If input flow rate is suddenly increased to 300 Liter/hr, Find level response and liquid level after 1 minutes by deriving transfer function and step response. (Cross section area of tank: 15 cm x 15 cm)	**07**
Q.3	**(a)**	What are advantages and disadvantages of P-control? Give application of P-Control.	**03**
	(b)	Discuss characteristics of underdamped step response for second order system.	**04**
	(c)	Derive the transfer function of U tube manometer as second order system.	**07**
		OR	
Q.3	**(a)**	Explain the following in control system 1. Load Variable 2. Set Point 3. Control Variable	**03**

	(b)	Differentiate between Feed-forward control and Feed-back control.	**04**
	(c)	Derive the transfer function of two non-interacting tanks and discuss nature of response after compare with second order system.	**07**
Q.4	**(a)**	What is controller? Explain its importance in close loop control system.	**03**
	(b)	What are advantages and disadvantages of PI-control? Give application of PI-Control.	**04**
	(c)	The characteristics equation of control system is given as following $s^3 + 3s^2 + 2s + K = 0$ Determine (1) The value of K for which system is stable system using Routh test (2) The value of K for which system is marginally stable (3) The frequency of system for sustain oscillations	**07**

OR

Q.4	**(a)**	Explain the working of cascade control system.	**03**
	(b)	Differentiate between servo-type and regulator-type problem.	**04**
	(c)	Explain the frequency response analysis of First order control system by bode diagram.	**07**
Q.5	**(a)**	Discuss the advantages with application of DCS.	**03**
	(b)	Explain the working principal and construction of Thermocouples.	**04**
	(c)	Explain principle, construction and working of bubbler system.	**07**

OR

Q.5	**(a)**	List the static and dynamic characteristics of Instruments.	**03**
	(b)	List the various instrument used for Viscosity measurement and explain working of any one.	**04**
	(c)	Explain principle, construction and working of pirani vacuum gauge.	**07**

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