Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2022

Subject Code:3151908 Date:04-01-2023

Subject Name:Control Engineering

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)**	1. What does the arrow on the branch of a Signal Flow Graph represent? 2. In a 4/3 DCV, 4 stands for _____ and 3 stands for _____ ? 3. Define self-loop.	**03**
	(b)	Write advantages and disadvantages of Open Loop System.	**04**
	(c)	Differentiate between Open Loop and Close Loop System.	**07**
Q.2	**(a)**	Write Laplace Transform of following, 1. t 2. e^{-at} 3. Sin ωt	**03**
	(b)	The transfer function of a system is given by, $$T(S) = \frac{K(S+6)}{S\,(S+2)(S+5)(S^2+7S+12)}$$ Determine: i) Poles ii) Zeros iii) Characteristic equation iv) Plot Poles and zeros on S-plane	**04**
	(c)	Explain the Analogous Elements of Mechanical Rotational System.	**07**
		OR	
	(c)	Determine C(s)/R(s) by using Block Diagram Reduction Technique. (Fig. 1)	**07**
Q.3	**(a)**	Explain the following, 1. Step Input 2. Ramp Input 3. Parabolic Input	**03**
	(b)	Compare Block Diagram and Signal Flow Graph.	**04**
	(c)	Determine C(s)/R(s) by using Mason's Gain Formula. (Fig. 2)	**07**
		OR	
Q.3	**(a)**	Define, i) Delay Time ii) Peak Time iii) Setting Time	**03**
	(b)	The characteristic equation of the system is given by $s^4 + 2s^3 + (4 + k)\,s^2 + 9s + 25 = 0$ Determine the range of k for the system to be stable.	**04**
	(c)	Find the Open Loop Transfer Function of an equivalent prototype, single loop unity feedback system having second order, whose step response is shown in (Fig. 3).	**07**
Q.4	**(a)**	Draw basic hydraulic circuit with standard symbols and label.	**03**
	(b)	Explain nozzle flapper amplifier with neat sketch.	**04**
	(c)	Obtain the transfer function for hydraulic system with PID control action.	**07**
		OR	
Q.4	**(a)**	Differentiate hydraulic and pneumatic control system.	**03**
	(b)	Write down the sources of hydraulic power.	**04**

(c) Sketch the root locus of the system whose open loop transfer function is, **07**

$$G(s) = \frac{K}{s\,(s+1)(s+3)}$$

Determine the value of K for damping ratio equal to 0.5.

Q.5 **(a)** Determine the stability of following system using Routh's Criterion. **03**

$$G(s)H(s) = \frac{9}{s^2(s+2)}$$

(b) Explain Lag – Lead Compensation of Time response. **04**

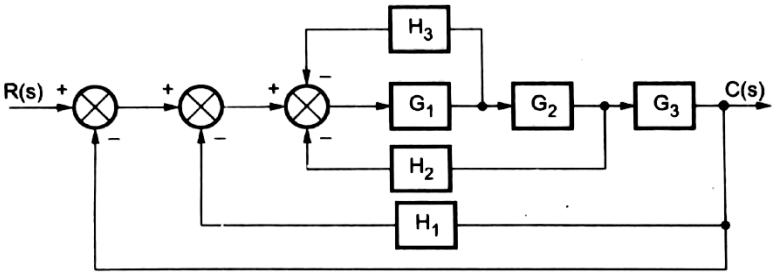
(c) Explain Phase margin and Gain margin related to frequency response. **07**

OR

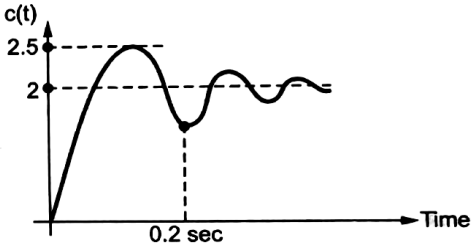
Q.5 **(a)** Obtain State Space model of Spring Mass Damper system. **03**

(b) Explain frequency response specifications, **04**
i) Resonant Peak ii) Bandwidth iii) Resonant Frequency

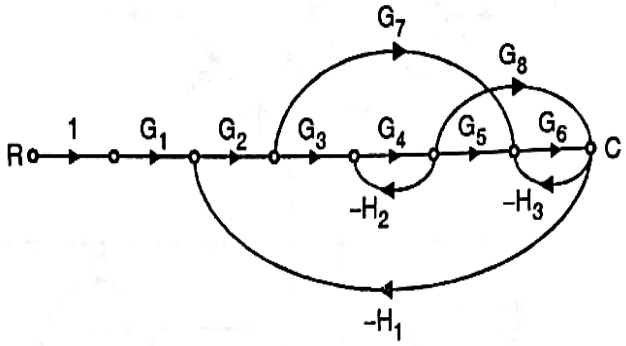
(c) Write a short note on Nyquist Stability Criteria. **07**



(Fig. 1)



(Fig. 3)



(Fig. 2)

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