Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–IV (NEW) EXAMINATION – WINTER 2020

Subject Code:2141708 Date:11/02/2021

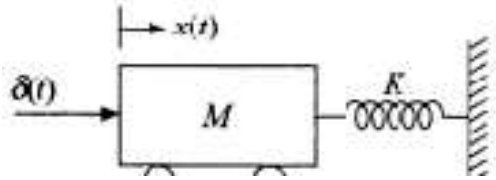
Subject Name:Control System

Time:02:30 PM TO 04:30 PM Total Marks:56

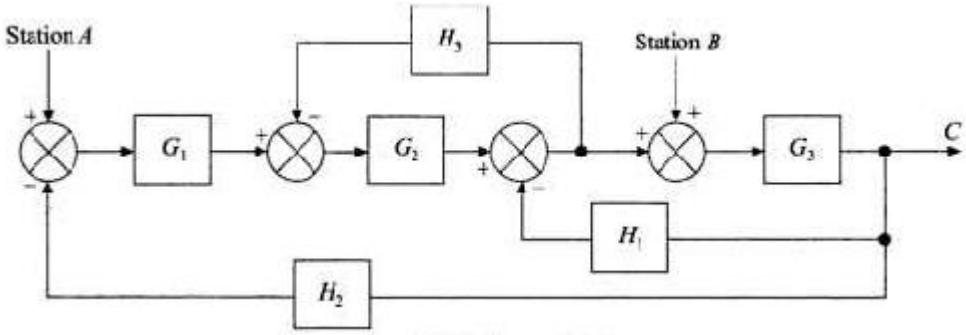
Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Define a) Characteristic Equation b) Proper Transfer Function c) Control System	**03**
	(b)	Enlist the characteristics of negative feedback.	**04**
	(c)	Consider the mechanical system shown in the figure below. Suppose that the system is set into motion by unit impulse force. Find the resulting oscillation. Assume that the system is at rest initially.	**07**

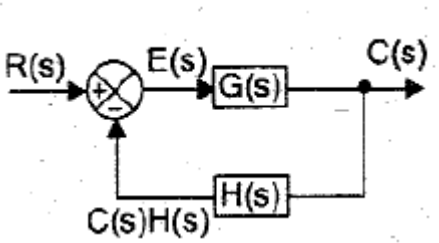


Q.2	**(a)**	Write the force balance equations for an 1) ideal mass 2) ideal spring and 3) ideal dash pot/damper.	**03**
	(b)	Explain any four rules of block diagram reduction.	**04**
	(c)	Using block diagram reduction technique, find out closed loop transfer function of the system when the input R(s) is at station A.	**07**



Q.3	**(a)**	Explain standard test signals.	**03**
	(b)	Explain Thermal System.	**04**
	(c)	List out and define the specifications of second order time response system. Derive equation for the peak overshoot and settling time.	**07**

Q.4	**(a)**	Define a) Rise Time b) Peak Time c) Delay Time	**03**
	(b)	Derive the expression for steady state error for the system shown below.	**04**



(c) A unity feedback control system has an open loop transfer function G(s) = 5/[s(s+1)]. Find the rise time, % overshoot, peak time and settling time for a step input of 10 units. Also determine the peak overshoot. **07**

Q.5 **(a)** Define **03**
a) Gain Margin
b) Phase Margin
c) Bandwidth

(b) The characteristic equation of a feedback control system is **04**

$$s^4 + 20s^3 + 15s^2 + 2s + K = 0$$

Determine the range of values of K for the system to be stable.

(c) Sketch the root locus for the unity feedback system whose open loop transfer function is **07**

$$G(s)\,H(s) = \frac{K(s+1.5)}{s(s+1)(s+5)}$$

Q.6 **(a)** Find the polar plot of G(s) = 1/(1+S) **03**

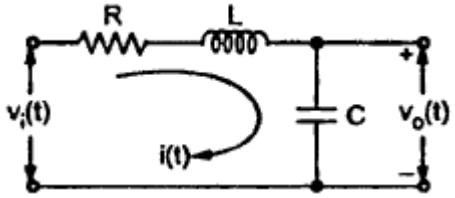
(b) Explain the Nyquist stability criterion. **04**

(c) Plot the Bode diagram for the unity feedback system whose open loop transfer function is given below and obtain the gain and phase cross over frequencies **07**

$$G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$$

Q.7 **(a)** List out the advantage of State variable analysis. **03**

(b) Obtain the state model of the given electrical system **04**



(c) Write the advantages and disadvantages of open and closed loop control system. Give examples for each type of system. **07**

Q.8 **(a)** Enlist the properties of State Transition matrix. **03**

(b) Derive the expression for transfer function from the state space representation of the system. **04**

(c) Obtain the mathematical model of a gear train. **07**

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