Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2021

Subject Code:2151908 Date:17/12/2021

Subject Name:Control Engineering

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)**	What are the standard input test signals? Give equations for the same.	**03**
	(b)	Compare the open and closed loop systems giving examples.	**04**
	(c)	Explain Force Voltage and Force-Current Analogy with Mechanical systems with neat sketches	**07**
Q.2	**(a)**	Define the resistance and capacitance of the liquid level systems.	**03**
	(b)	What is transfer function? List out the properties of transfer function.	**04**
	(c)	Obtain the Transfer function of the block diagram given in Fig. 1 using the block diagram reduction rules.	**07**
		OR	
	(c)	Obtain the transfer function for the signal flow network shown in Fig. 2 using Mason's Gain formula.	**07**
Q.3	**(a)**	Define State space, state variables and state vectors.	**03**
	(b)	Advantage and Disadvantages of state space analysis technique.	**04**
	(c)	Find the state space model i.e., state matrix, input matrix, output matrix and transmission matrix for a system that described by the following transfer function. $$\frac{C(s)}{R(s)} = \frac{24}{s^3 + 9s^2 + 26s + 24}$$ Also give block diagram representation for the state space model.	**07**
		OR	
Q.3	**(a)**	Explain two position controllers.	**03**
	(b)	Differentiate the pneumatic systems and Hydraulic systems.	**04**
	(c)	Obtain the transfer function for pneumatic PI controller with neat sketch.	**07**
Q.4	**(a)**	Define: (1) rise time (2) settling time (3) steady state error	**03**
	(b)	Plot the system response of the first order unity feedback system for unit impulse input.	**04**
	(c)	Obtain analytically the rise time, peak time, maximum overshoot and settling time in the unit-step response of a closed -loop system given by $$\frac{C(s)}{R(s)} = \frac{36}{s^2 + 4s + 36}$$	**07**
		OR	
Q.4	**(a)**	Explain absolute stability and relative stability	**03**
	(b)	Obtain the range of K for stability of the system whose characteristic equation is given by $$s^4 + 2s^3 + (4 + K)s^2 + 9s + 25 = 0$$	**04**
	(c)	Obtain a steady state error for simple unity feedback systems – having Type N= 0,1,2, ….. for unit step input signal. Comment on desirability of the system.	**07**

Q.5	**(a)**	Difference between transient and frequency response analysis	**03**
	(b)	State the advantages of frequency response analysis	**04**
	(c)	Draw the root locus plot for the system shown in Fig. 3. Find the break-in and breakaway points and locate on the plot. Also find the value of gain K at break-in and breakaway points.	**07**

OR

Q.5	**(a)**	Enlist the sources of hydraulic power.	**03**
	(b)	Explain the hydraulic control circuit with basic elements and neat sketch.	**04**
	(c)	Discuss the hydraulic PI controller with neat sketch and necessary transfer function.	**07**

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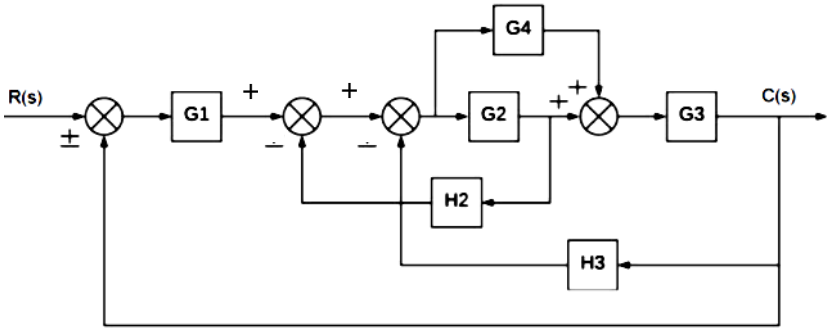

Fig. 1 Block diagram reduction (Q.2(c))

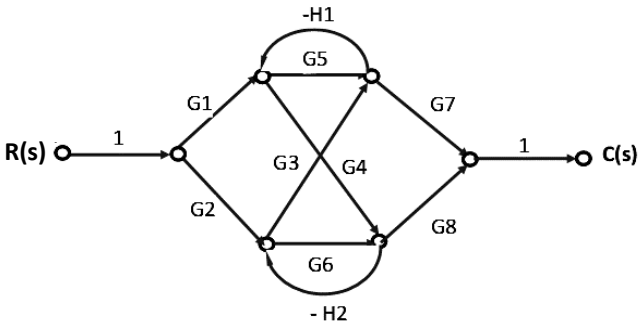

Fig. 2 Signal Flow graph (**OR** Q. 2(c))

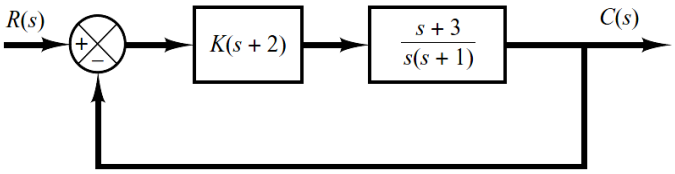

Fig. 3 (Q. 5(c))