Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III EXAMINATION – WINTER 2025

Subject Code:3131101 Date:12-12-2025

Subject Name: Control Systems

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

			Marks
Q.1	**(a)**	Explain standard test signals.	**03**
	(b)	Compare time response and frequency response of system.	**04**
	(c)	Explain any 7 rules of block diagram reduction technique.	**07**
Q.2	**(a)**	Write advantages of state space approach over classical methods.	**03**
	(b)	Discuss the effect of adding a pole to a closed loop transfer function.	**04**
	(c)	Explain Mason's Gain Formula with suitable example	**07**
		OR	
	(c)	Write a short note on state space representation of a control system.	**07**
Q.3	**(a)**	Explain in brief about PID controller.	**03**
	(b)	Discuss force voltage (F-V) analogous system with analogous quantity.	**04**
	(c)	Explain the steps of root locus	**07**
		OR	
Q.3	**(a)**	Explain in brief about PD controller.	**03**
	(b)	Discuss force current (F-I) analogous system with analogous quantity.	**04**
	(c)	Explain nature of Bode plot for i) Poles at the origin ii) Zeros at the origin.	**07**
Q.4	**(a)**	Find Laplace transform of x(t) = cos2t	**03**
	(b)	Explain, how the gain and phase margin are obtained from Nyquist plots?	**04**
	(c)	Explain Phase-Lag compensator in detail.	**07**
		OR	
Q.4	**(a)**	Find Laplace transform of x(t) = sin2t	**03**
	(b)	Explain polar plot with suitable example.	**04**
	(c)	Explain Phase-Lead compensator in detail.	**07**
Q.5	**(a)**	Define: State, State variable, State trajectory.	**03**
	(b)	Define steady state error and obtain its formula	**04**
	(c)	Discuss unit step response of first order system.	**07**
		OR	
Q.5	**(a)**	Define i) Gain Margin ii) Frequency response iii) Phase Margin	**03**
	(b)	Obtain equation of peak time for a second order control system when subjected to unit step input.	**04**
	(c)	Discuss impulse response of second order system.	**07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III (NEW) EXAMINATION – WINTER 2024

Subject Code: 3131101 **Date: 26-11-2024**

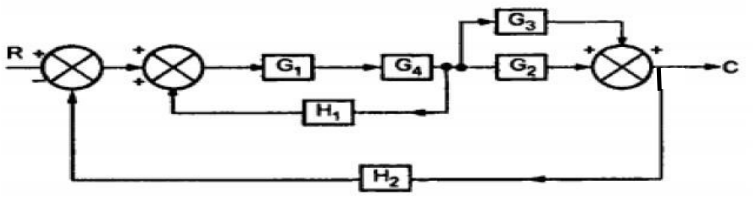
Subject Name: Control Systems

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

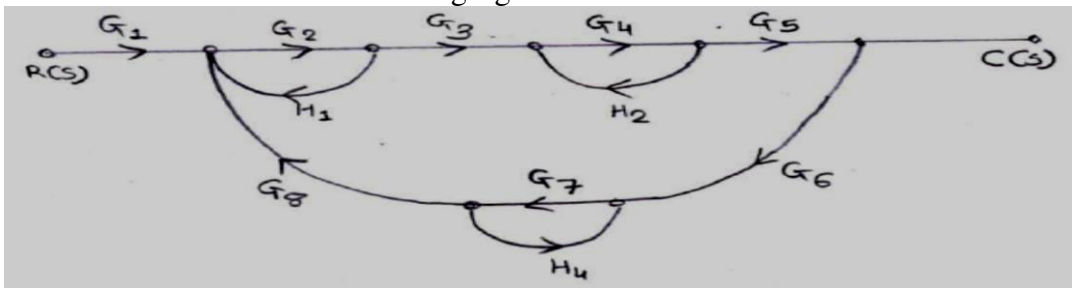
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Define standard test signals.	**03**
	(b)	Determine the transfer function for the following system.	**04**



	(c)	Compare open loop control system and closed loop control system with suitable examples.	**07**
Q.2	**(a)**	State advantages and limitations of Routh stability criterion.	**03**
	(b)	Discuss Nyquist criteria for stability.	**04**
	(c)	Derive the expression of a second order control system subjected to unit step signal.	**07**
		OR	
	(c)	Derive the expression of a first order control system subjected to unit step signal.	**07**
Q.3	**(a)**	Discuss the effect of feedback on stability.	**03**
	(b)	Compare time response and phase response of the system.	**04**
	(c)	Derive the expressions for the error coefficients k_p , k_v and k_a corresponding to step, ramp and parabolic input respectively.	**07**
		OR	
Q.3	**(a)**	Discuss the effect of feedback on time constant.	**03**
	(b)	Obtain the expression of steady state error.	**04**
	(c)	Find the transfer function of the following fig.	**07**



