Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III(NEW) EXAMINATION – SUMMER 2023

Subject Code:3130905 Date:01-08-2023

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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Define following terms: 1. Control system 2. Plants 3. Process.	**03**
	(b)	Define the transfer function of a system.	**04**
	(c)	Determine the transfer function of the system shown in figure 1 by using block diagram reduction technique.	**07**

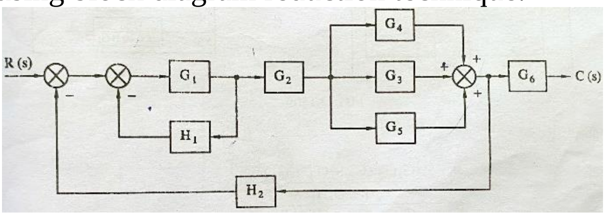

Figure 1

Q.2	**(a)**	Explain Steady state error.	**03**
	(b)	Explain about the time constant of first order system.	**04**
	(c)	Find K_p, Kv, K_a as well as steady state error for a system with open loop transfer function as G(S) H(S) = (10 (S+2) (S+3)) / (S (S+1) (S+5) (S+4)). Where input r(t) = 3+t+t^2.	**07**
		OR	
	(c)	List all the rules to construct a root locus and explain.	**07**
Q.3	**(a)**	State the advantages and limitation of frequency response analysis.	**03**
	(b)	For a second order system with unity feedback G(S) = 200/ S (S+8) response specification.	**04**
	(c)	For the unity feedback control system G(S) = 10 / S (S+1) (S+5). Sketch the bode plot. Determine the gain and phase margin. If the margin is increased to 150 %, what is the new gain margin and phase margin.	**07**
		OR	
Q.3	**(a)**	Write a brief note on polar plots with sketch of simple example.	**03**
	(b)	Sketch the polar plot for the given transfer function. G(s) = 10/ S+1	**04**
	(c)	Determine the stability of equation using roots criterion $S^3 + 6S^2 + 11S + 6 = 0$.	**07**
Q.4	**(a)**	Explain Nyquist stability criterion.	**03**
	(b)	Draw the Nyquist plot for the close loop transfer function. G(S) H(S) = 10 / (S+1) (S+2)	**04**
	(c)	Explain the derivative control mode. State it’s characteristics.	**07**

OR

Q.4	**(a)**	Write a note on PID controller.	**03**
	(b)	Explain the Integral control mode and state it's characteristics.	**04**
	(c)	Draw the Nyquist plot for the close loop transfer function G(S) H(S) = 10 / S (S+1)	**07**
Q.5	**(a)**	What is compensation? Which is the various compensation scheme used in practice.	**03**
	(b)	Explain the design in frequency domain of load compensation.	**04**
	(c)	Obtain the state variable equation.	**07**

OR

Q.5	**(a)**	Obtain the state variable equation X = Ax + Bu and Y = Cx + Du. Also draw the state diagram.	**03**
	(b)	Define and explain following term w.r.t. frequency response. I. Gain margin II. Phase margin III. Gain cross over frequency IV. Phase cross over frequency	**04**
	(c)	Sketch the root locus of a unity feed back control system with G(S) = K / S (S+1) (S+3) and determine the value of K for marginal stability.	**07**

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