Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V EXAMINATION – WINTER 2025

Subject Code:3150504 Date:02-12-2025

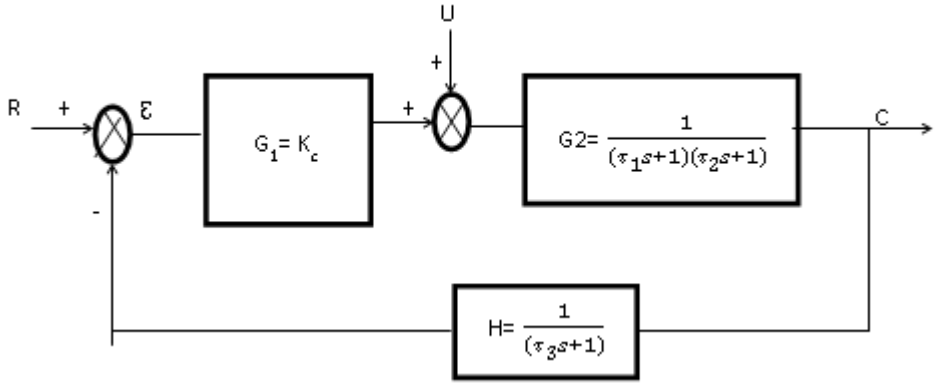
Subject Name: Instrumentation and Process Control

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)**	Discuss advantages of automatic control of a process.	**03**
	(b)	Differentiate between Feedback and feed forward control system with example.	**04**
	(c)	Derive the transfer function of mercury thermometer. Determine the response equation of mercury thermometer for Ramp function.	**07**
Q.2	**(a)**	State and prove translation of transform.	**03**
	(b)	$\frac{d^2x}{dt^2} + 2\frac{\mathrm{dx}}{\mathrm{dt}} + x = 1$ $x\,(0) = x'(0) = 0$ Solve the differential equation by Laplace transform	**04**
	(c)	Derive the transfer function of Manometer in which pressure P is acting in one limb and other limb is open to the atmosphere.	**07**
		OR	
	(c)	Derive the transfer function for 'loading' system where second tank will be load by first tank.	**07**
Q.3	**(a)**	Differentiate between interacting and non-interacting system	**03**
	(b)	Develop a transfer function relating the tank outlet temperature to changes in the inlet temperature considering mixed tank heater system	**04**
	(c)	For a second order transfer function with $\tau = 1$ and $\zeta = 0.8$, being distributed with a sine wave input 3 sin (0.5t). Determine the form of the response after transient have decayed and steady state oscillations are established.	**07**
		OR	
Q.3	**(a)**	Explain gain margin and phase margin.	**03**
	(b)	Differentiate between transfer lag and transportation lag.	**04**
	(c)	Discuss Bode plot for first order system	**07**
Q.4	**(a)**	Discuss the Nyquist stability criteria.	**03**
	(b)	Write in brief about PD controllers and its transfer function	**04**
	(c)	Determine the stability criteria of the system shown below for which PI controller is used. Use $\tau_1 = 1, \tau_2 = \frac{1}{2}, \tau_3 = \frac{1}{3}, K_c = 5$ and $\tau_I = 0.25$.	**07**

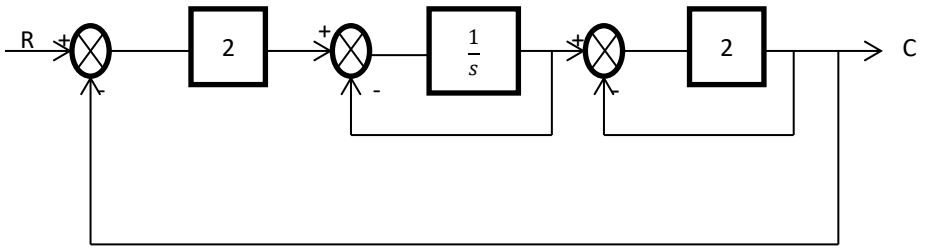


OR

Q.4 **(a)** Write in brief about ON/OFF controller. **03**

(b) Derive the transfer function of PID control **04**

(c) For the control system diagram shown below. derive the transfer function C(s)/ R(s) **07**



Q.5 **(a)** Describe PLC, DCS, and SCADA in brief. **03**

(b) Explain dynamic characteristics of an instrument. **04**

(c) Explain construction and working of optical pyrometer. **07**

OR

Q.5 **(a)** Explain working of wet bulb and dry bulb thermometer used for measurement of relative humidity. **03**

(b) Discuss the pitot tube for flow measurement. **04**

(c) Explain the principal, construction and working of bellows differential-pressure gauge. **07**

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