CMR
INSTITUTE OF
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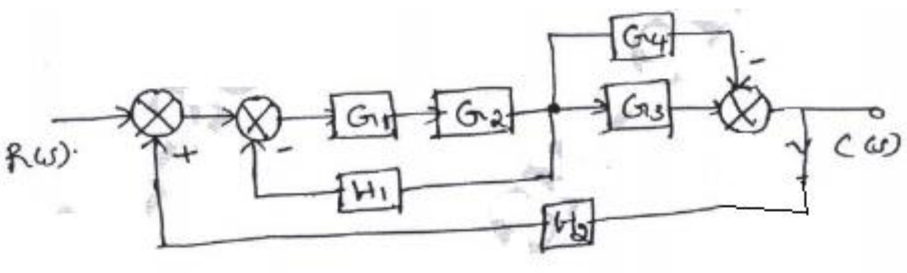
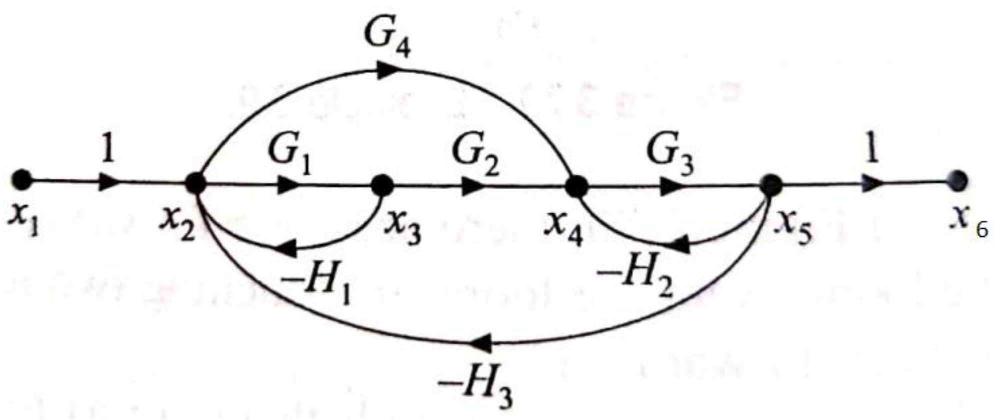
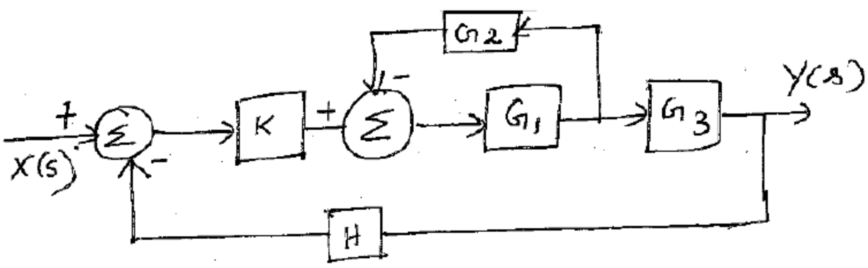
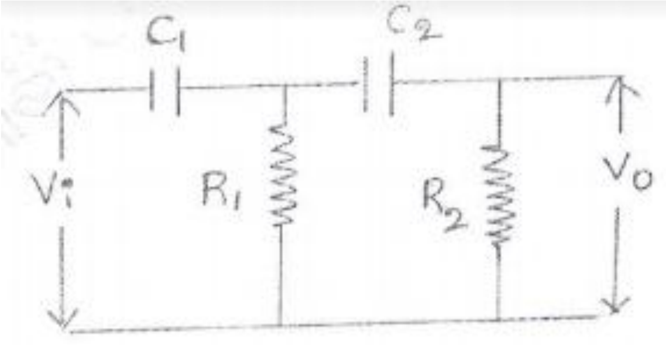
Internal Assesment Test - II

Sub:	**CONTROL SYSTEMS**							Code:	17EE61 / 18EE61
Date:	24/06/2021	Duration:	90 mins	Max Marks:	50	Sem:	6th	Branch:	EEE

