GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–III EXAMINATION – SUMMER 2025

Subject Code:3130905   **Date:06-06-2025**

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 the following terms. 1. Transfer function 2. Summing point 3. Take off point.	03
	(b)	Compare open loop and closed loop control systems.	04
	(c)	Explain block diagram reduction technique rules to find overall transfer function of control system.	07
Q.2	**(a)**	Define the standard test signals.	03
	(b)	Write advantages and features of transfer function.	04
	(c)	Determine the transfer function for given mechanical system shown in fig.1 and draw equivalent electrical circuit for F-V analogy.	07
		OR	
	(c)	Derive the transfer function of an armature-controlled D.C. motor.	07
Q.3	**(a)**	Define the following time response specifications. 1. Delay time 2. Rise time 3. Settling time	03
	(b)	Determine the stability of control system having following characteristic equation using R-H Criterion. $S^5+S^4+2S^3+2S^2+3S+5=0$	04
	(c)	Explain the analysis of first order system.	07
		OR	
Q.3	**(a)**	State the advantages of Nyquist plot.	03
	(b)	Sketch the polar plot for the transfer function G(S)= 5/(S+1) (S+2)	04
	(c)	Construct the bode plot for the given transfer function and determine the gain margin, phase margin and closed loop stability. G(S)H(S)= 4$/$S (1+0.5S) (1+ 0.08S)	07
Q.4	**(a)**	Draw the circuit of lead compensator and lag compensator.	03
	(b)	Explain about derivative control mode.	04
	(c)	Draw and explain the operation of electronic PID controller.	07
		OR	
Q.4	**(a)**	State the various compensation networks and different methods of compensation.	03
	(b)	Draw and explain polar plot of lag-lead network.	04
	(c)	Explain the design of Lag-Lead compensator using Root Locus.	07
Q.5	**(a)**	Write the properties of state transition matrix.	03
	(b)	State the advantages and limitations of state model using phase variables.	04
	(c)	Obtain the state space representation of given electrical circuit shown in fig.2	07
		OR	
Q.5	**(a)**	Define the terms: 1. Sate Variables 2. State Space 3. State Vector	03

(b) Find the controllability and Observability of the system described by the state   **04**
equation:

$$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} = \begin{bmatrix} 3 & 0 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$$

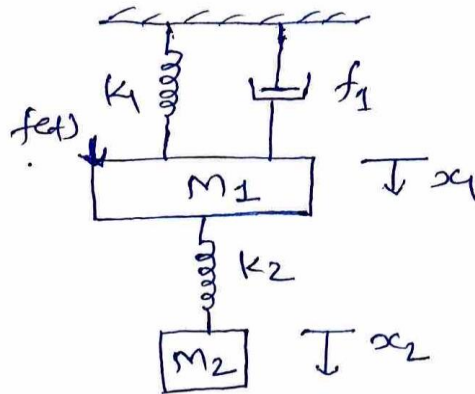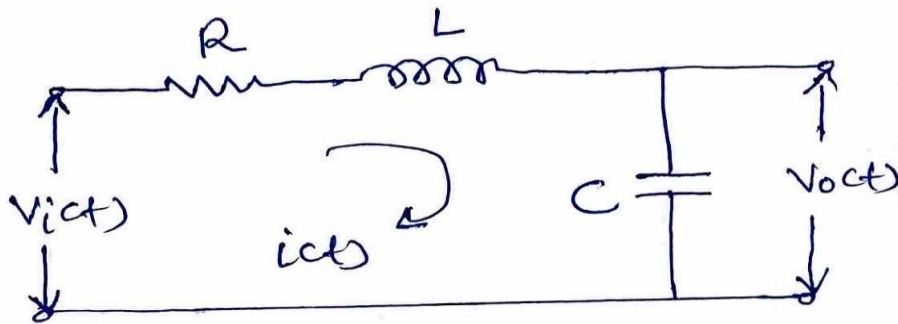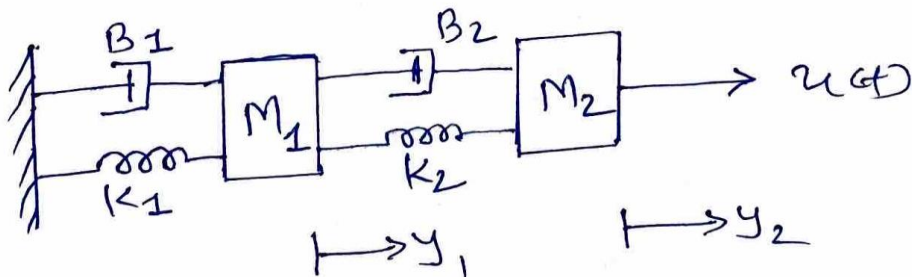**(c)** Obtain the state model of given mechanical model shown in fig.3   **07**

Fig. 1

Fig : 2

Fig : 3

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