U.S.N.										

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

Autonomous Institute Affiliated to VTU

January / February 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)	Draw the F-V & F-I analogous circuits for the given mechanical system shown Fig.1a and starting from the basics write the equations for both systems.	***CO*2**	***PO2***	**12**

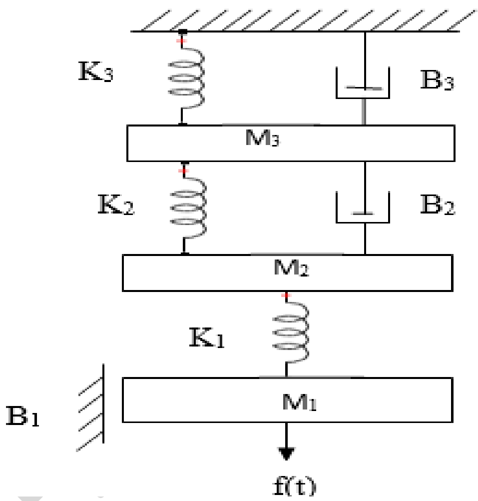


Fig.1a

	b)	Using Mason's gain formula, obtain the transfer function for the given Fig.1b	***CO*2**	***PO2***	**08**

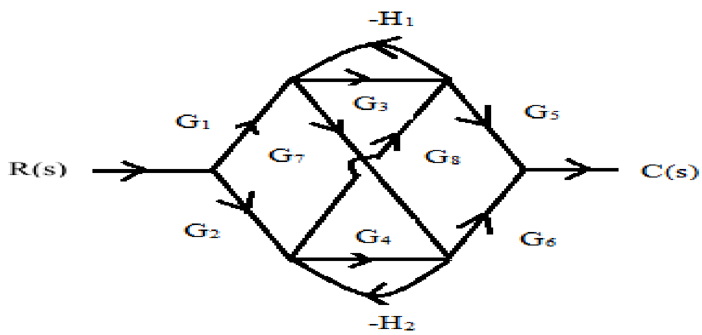
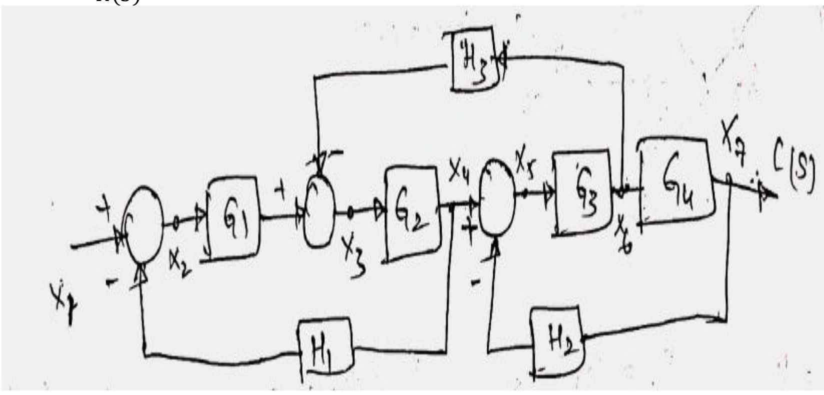
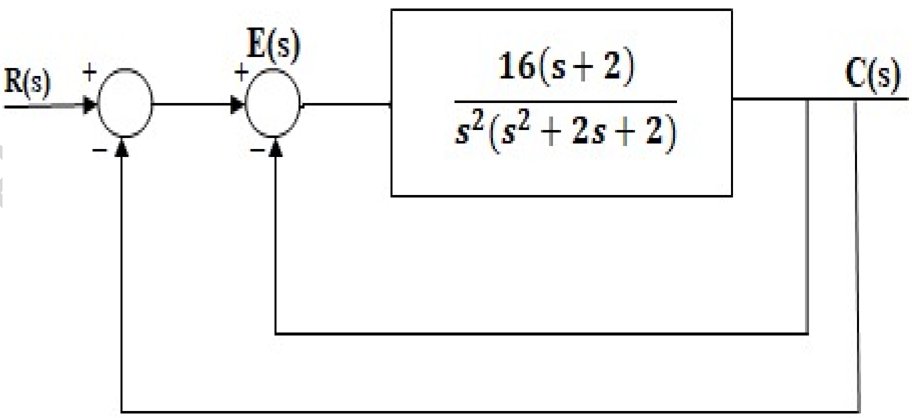
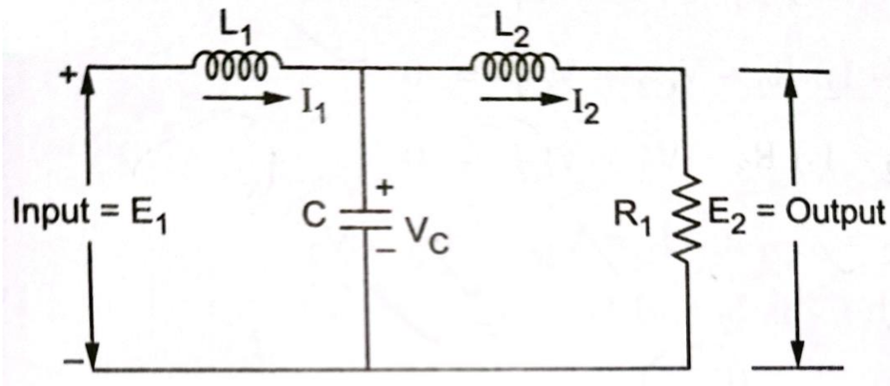
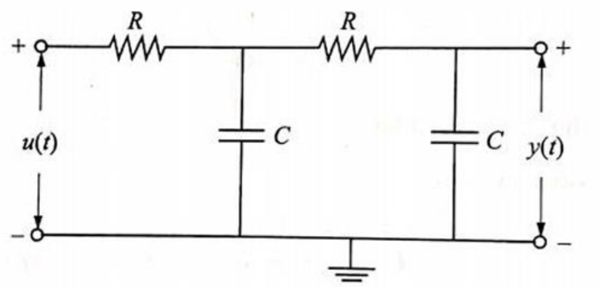