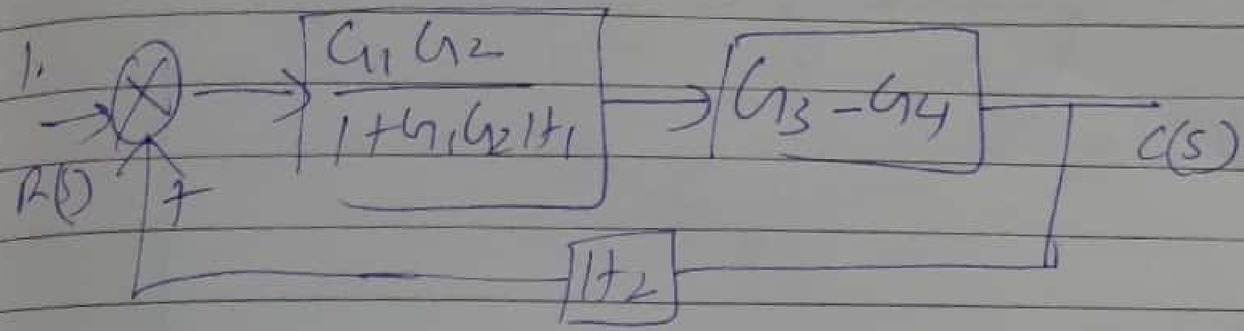
Answer Any FIVE FULL Questions

		Marks	OBE	
			CO	RBT
1	Obtain the closed loop transfer function using block diagram reduction technique for the fig Q1 shown.  Fig Q1	10	CO2	L3
2	Apply the Mason's Gain formula to the signal flow graph shown in fig Q2 to find the transfer function x_6 / x_1  Fig Q2	10	CO2	L3
3	Draw the signal flow graph for the block diagram shown in fig Q3 and determine the transfer function using Mason's gain formula.  Fig Q3	10	CO2	L3

4	Draw the signal flow graph for the electrical network shown in fig Q4 and find its transfer function  Fig Q4	10	CO2	L3
5	Obtain the expression for time response of the first order system subjected to unit step input and unit impulse input.	10	CO3	L4
6	Determine the output response of second order system for critically damped system and input is unit step.	10	CO3	L4
7	Obtain the output response of unity feedback system whose open loop transfer function is $G(s) = \frac{4}{s(s+5)}$ and when the input is unit step. Also determine the undamped natural frequency, Damping ratio and damped natural frequency	10	CO3	L4

IAT-2 Answer.

1.



$$\frac{C(s)}{R(s)} = \frac{\dfrac{G_1 G_2 (G_3 - G_4)}{1 + G_1 G_2 H_1}}{1 - \dfrac{G_1 G_2 (G_3 - G_4)}{1 + G_1 G_2 H_1} \times H_2}$$

$$= \frac{G_1 G_2 (G_3 - G_4)}{1 + G_1 G_2 H_1 - G_1 G_2 (G_3 - G_4) H_2}$$

(10)

2. $M_1 = G_1 G_2 G_3$, $\Delta_1 = 1$.

$M_2 = G_3 G_4$, $\Delta_2 = 1$.

$L_{11} = -G_1 H_1$

$L_{12} = -G_3 H_2$

$L_{13} = -G_1 G_2 G_3 H_3$

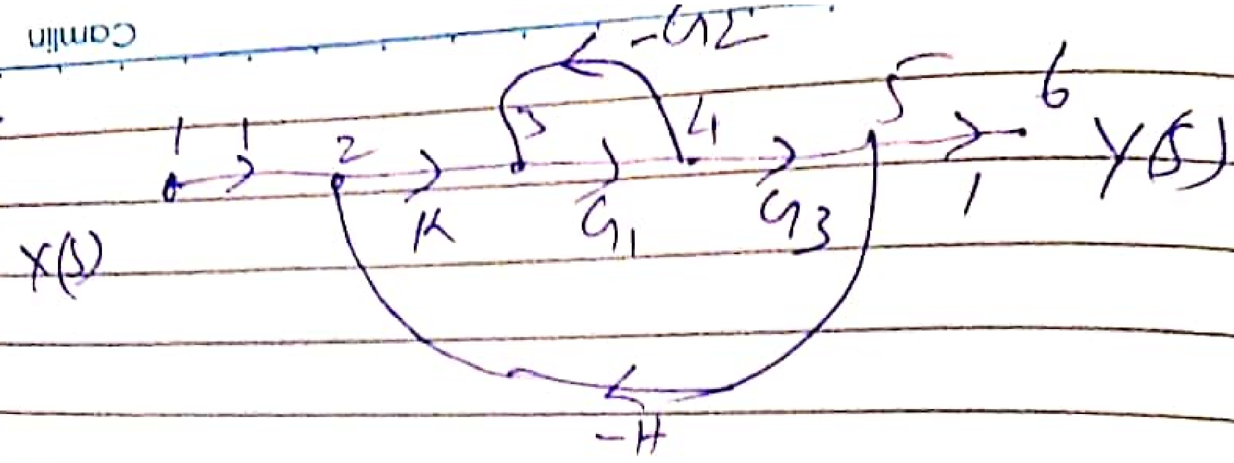
$L_{14} = -G_4 G_3 H_3$

$L_{21} = G_1 G_3 H_1 H_2$

$$\Delta = 1 + G_1 H_1 + G_3 H_2 + G_1 G_2 G_3 H_3 + G_4 G_3 H_3 + G_1 G_3 H_1 H_2$$

$$\frac{x_6}{x_1} = \frac{G_1 G_2 G_3 + G_3 G_4}{\Delta}$$

3.



