Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3131101 **Date:19-07-2024**

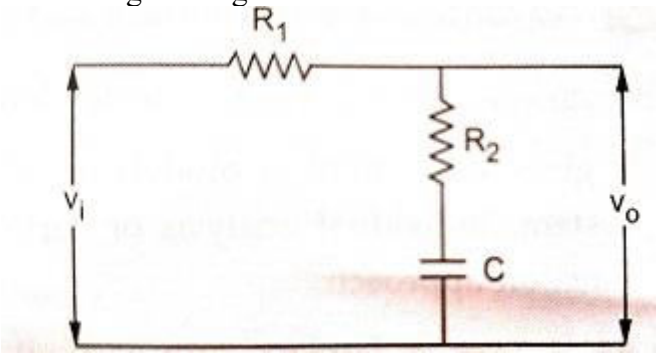
Subject Name: Control Systems

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: (1) System (2) Output (3) Input	**03**
	(b)	Compare open loop and closed loop system.	**04**
	(c)	What is transfer function? Define Pole, Zero, Gain and Characteristic equation with examples.	**07**
Q.2	**(a)**	List properties of Laplace Transform.	**03**
	(b)	Find Laplace transform of sin (wt)	**04**
	(c)	Determine the Transfer function Vo (s) /Vi (s) of the electrical system shown in given Figure.	**07**



OR

	(c)	Discuss rules for block diagram reduction with example	**07**
Q.3	**(a)**	Define: (1) State (2) State variable (3) State vector	**03**
	(b)	Discuss various standard inputs used in the control system analysis.	**04**
	(c)	Explain the mathematical modelling of fundamentals components of mechanical rotational system.	**07**

OR

Q.3	**(a)**	Define Type and order of the system	**03**
	(b)	Derive the expression for static error coefficients.	**04**
	(c)	What is force voltage analogous system? Which are analogous quantities according to this method?	**07**
Q.4	**(a)**	Define: (1) Undamped system (2) Damped frequency of oscillation (3) Natural frequency of oscillation	**03**
	(b)	Analyze necessary conditions for Hurwitz's criterion.	**04**
	(c)	Sketch the root locus of the system whose open loop transfer function is G(s) = K / s (s+2) (s+4). Find the value of K so that the damping ratio of the closed loop system is 0.5.	**07**

OR

Q.4	**(a)**	Define: (1) Peak overshoot (2) Settling time (2) Delay time	**03**
	(b)	Analyze Routh's stability criterion.	**04**
	(c)	Discuss general steps to solve the problem on root locus.	**07**

Q.5	**(a)**	Define: (1) Conditional stable system (2) Unstable system (3) Marginally stable system	**03**
	(b)	Discuss steps to sketch the bode plot.	**04**
	(c)	Explain the following controllers (1) P controller (2) PI controller (3) PID controller	**07**

OR

Q.5	**(a)**	Define: (1) Gain margin (2) Phase margin (3) cut-off frequency	**03**
	(b)	Consider a system with open loop transfer function as G(s)H(s) = 10 / s, obtain its polar plot.	**04**
	(c)	A unity feedback control system has G(s) = 80 / s (s+2) (s+20). Draw the bode plot.	**07**

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Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - III EXAMINATION - SUMMER 2025

Subject Code: 3131101 **Date: 29-05-2025**

Subject Name: Control Systems

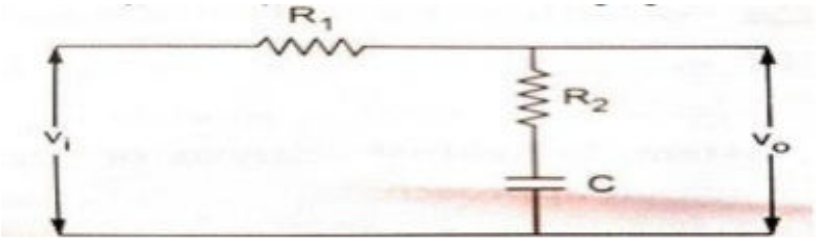
Time: 02:30 PM TO 05:00 PM **Total Marks: 70**

