GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–III (NEW) EXAMINATION – WINTER 2024

Subject Code:3130905   **Date:10-12-2024**
Subject Name: Control System Theory
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.**

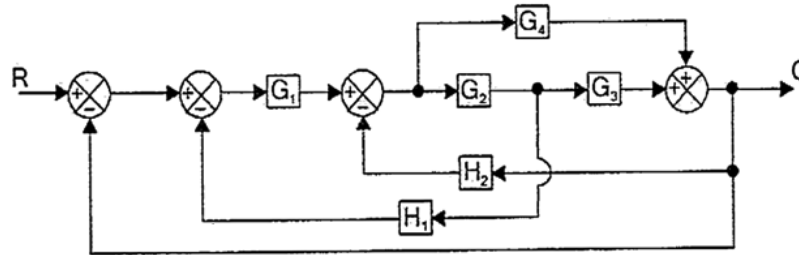|			MARKS
Q.1	**(a)**	What is control system? Give classifications of control systems.	**03**
	(b)	What are the components of feedback control system?	**04**
	(c)	Determine the transfer function of the system shown in figure 1 below by using block diagram reduction technique.	**07**

Figure-1

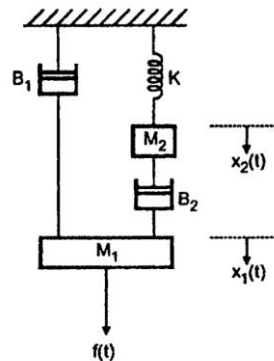|			
Q.2	**(a)**	Distinguish between type and order of the system.	**03**
	(b)	Explain the time constant of the first-order system.	**04**
	(c)	Determine the transfer function for the given mechanical system shown in figure 2 and draw equivalent electrical circuit for F-V and F-I analogy.	**07**

Figure-2
OR

	(c)	Explain Type 0, Type 1 and Type 2 control system. Derive equation for the steady state error of the Type 2 control system for step, ramp and parabolic input.	**07**

Q.3	**(a)**	Explain Standard Test Signals used in control system.	**03**
	(b)	For the system $s^4+22s^3+10s^2+s+K$, find K_{marg} and ω_{marg}.	**04**

	(c)	With neat sketch explain all the time response specifications.	07

<div align="center">OR</div>

Q.3	(a)	Explain Gain margin and Phase margin.	03
	(b)	Draw the polar plot of	04

$$G(s) = \frac{1}{1 + sT}$$

	(c)	State and explain Nyquist stability criteria.	07

Q.4	(a)	Define compensation. List out different types of compensations.	03
	(b)	List the advantages and disadvantages of phase lag network.	04
	(c)	Draw the root locus for the transfer function given by	07
		G(s)=K/(s(s²+4s+20))	

<div align="center">OR</div>

Q.4	(a)	What is the significance of integral controller and derivative controller in a PID controller?	03
	(b)	What is the effect of PI controller on the system performance?	04
	(c)	Explain the design of lead compensator using bode plot.	07

Q.5	(a)	Define (a) state variable (b) state vector (c) state space	03
	(b)	Define the state transition matrix's properties.	04
	(c)	Check controllability and observability for the system described by	07

$$x = \begin{bmatrix} 0 & 6 & -5 \\ 1 & 0 & 2 \\ 3 & 2 & 4 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 2 & 3 \end{bmatrix} x$$

<div align="center">OR</div>

Q.5	(a)	What are the advantages of state space representation?	03
	(b)	Explain the concepts of controllability and observability.	04
	(c)	Draw a series RLC circuit. Obtain its state space model considering current and capacitor voltage as state variables.	07

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