Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV EXAMINATION – SUMMER 2020

Subject Code: 3141708 **Date:27/10/2020**

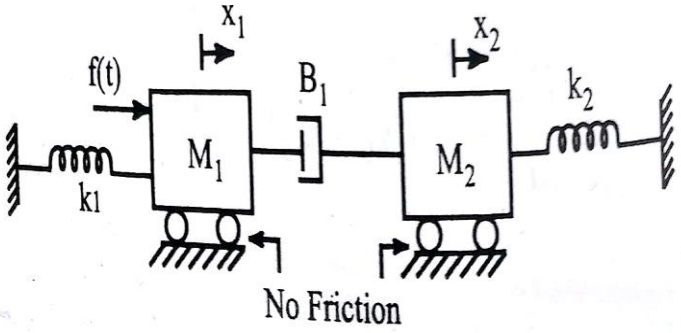
Subject Name: Control Theory

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

Instructions:

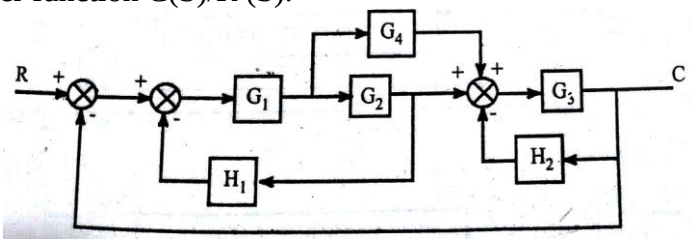
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Differentiate between open loop and close loop system	**03**
	(b)	For mechanical translational system. Write the analogous electrical elements in force voltage and force-current analogy.	**04**
	(c)	Explain standard Test signals & derive equation of steady state	**07**
Q.2	**(a)**	Define transfer function and Explain importance of Laplace transform in control system.	**03**
	(b)	Explain following terms with necessary diagrams. (1) Delay Time (2) Rise Time (3) Peak Time (4) Steady state error	**04**
	(c)	For the given mechanical system Write down differential equations, mechanical circuit diagram and obtain force-current analogy.	**07**



OR

	(c)	What is force voltage analogous system? Which are the analogues quantities according to this method?	**07**
Q.3	**(a)**	State the limitation of Routh criterion and how these limitations are overcome by Root Locus.	**03**
	(b)	Explain the mathematical model of thermal system.	**04**
	(c)	A linear feedback control system has the block diagram shown in Figure. Using block diagram reduction rules, obtain overall transfer function C(S)/R (S).	**07**

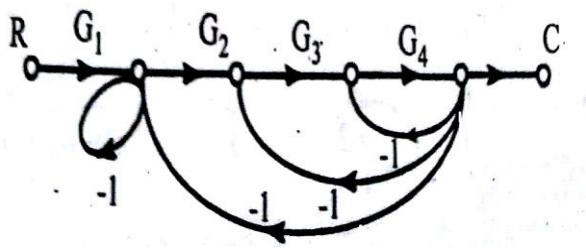


OR

Q.3 **(a)** Derive unit step response of a first order system. **03**

(b) By means of Routh criterion, determine the stability of the system described by characteristic equations. **04**
$S^4+8S^3+18S^2+16S+5=0$
Comment on location of the roots.

(c) For the signal flow graph shown in Figure, using Masson's gain formula determine the overall transfer function C/ R. **07**



Q.4 **(a)** Define pole, zero and order of a system. **03**

(b) Explain Performance Indices. **04**

(c) List all the rules to construct a root locus and explain. **07**

OR

Q.4 **(a)** Derive expression of K_P, K_V, K_A for Type '0' control system **03**

(b) Define and explain following terms with respect to frequency response (i) Gain Margin (ii) Phase Margin **04**

(c) Explain Sensitivity of Control Systems to Parameter Variations. **07**

Q.5 **(a)** Define : 1) state variable, 2) state vector, 3) state space **03**

(b) With example explain the location of the roots of characteristics equation for the stable control system. **04**

(c) Sketch the root locus for the given open loop transfer function **07**
$G(s)H(s)$= K /s (s + 2)(s + 3)

OR

Q.5 **(a)** Explain the Nyquist stability criterion. **03**

(b) Sketch polar plot for the system with open loop transfer function is $G(s)H(s)$= 1/(s + 4)(s + 2) **04**

(c) Sketch the Bode plot and determine the gain margin and phase margin for the given unity feedback control system. **07**
$G(s)H(s)$= k / s (1+0.02s)(1 + 0.04s).

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