Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III (New) EXAMINATION – WINTER 2019

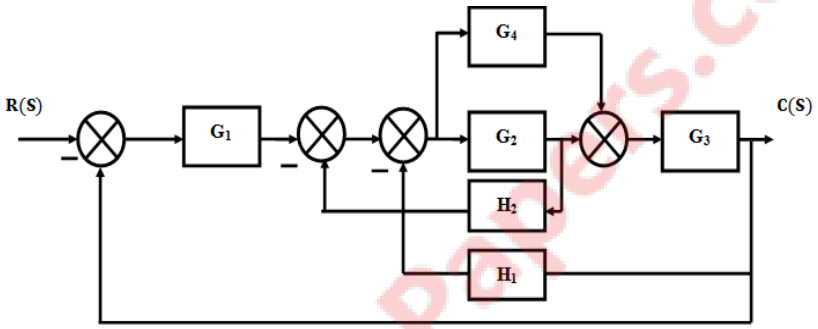
Subject Code: 3130905 Date: 3/12/2019

Subject Name: Control System Theory

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)**	Define the following terms. (1) Control system(2) Plants (3) Process	**03**
	(b)	Explain transfer function and State advantages and Dis-advantages of transfer function.	**04**
	(c)	Solve the block diagram to find transfer function of the system shown in figure. 	**07**
Q.2	**(a)**	Explain Steady state Error.	**03**
	(b)	Compare Open loop Vs close loop control systems	**04**
	(c)	The characteristic equation of feedback control system is given by $s^4+20s^3+15s^2+2s+K=0$ 1) Calculate the range of K for the system to be stable. 2) Can the system be marginally stable? If so, find the required value of k and frequency of sustained oscillation.	**07**
		OR	
	(c)	Write Nyquist contour and Nyquist stability criterion in brief.	**07**
Q.3	**(a)**	Calculate damping ratio and Undamped natural frequency of oscillation for the open loop transfer function of a servo system with unity feedback system: $G(S) = \frac{10}{(S+2)(s+5)}$	**03**
	(b)	Explain Standard Test Signals used in control system	**04**
	(c)	Construct the root loci of open loop transfer function of the feedback control system given as $G(S)H(S) = \frac{k(S+3)}{s(s+2)}$	**07**
		OR	
Q.3	**(a)**	Simplify the significance of proportional control.	**03**
	(b)	Define following terms with respect to second order system. 1) Delay Time 2) Rise Time 3) Peak Time 4) Steady state error	**04**

(c) Consider a lag-lead network defined by

$$Gc(s) = k\frac{(s+\frac{1}{T1})(s+\frac{1}{T2})}{(s+\frac{\beta}{T1})(s+\frac{1}{\beta T2})}$$

Show that at frequency ω_1, where $\omega_1 = \frac{1}{\sqrt{T_1 T_2}}$, the phase angle of $Gc(j\omega)$ becomes zero. **07**

Q.4 **(a)** Explain the effect of integral control action on system Performance. **03**

(b) Explain relationship between time and frequency response. **04**

(c) Explain step by step Procedure for Phase Lag Network. **07**

OR

Q.4 **(a)** Explain the advantages of bode plot. **03**

(b) Summarize types of compensation and explain any one. **04**

(c) Explain the step by step procedure for obtaining bode plot. **07**

Q.5 **(a)** Explain polar plots with a sketch of a simple example **03**

(b) Decide that How stability can be ensured from Routh Table? **04**

(c) Distinguish state variable approach verses the classical approach of transfer function for the analysis of control systems. **07**

OR

Q.5 **(a)** Explain following terms. 1) State variable 2) State trajectory 3) State vector **03**

(b) Define and explain following terms with respect to frequency response. **04**

1) Gain Margin
2) Phase Margin
3) Gain Crossover frequency
4) Phase Crossover frequency

(c) Investigate Controllability and observability of the system **07**

$$X(t) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} X(t) + \begin{bmatrix} 0 \\ 0 \\ 2 \end{bmatrix} u(t)$$

$$c(t) = [1 \quad 0 \quad 0]x(t)$$

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