Instructions

1. Attempt all questions.

2. Make suitable assumptions wherever necessary.

3. Figures to the right indicate full marks.

			Marks
Q.1	**(a)**	Define i) Settling time ii) Peak time iii) Peak Overshoot	**03**
	(b)	Explain Force Voltage analogy.	**04**
	(c)	Derive the expression of a second order control system subjected to unit step signal.	**07**
Q.2	**(a)**	State advantages and limitations of Routh stability criterion.	**03**
	(b)	Explain the steps of Bode plot.	**04**
	(c)	State root locus technique rules.	**07**
		OR	
	(c)	Sketch the complete root locus of system having unity feedback and $G(S) = \frac{K}{S(S+2)(S+4)}$	**07**
Q.3	**(a)**	Explain standard test signals.	**03**
	(b)	Find laplace transform of x(t) = cosh (4t)	**04**
	(c)	Explain the following controllers (!) PID controller (2) P controller (3) PI controller	**07**
		OR	
	(a)	Define i) State vector ii) Delay time iii) Rise time	**03**
	(b)	Write properties of transfer function.	**04**
	(c)	Find the transfer function of the following fig. 	**07**
Q.4	**(a)**	Define i) Marginally stable state ii) Conditional stable state iii) Unstable state.	**03**
	(b)	Explain Nyquist Stability Criteria.	**04**

	(c)	Obtain the expression of steady state error. Also, find the equations for static error coefficients.	**07**

OR

	(a)	Write advantages of state space approach over classical methods.	**03**
	(b)	Explain polar plot with suitable example.	**04**
	(c)	Write all the rules of Block Diagram Reduction technique.	**07**
Q.5	**(a)**	Define i) Gain Margin ii) Frequency response iii) Phase Margin	**03**
	(b)	Explain Mason's Gain Formula.	**04**
	(c)	State and explain compensator. Explain Phase-Lag compensator in detail.	**07**

OR

	(a)	Compare open loop and closed loop control systems.	**03**
	(b)	Explain gain crossover frequency and phase crossover frequency.	**04**
	(c)	Explain Phase-Lead compensator in detail.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3131101 Date:26-07-2023

