Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER– V EXAMINATION – SUMMER 2026

Subject Code:3150504 Date:06-06-2026

Subject Name: Instrumentation and Process Control

Time: 02:30 PM TO 05:00 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. Sin kt 2. Cosh kt 3. $e^{-at}\sin kt$	**03**
	(b)	State and prove the Initial-Value Theorem	**04**
	(c)	Determine the x(t) for x(s) $$x(s) = \frac{1}{s^2(s+1)}$$	**07**
Q.2	**(a)**	What is transportation lag? Explain with example.	**03**
	(b)	Explain first order system by giving physical example of mixing process.	**04**
	(c)	Derive the transfer function of mercury thermometer. List the assumptions and justify them.	**07**
		OR	
	(c)	A thermometer having a time constant of 1 min is initially at 34 ^{o}C and steady state condition. It is immersed in a bath maintained at 100 ^{o}C at time t = 0. Determine the temperature reading of thermometer at t = 1.1 min.	**07**
Q.3	**(a)**	Explain the overshoot, decay ratio and response time for second order underdamped system.	**03**
	(b)	What is Servo Problem? Explain with example from chemical industry.	**04**
	(c)	Derive the transfer function of damped vibrator as second order system and find the critically damped step response.	**07**
		OR	
Q.3	**(a)**	With neat sketch explain the various parts of control system.	**03**
	(b)	Differentiate between Interacting and Non-interacting system.	**04**
	(c)	Discuss the rules for reduction of block diagram with example of each.	**07**
Q.4	**(a)**	Derive the overall transfer function of PID control.	**03**
	(b)	What is ratio control? Give important applications of it in chemical industry.	**04**
	(c)	The characteristics equation of control system is given as following $$s^3 + 6s^2 + 11s + 6(1 + K_c) = 0$$	**07**

(1) Determine the value of K_c for which system is stable system using Routh test

(2) Determine the roots of the characteristic equation when value of K_c for which the system is on the threshold of instability.

OR

Q.4	**(a)**	What is ON/OFF control? Discuss applications of ON/OFF Control.	**03**
	(b)	What is regulator Problem? Explain with example from chemical industry.	**04**
	(c)	Discuss Phase margin and Gain margin using stability criteria for Bode diagram.	**07**
Q.5	**(a)**	List the various methods used in industrial process for pressure measurement.	**03**
	(b)	Explain the working principal and construction of bimetallic thermometer.	**04**
	(c)	Discuss the construction and working of Distributed Control System (DCS) with all merits and demerits.	**07**

OR

Q.5	**(a)**	List the various methods used in industrial process for liquid level measurement.	**03**
	(b)	Discuss the working principal of bubbler system	**04**
	(c)	Explain principle, construction and working of radiation pyrometer.	**07**

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