U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Cluster (EEE/EIE/ECE/ETE) **Duration: 3 hrs.**
Course Code: 19ES4ESCST **Max Marks: 100**
Course: Control Systems

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT – I	CO	PO	Marks
1	a)	Define transfer function of a system. List the differences between open and close loop control system.	*CO1*	*PO1*	**08**
	b)	For the mechanical rotational system shown in Fig. 1 (b), obtain (i) Differential equations, (ii) T–V analogous circuit and (iii) T–I analogous circuit.	*CO2*	*PO2*	**12**

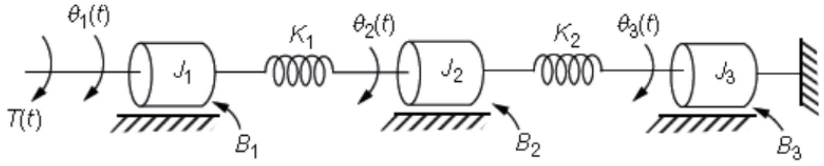


Fig 1b

OR

2	a)	Draw the F-V & F-I analogous circuits for the given mechanical system shown Fig.2a and starting from the basics write the equations for both systems.	*CO2*	*PO2*	**12**

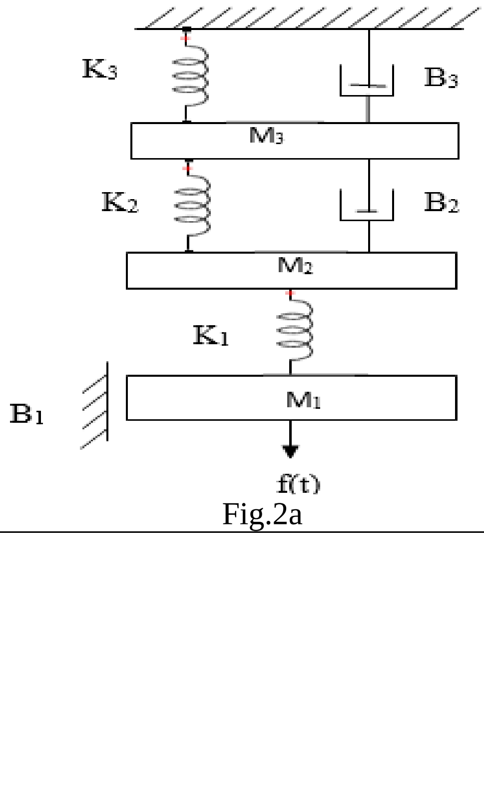
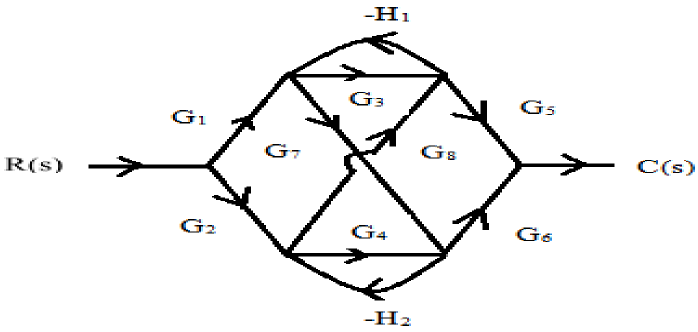
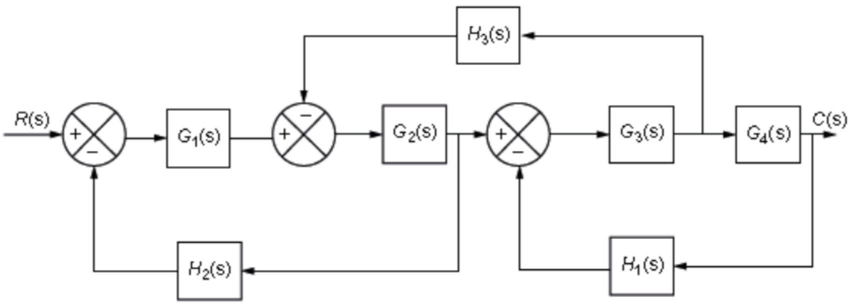
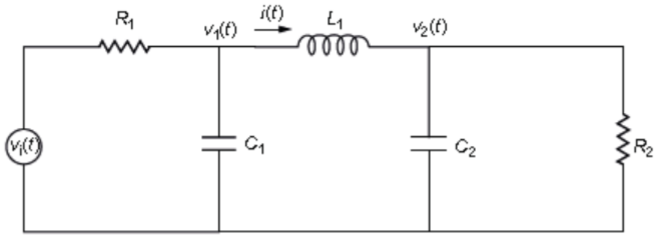