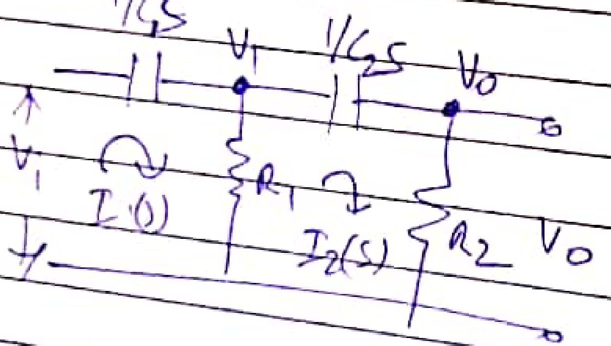
$M_1 = K G_1 G_3 \, , \; \Delta_1 = 1.$

$L_{11} = -G_1 G_2 \, , \; L_{12} = -K G_1 G_3 H.$

$\Delta = 1 + G_1 G_2 + K G_1 G_3 H.$

$$\frac{Y(s)}{X(s)} = \frac{K G_1 G_3}{1 + G_1 G_2 + K G_1 G_3 H}$$

4.



$V_0(s) = R_2 I_2(s) \quad \text{—} (1).$

$V_1 - V_0 = I_2(s) \frac{1}{C_2 s}$

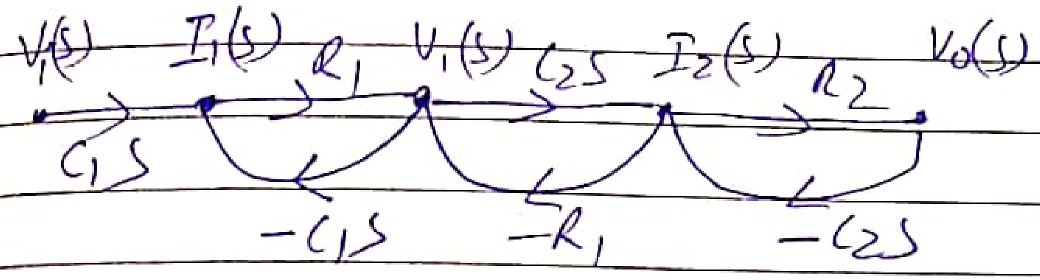
$I_2(s) = (V_1 - V_0) C_2 s$

$= V_1(s) C_2 s - V_0(s) C_2 s \quad \text{—} (2).$

$V_1(s) = R_1 I_1(s) - R_1 I_2(s) \quad \text{—} (3)$

$V_i(s) - V(s) = I_1(s) \frac{1}{C_1 s}$

$I_1(s) = \{V_i(s) - V_1(s)\} C_1 s \quad \text{—} (4).$



$M_1 = R_1 R_2 C_1 C_2 s^2$, $\Delta_1 = 1$.

$L_{11} = -R_1 C_1 s$

$L_{12} = -R_1 C_2 s$

$L_{13} = -R_2 C_2 s$

$L_{21} = R_1 R_2 C_1 C_2 s^2$.

$\Delta = 1 + R_1 C_1 s + R_1 C_2 s + R_2 C_2 s + R_1 R_2 C_1 C_2 s^2$.

$$\therefore \frac{V_o(s)}{V_i(s)} = \frac{R_1 R_2 C_1 C_2 s^2}{1 + R_1 C_1 s + R_1 C_2 s + R_2 C_2 s + R_1 R_2 C_1 C_2 s^2}.$$

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5) Step: $c(t) = 1 - e^{-t/T}$ $A=1, B=-1$

$R(s) = R(s) \frac{1/T}{s+1/T}$

Impulse $c(t) = \frac{1}{T} e^{-t/T}$.

6. Critically $\delta = 1$. $A=1, C=-1,$ $B = -\omega_n$.

$c(t) = 1 - e^{-\omega_n t}(1+\omega_n t)$

7. $c(t) = 1 - \frac{4}{3} e^{-t} + \frac{1}{3} e^{-4t}$ $A=1, B=-\frac{4}{3}, C=\frac{1}{3}$.

$\frac{C(s)}{R(s)} = \frac{4}{s^2+5s+4} = \frac{\omega_n^2}{s^2+2\delta\omega_n s+\omega_n^2}$

$\omega_n^2 = 4$.
$\omega_n = 2$ rad/se | $2\delta\omega_n = 5$.
$\delta = \frac{5}{2\times2} = \frac{5}{4} = 1.25$

$\omega_d = \omega_n\sqrt{1-\delta^2}$
$= 2\sqrt{1-(1.25)^2}$