U.S.N.										

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

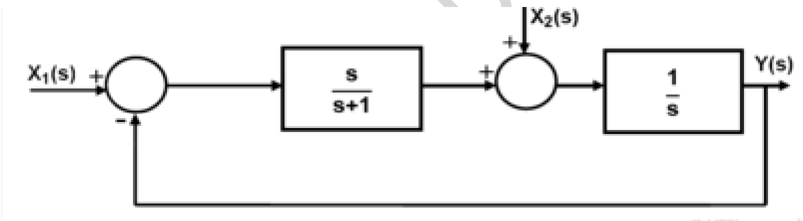
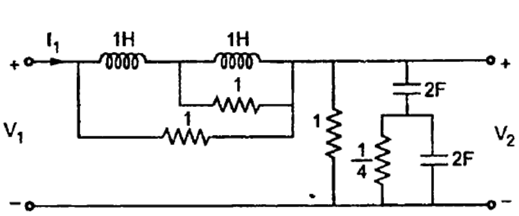
Autonomous Institute Affiliated to VTU

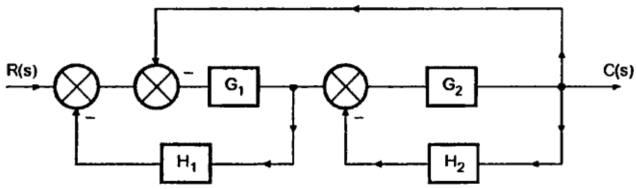
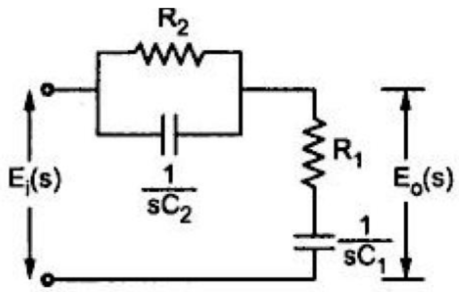
February 2025 Semester End Main Examinations

Programme: B.E. | **Semester: IV**
Branch: ES Cluster(EC,EE,EI & ET) | **Duration: 3 hrs.**
Course Code: 22ES4ESCST | **Max Marks: 100**
Course: Control Systems

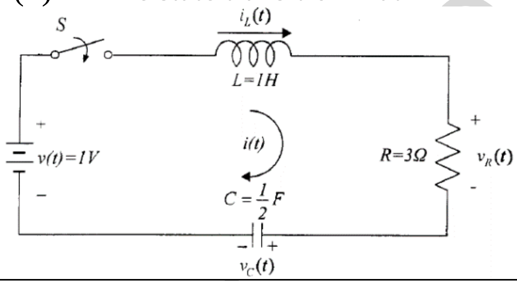
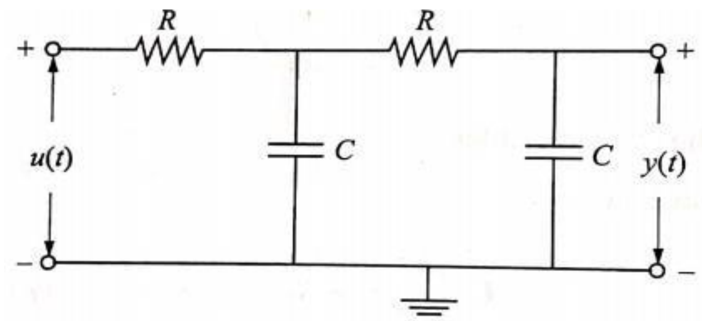
Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

