Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2024

Subject Code:3141708 Date:18-07-2024

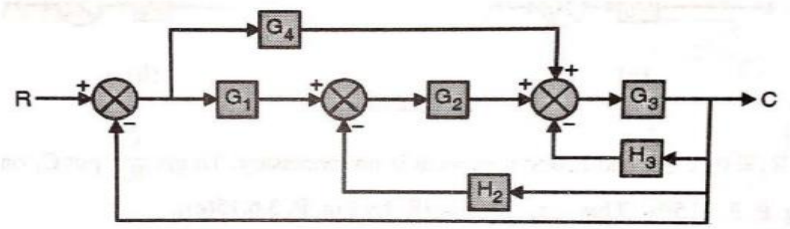
Subject Name: Control Theory

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

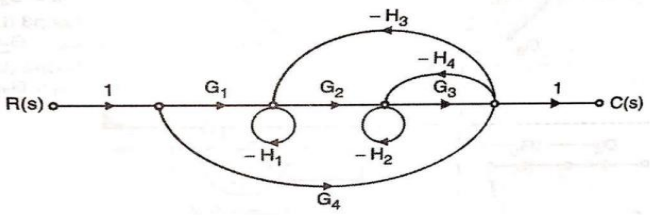
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	What is feedback? Explain the effect of feedback.	**03**
	(b)	What is transfer function? Discuss properties, advantages and disadvantages of it.	**04**
	(c)	What is control system? What are the different types of control systems? Compare openloop and closed-loop control system.	**07**
Q.2	**(a)**	Define: Order of the system, Self-loop, Steady-state error.	**03**
	(b)	Explain the conditions for Stable, Marginally stable and Unstable systems.	**04**
	(c)	For the system represented by the block diagram shown in Fig. evaluate the closed-loop transfer function.	**07**



OR

	(c)	What is analogous system? Explain Force-Voltage and Force-Current Analogy with suitable Example.	**07**
Q.3	**(a)**	Explain: State, State variable, state space.	**03**
	(b)	Explain standard test signals.	**04**
	(c)	Determine the transfer function of the system with signal flow graph shown in figure.	**07**



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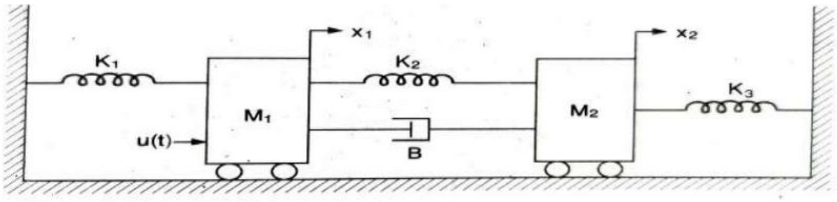
OR

Q.3	**(a)**	Compare Block diagram and Signal flow graph methods.	**03**
	(b)	Write a short note on state space representation of a control system.	**04**

(c) Obtain Transfer function of the mechanical system shown in figure. **07**



Q.4 **(a)** Explain: Frequency response, Root locus, Centroid. **03**

(b) Derive an expression for the Peak Overshoot for a second order control system subjected to a unit step input. **04**

(c) The characteristic equation of a system is given by **07**
$S^4 + 8S^3 + 18S^2 + 16S + 4 = 0$. Investigate the stability of a system by means of Routh criterion,

OR

Q.4 **(a)** Find error constant and steady state error for type-1 system for unit step input. **03**

(b) Define: (1) Delay time (2) Rise time (3) Peak time (4) Settling time **04**

(c) Sketch root locus for unity feedback control system, having following open loop transfer function. **07**

$$G(s) = \frac{k}{s(s+1)(s+3)(s+4)}$$

Q.5 **(a)** Explain gain margin and phase margin. **03**

(b) List properties of M-circles. **04**

(c) Determine gain margin & phase margin by sketching Bode plots of a unity feedback control system, having open loop transfer function **07**
G(S) H(s) = $100/ s(s + 1)(s + 2)$

OR

Q.5 **(a)** Explain Gain Crossover frequency and Phase Crossover frequency. **03**

(b) Write a short note on PID controller. **04**

(c) Draw Nyquist plot for unity feedback system having following open loop transfer function. Comment on stability. **07**

$$G(s) = \frac{1}{s(s+4)(s+8)}$$

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