U.S.N.										

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

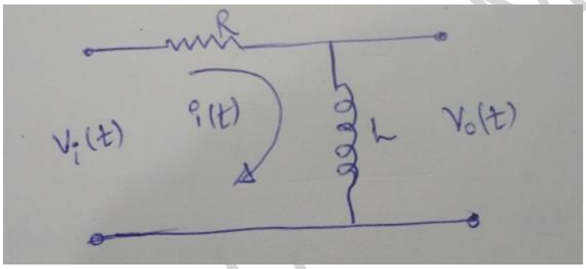
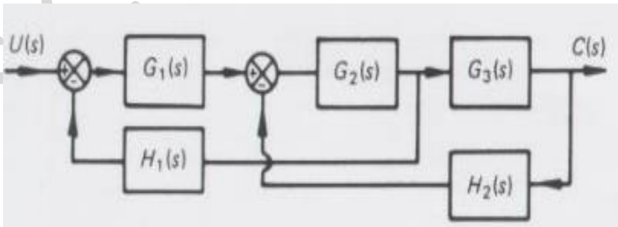
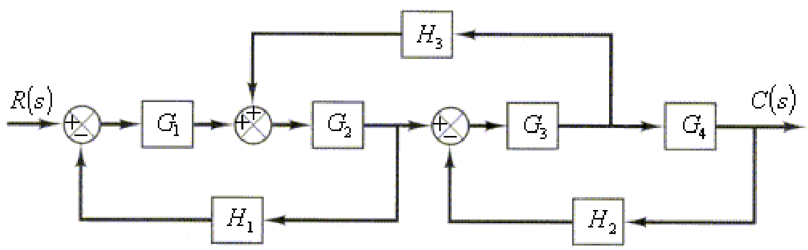
Autonomous Institute Affiliated to VTU

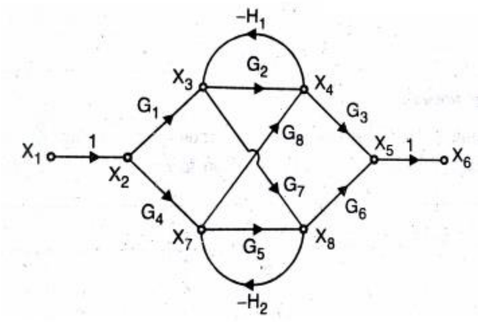
February 2025 Semester End Main Examinations

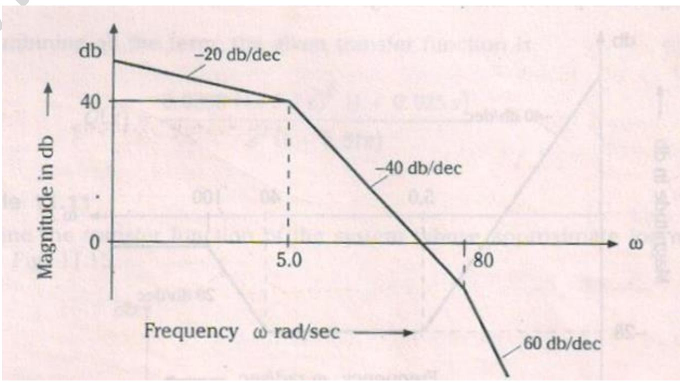
Programme: B.E. | **Semester: IV**
Branch: ES Cluster (EEE/ET/ECE/EIE/MD) | **Duration: 3 hrs.**
Course Code: 23ES4ESCST | **Max Marks: 100**
Course: Control Systems

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.

			CO	*PO*	Marks
		UNIT – I			
1	a)	Define Transfer function. Give difference between open loop and closed loop transfer function. Find the transfer function of the given electrical network shown in figure 1 below  figure 1	***CO*1**	***PO1***	**10**
	b)	Find the transfer function of the system shown in figure 2 using block diagram reduction technique only.  figure 2	***CO*1**	***PO1***	**10**
		OR			
2	a)	Find the transfer function of the following system using block diagram approach 	***CO*1**	***PO1***	**10**

		b)	Find the transfer function of the following system represented by SFG using Mason's Gain formula. 	*CO*1	*PO1*	**10**
			UNIT – II			
	3	a)	Determine the time response of First order system with ramp input. Draw its response curve.	*CO*1	*PO1*	**10**
		b)	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*1	*PO1*	**10**
			OR			
	4	a)	Represent step, ramp and parabolic function mathematically. 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*1	*PO1*	**10**
		b)	A unity feedback system has $G(s) = \frac{K}{s(s+1)(0{\cdot}5s+1)}$ and r(t) = 5t (i) Determine the steady state error if K = 1·5. (ii) Also find the minimum value of K if the steady state error $\leq$ 0·1 for a unit ramp input.	*CO*1	*PO1*	**10**
			UNIT – III			
	5	a)	Determine the stability of the characteristic equation $3S^4 + 10S^3 + 5S^2 + 5S + 3 = 0$ Using Routh stability criterion.	*CO* 2	*PO2*	**5**
		b)	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* 2	*PO2*	**5**
		C)	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* 2	*PO2*	**10**
			OR			

	6	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*** 2	***PO2***	**5**
		b)	The characteristic equation of feedback control system is $S^4+20S^3+15S^2+2S+K=0$ Determine the range of value of K for the system to be stable and can be the system be marginally stable? If so find the required value of K and the frequency of sustained oscillations.	***CO*** 2	***PO2***	**5**
		c)	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*** 2	***PO2***	**10**
			UNIT – IV			
	7	a)	Sketch the polar plot for the function $$G(s)=\frac{1}{(1+sT_1)(1+sT_2)}$$	***CO*** 2	***PO2***	**10**
		b)	The open loop transfer function of closed loop system is $G(s)H(s)=\frac{4S+1}{S^2(S+1)(2S+1)}$ Plot the Nyquist plot and determine stability using Nyquist criterion	***CO*** 2	***PO2***	**10**
			OR			
	8	a)	For a given open loop transfer function construct Bode plot and determine the value of K that will result in a phase margin of 45^0. $$G(s)H(s)=\frac{250K}{s(s+5)(s+50)}$$	***CO*** 2	***PO2***	**12**
		b)	Find the open loop transfer function of system whose approximate Bode plot is shown in figure below. 	***CO*** 2	***PO2***	**8**

			UNIT – V			
	9	a)	From the given state space model, obtain the Transfer function. $A = \begin{bmatrix} -5 & -6 \\ 1 & 0 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}, C = \begin{bmatrix} 1 & 1 \end{bmatrix}, D = 0$	***CO*** 1	***PO1***	**10**
		b)	Derive the state model for the below given transfer function. $\frac{Y(s)}{U(s)} = \frac{24}{s^3 + 9s^2 + 26s + 24}$	***CO*** 1	***PO1***	**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*** 1	***PO1***	**10**
		b)	Represent the differential equation given below in a state model $\frac{d^3 y(t)}{dt^3} + 3\frac{d^2 y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 7y(t) = 2u(t)$	***CO*** 1	***PO1***	**10**

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