Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2018

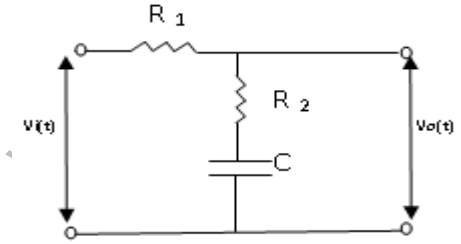
Subject Code:2141708 **Date:28/11/2018**

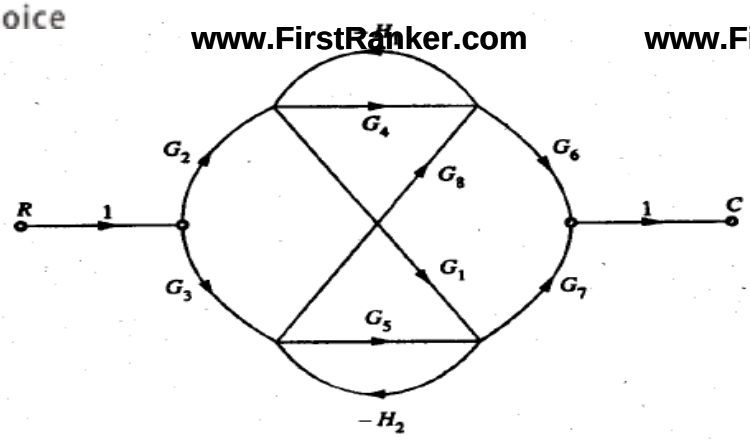
Subject Name:Control System

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.**

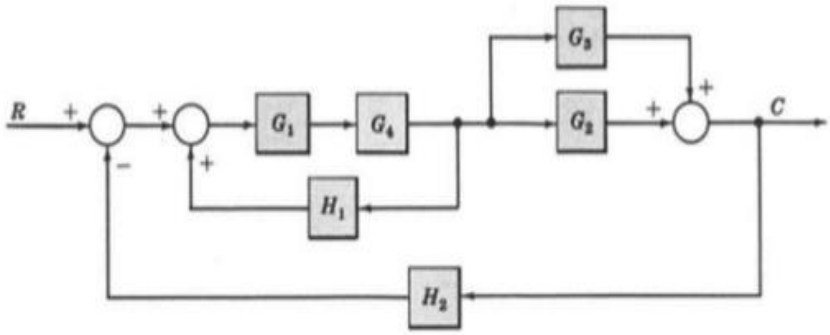
			MARKS
Q.1	**(a)**	Explain Initial value theorem and Final Theorem in Laplace Transformation.	**03**
	(b)	Find the inverse Laplace Transform of the following function: $F(s) = \frac{5s+3}{(s+1)(s+2)(s+3)}$	**04**
	(c)	Explain in detail open loop and closed loop control system along with example, advantages and disadvantages.	**07**
Q.2	**(a)**	Write advantages and disadvantages of polar plot.	**03**
	(b)	Explain constant-M circle.	**04**
	(c)	Sketch the bode plot and determine the gain cross-over and phase cross over frequencies for the following transfer function. $G(s) = \frac{10}{s(1+0.5s)(1+0.1s)}$	**07**
		OR	
	(c)	Draw the Bode plot for a system having $G(s)H(s) = \frac{100}{s(s+1)(s+2)}$ Find gain margin, phase margin.	**07**
Q.3	**(a)**	Obtain the transfer function of following electrical system. 	**03**
	(b)	Derive force-voltage and force-current analogy.	**04**
	(c)	Obtain the transfer function from the given signal flow graph.	**07**



OR

Q.3 **(a)** Explain absolute stability, relative stability and BIBO stability. **03**

(b) Determine the transfer function of a system whose block diagram is given below. **04**



(c) Derive the transfer function of armature-controlled DC motor. **07**

Q.4 **(a)** A unity feedback system has transfer function **03**

$$G(s) = \frac{K(2s+1)}{s(4s+1)(s+1)^2}$$

Determine the value of K, if the steady state value of error to be less than 0.1 when an input r(t) = 1 + 5t is applied.

(b) State the rules for construction of root locus. **04**

(c) Draw the root-locus for open-loop transfer function **07**

$$G(s)H(s) = \frac{K}{s(s+3)(s^2+2s+2)}$$

when K is varied from 0 to infinity.

OR

Q.4 **(a)** Derive steady state errors for unit step, unit ramp and unit parabolic input. **03**

(b) A unity feedback system is given by open loop transfer function **04**

$$G(s) = \frac{K}{s(s+10)}$$

Determine the gain K with damping factor of 0.5. Also determine settling time, peak overshoot and peak time for a unit step input with the obtained K.

(c) The open loop transfer function of a feedback control system is **07**

$$G(s)H(s) = \frac{K}{s(s+4)(s^2+4s+20)}$$

Find the root locus as K is varied from 0 to infinity.

Q.5 **(a)** Consider the characteristic equation **03**

$s^4 + 8s^3 + 18s^2 + 16s + 5 = 0$

Find out the stability using Hurwitz's criterion.

(b) Compute e^{-At} if **04**

using laplace transform method.

(c) Obtain the transfer function of the system having following state transition equations. **07**

$$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \\ \dot{x_3} \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -5 & -25 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 25 \\ -120 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

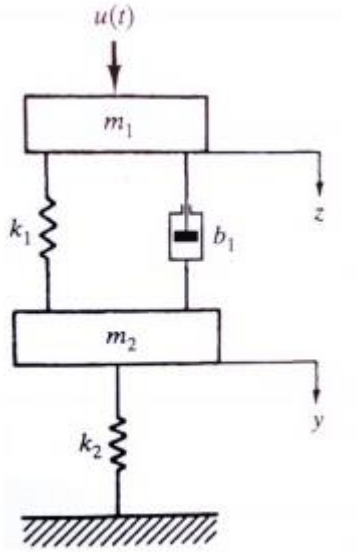
OR

Q.5 **(a)** What are the advantages of state variable analysis over classical methods? **03**

(b) Using Routh's test determine the stability of a system whose characteristic equation is given by **04**

$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$

(c) Obtain the state equations for the following system. **07**



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