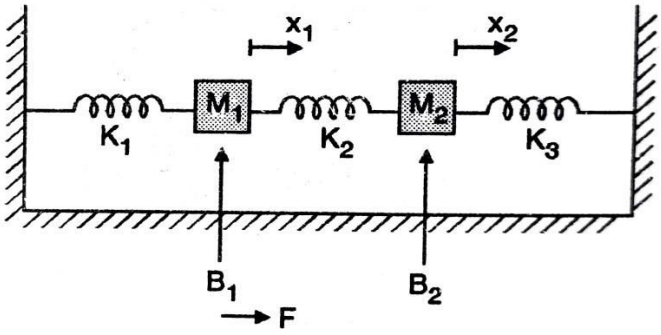
Subject Name:Control Systems

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)**	Explain Close Loop System with Block diagram & Example.	**03**
	(b)	Discuss Force-Current (F-I) analogous system with analogous quantity.	**04**
	(c)	Define: Transfer function, Loop Gain, Steady-state error, Path Gain	**07**
Q.2	**(a)**	Discuss following terms with respect to Frequency response analysis. (i) Resonant Peak (ii) Resonant Frequency (iii) Bandwidth	**03**
	(b)	Explain standard test signals.	**04**
	(c)	Discuss Unit-step time response of Second-order systems for $\xi > 0$.	**07**
		OR	
	(c)	Consider a system represented by the following equations. Draw the Signal Flow Diagram of the system. $X_1 = 6X_0 + 3X_2$, $X_2 = 12X_1 + 5X_2 + 2X_3$ $X_3 = 2X_2 + 3X_4$, $X_4 = 11X_3$	**07**
Q.3	**(a)**	List properties of M-circles.	**03**
	(b)	Explain the Stable, Marginally stable and Unstable systems with diagram.	**04**
	(c)	Explain rules for block-diagram reduction technique.	**07**
		OR	
Q.3	**(a)**	What is polar plot? Explain in brief.	**03**
	(b)	Derive the expressions for error constants K_p , K_v & K_a corresponding to step, ramp and parabolic input respectively.	**04**
	(c)	System-1 has transfer function $G_1(s) = \frac{30}{4s^2+3s+6}$ and System-2 has transfer function $G_2(s) = \frac{2}{s+4}$. Find Cascade and parallel transfer function for system 1 and system 2.	**07**
Q.4	**(a)**	Explain: Root locus And Centroid	**03**
	(b)	Explain the frequency response, state its application with possible limitations.	**04**
	(c)	Discuss Lag compensator. Obtain the transfer function of a Lag Compensator.	**07**
		OR	
Q.4	**(a)**	Describe Correlation between transfer function and state space equations.	**03**
	(b)	Discuss Nyquist stability criterion.	**04**
	(c)	Draw the equivalent mechanical system of the system shown in the figure Write the set of equilibrium equation for it and obtain electrical analogous circuit using F-V Analogy.	**07**



Q.5	**(a)**	Explain concept of Relative stability.	**03**
	(b)	Write a short note on state space representation of a control system.	**04**
	(c)	Obtain the Root-locus plot for the unity feedback system with transfer function. $G(s) = \frac{k}{s\,(s+2)}$	**07**

OR

Q.5	**(a)**	Define: State & State Vector	**03**
	(b)	Write short note on PID controller.	**04**
	(c)	By Hurwitz, find stability of $s^4 + 8s^3 + 18s^2 + 16s + 5 = 0$	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3131101 **Date:13-07-2022**

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)**	What is feedback? Explain the effect of feedback.	**03**
	(b)	Define: Transfer function, Self loop, Steady-state error	**04**
	(c)	What is control system? What are the different types of control systems? Compare open-loop and closed-loop control system.	**07**
Q.2	**(a)**	List properties of the Transfer Function.	**03**
	(b)	Compare Block diagram and Signal flow graph methods.	**04**
	(c)	What is an analogous system? Establish force-current and force-voltage analogy.	**07**
		OR	
	(c)	Obtain Transfer function of the mechanical system shown in figure 1.	**07**

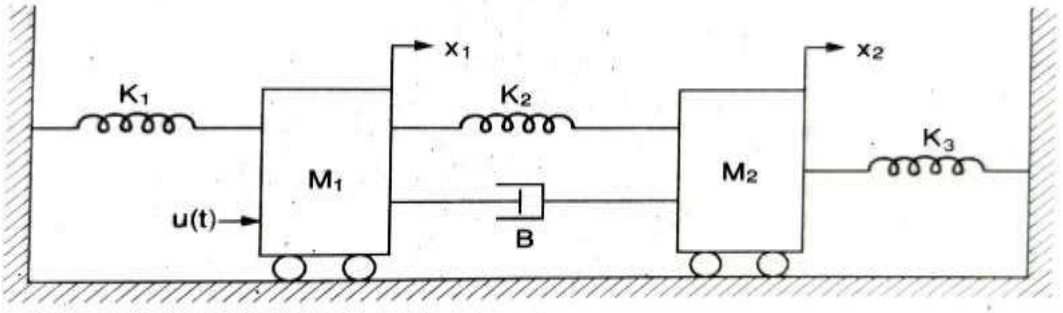

Figure 1.