Q.4	**(a)**	Define i) Rise time ii) Peak time iii) Settling time	**03**
	(b)	Explain Force Voltage analogy.	**04**
	(c)	Sketch the complete root locus of system having $G(s)\,H(s) = \frac{K}{S(S+1)(S+3)}$	**07**

OR

Q.4	**(a)**	Define i) Gain Margin ii) Frequency response iii) Phase Margin	**03**
	(b)	Explain Force Current analogy.	**04**
	(c)	State root locus techniques rules.	**07**
Q.5	**(a)**	What is transfer function? Discuss its properties.	**03**
	(b)	Explain polar plot with example	**04**
	(c)	State and explain compensator. Explain Phase-Lead compensator in detail.	**07**

OR

Q.5	**(a)**	Discuss briefly PID controller.	**03**
	(b)	Explain steps of bode plot.	**04**
	(c)	Write a short note on state space representation of a control system.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3131101 Date:16-01-2024

Subject Name:Control Systems

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

			MARKS
Q.1	**(a)**	Define: Transfer function, Self loop, Steady-state error.	**03**
	(b)	Compare block-diagram and signal flow graph method.	**04**
	(c)	Explain rules for block-diagram reduction technique.	**07**
Q.2	**(a)**	Discuss Nyquist criteria for stability.	**03**
	(b)	Derive the expressions for error constants $\mathbf{K}_p$, $\mathbf{K}_v$ and $\mathbf{K}_a$ corresponding to step, ramp and parabolic input respectively.	**04**
	(c)	Reduce the given block-diagram of figure.1 to its simple form and hence obtain the equivalent transfer function $\frac{C(s)}{R(s)}$.	**07**

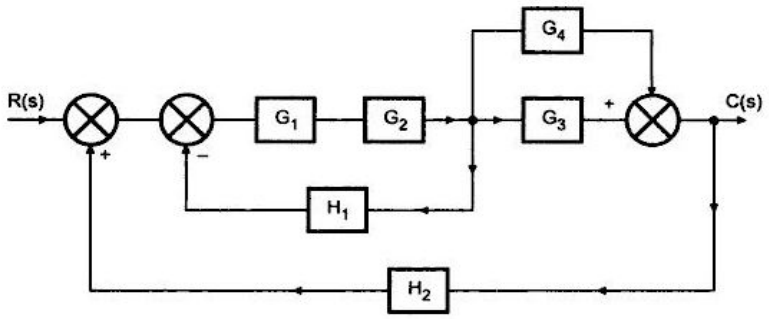

Figure.1

OR

	(c)	Derive expressions of (i) Rise time, t_r (ii) Peak time, t_p and (ii) Peak overshoot, M_p for a second order control system subjected to a unit step input.	**07**
Q.3	**(a)**	Explain: Frequency response, Root locus, Centroid.	**03**
	(b)	Write short note on PID controller.	**04**
	(c)	Obtain the transfer function $\frac{Y(s)}{X(s)}$ of the signal flow graph shown in figure 2.	**07**

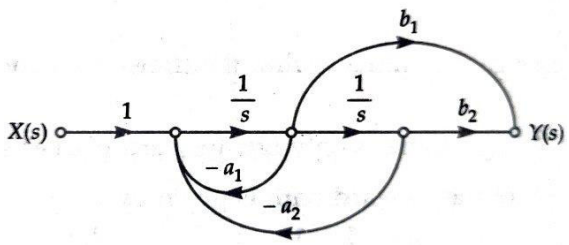

Figure.2

OR

Q.3 **(a)** What is polar plot? **03**

(b) Conclude Usefulness of analogues system and explain Force (Torque)- Voltage Analogy. **04**

(c) Determine the stability of a system having the characteristic equation **07**
$s^6+5s^5+11s^4+25s^3+36s^2+30s+36=0$.

Q.4 **(a)** Derive an expression for the rise time for a 2nd order control system subjected to a unit step input. **03**

(b) List properties of M-circles. **04**

(c) Explain rules for construction of root locus. **07**

OR

Q.4 **(a)** Discuss Nyquist stability criterion. **03**

(b) Write a short note on state space representation of a control system. **04**

(c) The open-loop transfer function of a system is given by **07**
$G(s)\,H(s) = \frac{K(s+12)}{s^2(s+20)}$.
Sketch the root loci for the system when K is varied from 0 to ∞.