Fig.1b

OR

	2	a)	Draw the Signal Flow Graph for the given block diagram in Fig.2a and hence find $\frac{C(s)}{R(s)}$  Fig.2a	*CO*2	*PO2*	**10**
		b)	Draw the block diagram for the system described by following equations & hence find $\frac{C(S)}{R(S)}$ $E_1 = R(S) - C(S).H_3$; $E_2 = E_1 - E_4.H_1$; $E_3 = E_2.G_1 - C(S).H_2$; $E_4 = E_3.G_2$; $C(S) = E_4.G_3$.	*CO*2	*PO2*	**10**
			UNIT-II			
	3	a)	Starting from the fundamentals, derive an expression for the step response of a typical underdamped second order closed loop control system. Show the typical variation of the response and mark the settling time on a 2% tolerance basis.	*CO*2	*PO2*	**10**
		b)	For the system shown in fig 3b, find **(i)** $\frac{C(S)}{R(S)}$ & type represented by $\frac{C(S)}{E(S)}$ **(ii)** $\frac{C(S)}{R(S)}$ **(iii) K_P, K_V, Ka** **(iv)Steady State Values if r(t)=10 u(t)** .  fig 3b	*CO*2	*PO2*	**10**
			OR			
	4	a)	A second order system is given by $\frac{C(s)}{R(s)} = \frac{25}{s^2+6s+25}$ Find its rise time, peak time, peak overshoot and settling time if subjected to unit step input. Also find expression for its output response.	*CO*2	*PO2*	**10**

		b)	Determine the time response of First order system with ramp input. Draw its response curve. Determine the step, ramp and parabolic error constants of the following unity feedback control system. $G(s) = \frac{100}{(1+0.4s)(1+5s)}$	*CO*2	***PO2***	**10**
			UNIT - III			
	5	a)	Determine the stability of a system with the characteristic equation, (i) $S^4+S^3+6S^2+10S+15=0$. (ii) $S^6+2S^5+8S^4+12S^3+20S^2+16S+16=0$	*CO*3	***PO2***	**08**
		b)	Sketch the complete Root locus diagram for the given transfer function, $G(S)H(S) = \frac{K}{S(S+2)(S+4)}$ from root locus diagram, find the following: (i)Calculate the maximum value of 'K' (ii) when the system is critically damped find 'K'.	*CO*3	***PO4***	**12**
			OR			
	6	a)	Sketch the complete root locus for the following system, comment on stability. $G(s)H(s) = \frac{K(s+5)}{(S^2+4S+20)}$	*CO*3	***PO2***	**08**
		b)	Determine the stability of the characteristic equation $3S^4+10S^3+5S^2+5S+3=0$ Using Routh stability criterion. 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***	**12**
			UNIT - IV			
	7	a)	Sketch the Bode plots and Investigate the stability of a negative feedback control system whose open loop transfer function is given by GH(S)= $\frac{50}{(1+0.5s)(1+0.05s)}$	*CO*3	***PO4***	**12**
		b)	Explain the procedure to plot Nyquist Plot.	*CO*3	***PO4***	**08**
			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 frequency domain specifications.	*CO*3	***PO2***	**08**

			UNIT – V			
9	a)	A linear time invariant system is characterized by the homogeneous state equation: $$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$ Compute the solution of homogeneous equation, assume the initial state vector $x_0 = \begin{bmatrix}1\\ 0\end{bmatrix}$.	***CO***3	***PO2***	**10**
	b)	Obtain the state equation and output equation of the electric circuit as show in Fig.9b  Fig.9b	***CO***3	***PO2***	**10**
			OR			
10	a)	Obtain the state model for a system represented by an electrical system as shown in fig10a.  Fig 10a	***CO***3	***PO2***	**10**
	b)	Represent the differential equation given below in a state model. $$\frac{d^3y}{dt^3} + \frac{d^2y}{dt^2} + 6\frac{dy}{dt} + 7y = 2u(t)$$	***CO***3	***PO2***	**10**

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