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)	Explain the following types of Control Systems with examples (i) Open loop Control Systems (ii) Closed loop Control Systems	-	-	**5**
	b)	Reduce the block diagram shown in figure below using reduction rules and obtain Y(S)/ X1(S) and Y(S)/ X2(S) 	1	*1*	**5**
	c)	Determine the transfer function $\frac{V2(s)}{V1(s)}$ of the electrical system shown in figure 	*1*	*1*	**10**
		OR			
2	a)	Derive the transfer function of the negative feedback system with relevant diagrams	*1*	*1*	**5**
	b)	Reduce the block diagram shown in figure below using reduction rules and obtain C(s)/R(s).	*1*	*1*	**5**

					
	c)	Determine the transfer function $\frac{Eo(s)}{Ei(s)}$ of the electrical system shown in figure 	*1*	*1*	**10**
		UNIT - II			
3	a)	A 2nd order control system is governed by the following differential equation $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+16y=16x$ where y is output and x is input. If x is unit step function, evaluate the rise time, settling time and peak overshoot	*1*	*1*	**10**
	b)	Evaluate kp , kv , ka and steady state error for a system whose open loop transfer function is given below $G(s)H(s)=\frac{15(s+4)(s+7)}{s(s+3)(s+6)(s+8)}$ Where the input is $r(t) = 4+t+t^2$	*1*	*1*	**10**
		OR			
4	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 $r(t) = 2+4t+6t^2$, $t \geq 0$	*1*	*1*	**10**
	b)	Analyze the given transfer function to determine K, α, β such that steady-state position error for ramp input equals to 1/10 and the closed loop poles are located at -1±j1	*2*	*2*	**10**

			$$G(S)H(S) = \frac{K\,(s+\alpha)}{s\,(s+\beta)}$$			
			UNIT - III			
	5	a)	Assess the critical value of the K to maintain the system stability for the given unity feedback system having an open loop transfer function $$G(s) = \frac{K}{s(4s+13+s^2)}$$	*1*	*1*	**10**
		b)	Construct the root locus for a feedback control system with open loop TF $$G(s) = \frac{K}{S(S^2+6S+10)}$$ Show all the salient points on the sketch. Determine the value of K for which the closed loop poles are all real.	*2*	*2*	**10**
			OR			
	6	a)	Assess the stability of the system whose The characteristic equation is $Q(s)=S^3+2s^2+4s+K$ Where K is loop gain. Find the range of K for the system to be stable. Determine the roots of characteristic equation which make the system marginally stable	*1*	*1*	**10**
		b)	Sketch the closed loop poles of the feedback control system with open loop transfer function $$G(S)H(S) = \frac{K(S+5)}{S(S^2+4S+5)}$$ Determine the value of K for which the closed loop poles are all real.	*2*	*2*	**10**
			UNIT - IV			
	7	a)	Sketch the polar plot for the following transfer function. Identify the frequency at which polar plot intersects real and imaginary axis $$G(s) = \frac{1}{(1+3s)(1+4s)(1+5s)}$$	*2*	*2*	**10**
		b)	Consider a feedback system with the following open loop transfer function $$G(s)H(s) = \frac{K}{s(s+3)(s+5)}$$ Investigate the stability of this system for various values of K. Draw Nyquist Plot and use Nyquist criterion for stability analysis.	*2*	*2*	**10**
			OR			

	8	a)	Construct the Bode Plot for a unity feedback system showing each step indetail , whose Open Loop TF is given by $$\mathbf{G(s)H(s) = \frac{10}{s(1+s)(1+0.02s)}}$$ From the Bode plot determine (i) Gain & Phase Crossover frequencies (ii) Gain & Phase Margin (iii) Stability of the closed loop system	*2*	*2*	**10**
		b)	For Unity feedback system with OLTF $$G(s) = \frac{40}{(s+4)(s^2+4s+8)}$$ Sketch Polar plot. Determine the points of intersection with Re and Im axes. Find Gain Margin and Phase margin.	*2*	*2*	**10**
			UNIT - V			
	9	a)	Explain the following with suitable example (i) State and state variable (ii) State vector (iii) State space (iv) State matrix	-	-	**10**
		b)	For the n/w shown, with initial conditions $i_L(0)=1$ and $v_C(0)=0$, Determine (i) A state space description (ii) The state transition matrix 	*1*	*1*	**10**
			OR			
	10	a)	List the drawbacks of Transfer function method compared to state space representation of a control system. Write the state model of a MIMO system with 'm' inputs, 'p' outputs and 'n' state variables	-	-	**10**
		b)	Obtain the state model for a system represented by an electrical system as shown in figure 	*1*	*1*	**10**

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