Q.5 **(a)** Define: (i) State (ii) State Variable (iii) State Vector. **03**

(b) Define the following terms **04**
1) Gain cross over frequency
2) Phase cross over frequency
3) Gain Margin
4) Phase Margin

(c) Sketch the Nyquist plot for the open-loop transfer function **07**
$G(s)\,H(s) = \frac{10}{(s+2)(s+4)}$.
Determine the stability of the closed-loop system by Nyquist criterion.

OR

Q.5 **(a)** Explain standard test signals. **03**

(b) List Advantages of State variable analysis. **04**

(c) Derive the state variable equation $X=AX+BU$ and $Y=CX+DU$. Also draw the block diagram. **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III(NEW) EXAMINATION – WINTER 2022

Subject Code:3131101 Date:22-02-2023

Subject Name:Control Systems

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)**	Compare closed loop and open loop system.	**03**
	(b)	Discuss Force-Current (F-I) analogous system with analogous quantity.	**04**
	(c)	Define steady state error and derive the expressions for static error coefficients corresponding to step, ramp and parabolic inputs respectively.	**07**
Q.2	**(a)**	List properties of the transfer function.	**03**
	(b)	Discuss unit step response of first order system.	**04**
	(c)	Draw the Nyquist plot for $G(s) = 1/s(s+1)$ and comment on system stability.	**07**
		OR	
	(c)	For the signal flow graph shown in Fig. 1, using Mason's gain formula determine the overall transmission C/R.	**07**
Q.3	**(a)**	What is polar plot?	**03**
	(b)	Using Routh's criterion check the stability of a system whose characteristic equation is given by $s^5 + 2s^4 + 2s^3 + 4s^2 + 11s + 10 = 0$	**04**
	(c)	Obtain the state transition matrix for the state model whose system matrix is given by A=[1 1;0 1].	**07**
		OR	
Q.3	**(a)**	Describe in brief about PD controller.	**03**
	(b)	List advantages of state variable analysis.	**04**
	(c)	Draw the bode plot for a unity feedback system having, $G(s) = \frac{100}{s(1+0.5s)(1+0.1s)}$	**07**
Q.4	**(a)**	Discuss following transient response specification: Delay Time, Peak overshoot, Settling Time	**03**
	(b)	Describe critical rules of block diagram reduction techniques.	**04**
	(c)	What is Root locus? Sketch the Root locus plot for the unity feedback system having open loop transfer function, $G(s) = \frac{K}{s(s+3)(s^2+3s+4.5)}$	**07**
		OR	
Q.4	**(a)**	Define: Gain margin, phase margin, absolute stability	**03**
	(b)	Describe any four block diagram reduction techniques.	**04**
	(c)	Discuss steps to design a Lag Compensator using Bode plot method.	**07**
Q.5	**(a)**	Write a note on PID controller.	**03**
	(b)	Derive the expression for peak time Tp for a second order control system subjected to a unit step input.	**04**
	(c)	Write a short note on state space representation of a control system.	**07**

OR

Q.5 **(a)** Discuss the effect of feedback on sensitivity. **03**

(b) Explain the Lead Compensator with its transfer function. **04**

(c) Derive the state variable equation $\dot{X} = AX + BU$ and $Y = CX + DU$. Also draw the state diagram **07**

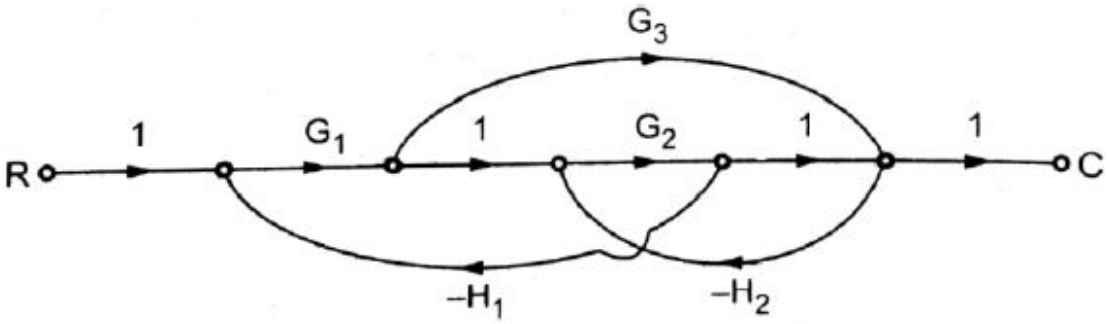

Fig. 1

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