Q.3	**(a)**	Explain: Frequency response, Root locus, Centroid.	**03**
	(b)	Discuss standard Test signals used in control system.	**04**
	(c)	Derive the closed loop transfer function using block diagram reduction technique for the figure 2.	**07**

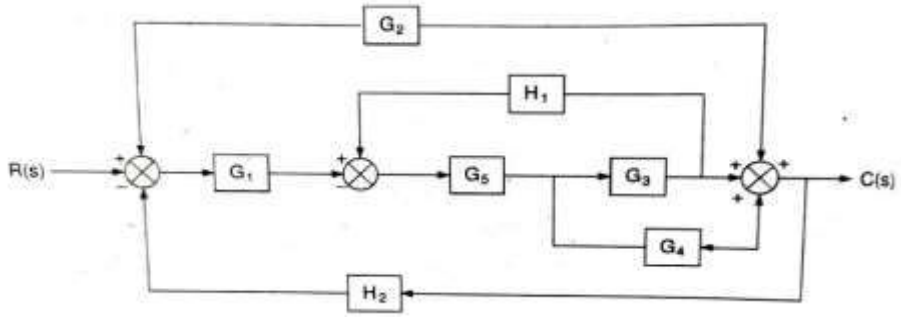

Figure 2.

OR

Q.3	**(a)**	Discuss Hurwitz's stability criteria.	**03**
	(b)	Define: (1) Delay time (2) Rise time (3) Peak time (4) Settling time	**04**

(c) Obtain the transfer function C/R of the block diagram shown in figure 3. Using Mason's gain formula. **07**

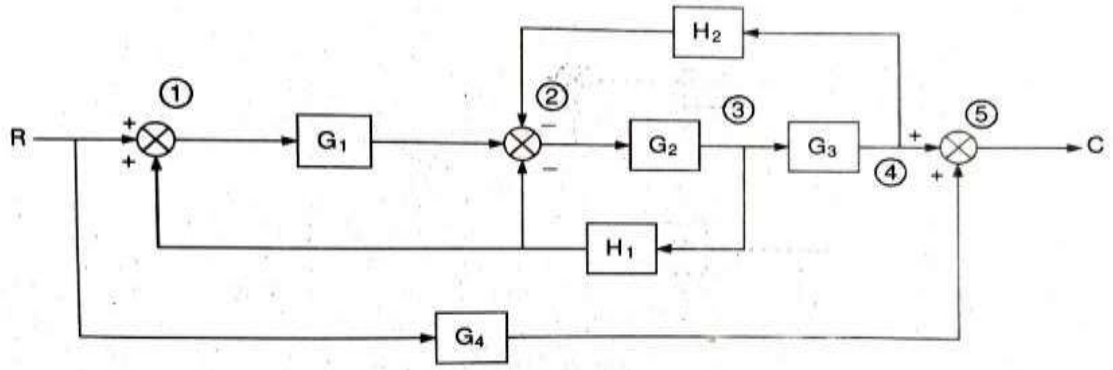

Figure 3.

Q.4 **(a)** Explain: Gain margin, Phase margin, Polar plot. **03**

(b) Apply Routh-Hurwitz criterian to determine stability of a control system whose open-loop transfer function is given below. **04**

$$G(s)H(s) = \frac{5}{s(s^2 + 2Ks + K + 4)}$$

(c) For the given type-2 system, find root locus and comment on stability. **07**

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

OR

Q.4 **(a)** Explain: State, State variable, state trajectory. **03**

(b) Write short note on PID controller. **04**

(c) For the given type-2 system, Draw the polar plot. **07**

$$G(s) = \frac{40}{(s^2)(s+4)}$$

Q.5 **(a)** Derive an expression for the rise time for a 2nd order control system subjected to a unit step input. **03**

(b) Derive the expression for peak time Tp for a second order control system subjected to a unit step input. **04**

(c) State and explain nyquist stability criteria. **07**

OR

Q.5 **(a)** Derive Correlation Between Transfer Functions and State-Space Equations. **03**

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

(c) For the given open-loop unstable system with transfer function **07**

$$G(s)H(s) = \frac{s+2}{(s^2 - 1)}$$

Draw Nyquist contour and plot.

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