Fig.2a

Q.No		Question	CO	PO	Marks
	b)	Using Mason's gain formula, obtain the transfer function for the given Fig.2b  Fig.2b	CO2	PO2	08
		UNIT - II			
3	a)	The block diagram of the system is shown in Fig. 3a. Determine the transfer function for the system using block diagram reduction technique.  Fig. 3a	CO2	PO2	10
3	b)	Define any three time domain specifications with a neat diagram indicating the response of a second order system subjected to a unit step input.	CO2	PO2	10
4		OR			
	a)	For the unity negative feedback system with forward path gain $G(S) = \frac{50}{S(S+5)}$, find i) Percentage overshoot for a unit – step input ii) Setting time for a unit step input and iii) Steady state error for an input defined by the polynomial $r(t) = 2+4t+6t^2$, $t \geq 0$	CO2	PO2	10
	b)	The open loop transfer function of a feedback control system is given by $G(S)H(S) = \frac{K}{S(S+4)(S^2+2S+2)}$, Find the stability of the system when K=12 and find the range of the value of K for stability.	CO2	PO2	10

			UNIT - III			
	5	a)	The characteristic equation of a feedback system is given as i) $F(s) = s^4 + 12s^3 + 69s^2 + 198s + (200 + k) = 0$ ii) $F(s) = s^5 + 6s^4 + 15s^3 + 30s^2 + 44s + 24 = 0$ Examine the range of values of gain K, using Routh's table for the system to be stable	*CO*3	*PO4*	**10**
		b)	Sketch the root locus of the system whose loop transfer function is given by $G(s)H(s) = \frac{K(s+a)}{s(s^2+2s+2)}$, $a = -4$. Comment on the stability of the system	*CO*3	*PO4*	**10**
	6		**OR**			
		a)	A unity feedback control system is characterized by open loop transfer function $$G(s) = \frac{K(s+13)}{s(s+3)(s+7)}$$ Using Routh criterion, Calculate the range of values of K for the system to be stable.	*CO*3	*PO4*	**10**
		b)	The Transfer function of a unity feedback system is given by $$G(s) = \frac{K}{s(s+4)(s+5)}$$ Sketch the root locus as K varies from zero to infinity. Comment on stability.	*CO*3	*PO4*	**10**
			UNIT – IV			
	7	a)	Define Gain Crossover Frequency, Phase Crossover Frequency, Phase Margin and Gain Margin.	*CO*3	*PO4*	**06**
		b)	Comment on stability using Nyquist criterion for the system having $G(s)H(s) = \frac{50}{(1+s)(2+s)}$	*CO*3	*PO4*	**08**
		c)	The loop transfer function of a unity feedback system is given by $G(s)H(s) = \frac{8}{(1+s)(2+s)}$. Sketch the polar plot for the system and comment on the stability of the system.	*CO*3	*PO4*	**06**
			OR			
	8	a)	Sketch the Bode plot for the transfer function G(S)= $\frac{10k}{s(1+0.05s)(1+0.1s)}$ .Determine the values of K such that (i)GM=20dB (ii)PM=10°	*CO*3	*PO4*	**12**
		b)	Explain the procedure of Nyquist Plot.	*CO*3	*PO4*	**08**

			UNIT – V			
	9	a)	Determine the state-space model for the electrical system shown in Fig. 7a  Fig. 7a	***CO*3**	***PO4***	**10**
		b)	Find the state equation and output equation for the system given by $$\frac{Y(s)}{U(s)} = \frac{(s^3 + 5s^2 + 6s + 1)}{(s^3 + 4s^2 + 3s + 3)}$$	***CO*3**	***PO4***	**10**
			OR			
	10	a)	A system is described by $$\dot{x} = \begin{bmatrix} -1 & -4 & -1 \\ -1 & -6 & -2 \\ -1 & -2 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u$$ $$y = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} x$$ Find the transfer function	***CO*3**	***PO4***	**10**
		b)	Obtain the transfer function for the state-space representation of a system given by A=[0 1 -1 -4] B=[1 0] C=[1 0] D=[0]	***CO*3**	***PO4***	**10**

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