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**

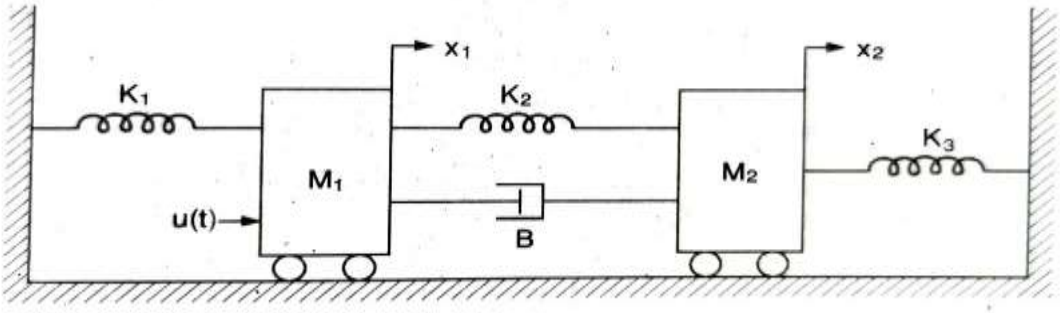

Figure 1.

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**

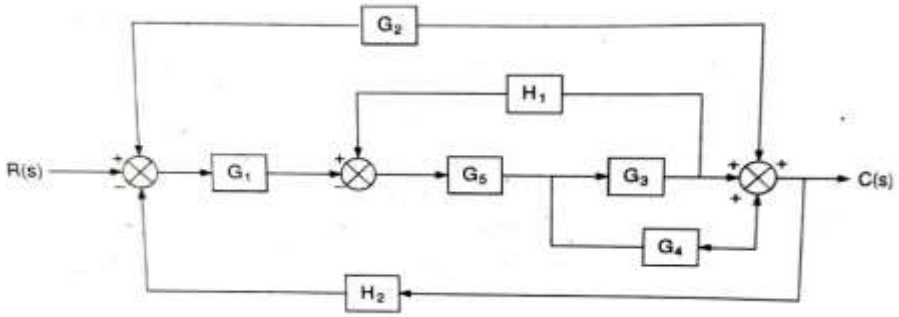

Figure 2.

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**

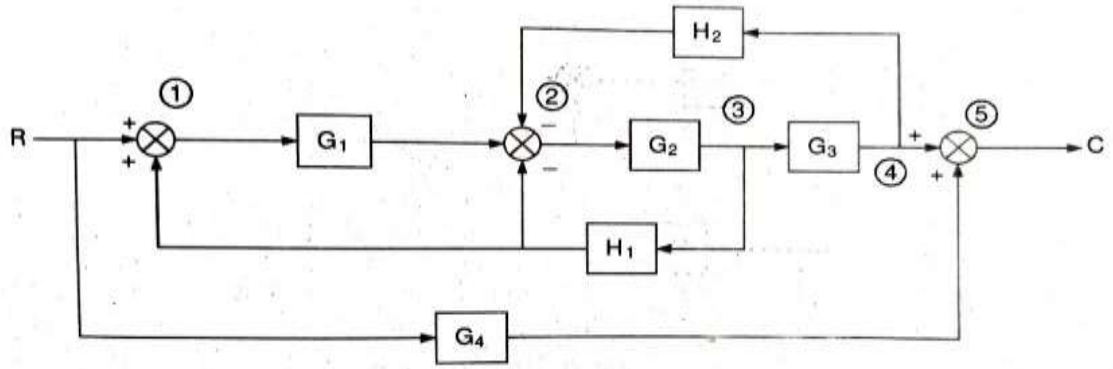

Figure 3.

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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