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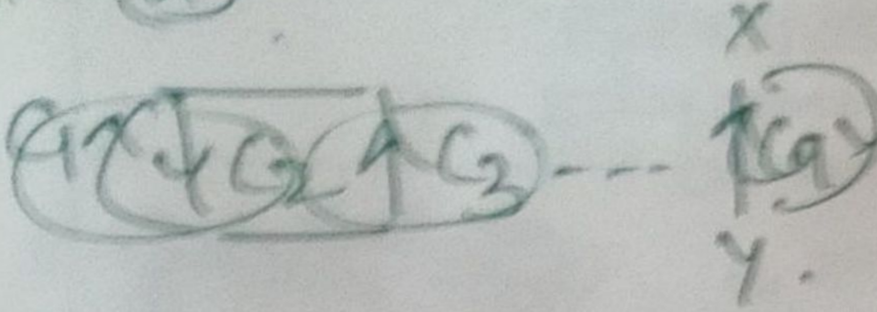
PRCSED4

Q1. (a)

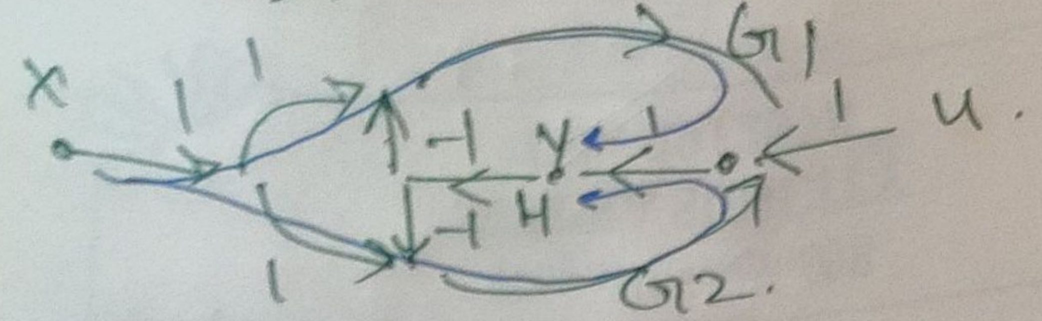


$$\frac{C_2}{1-C_1C_2} \quad \frac{C_3}{1-\frac{C_3C_2}{1-C_1C_2}} \quad - - -$$

$$\frac{y}{x} = \frac{1}{1-\frac{C_9}{1-\frac{C_9C_8}{1-\frac{C_8C_7}{1-C_7C_6}}}}$$

$$\therefore \frac{y}{x} = \frac{1}{1-\frac{h}{1+\frac{gh}{1+\frac{gh}{1+gh\ \cdots}}}} = \frac{1}{1-\frac{C_9}{1-\frac{C_9C_8}{1-\frac{C_8C_7}{1-C_7C_6}}}} \quad \cdots \quad \frac{1-C_3C_2}{1-C_2C_1}$$

Q1. (b).



$M_1 = G1$.

$M_2 = G2$.

$\Delta = 1 - (1 - HG2 - HG1)$.

$\Delta_1 = 1 - 0$

$\Delta_2 = 1 - 0$.

$$\frac{Y}{X} = \frac{M_1\Delta_1 + M_2\Delta_2}{\Delta}$$

$$= \frac{G_1 + G_2}{H(G_1 + G_2)} = 1/H$$

Q2.

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & -2\\ 1 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}.$$

$$\dot{x}_1 = -2x_2 \quad \cancel{\longrightarrow x_1+2}$$

$$\dot{x}_2 = x_1 - 3x_2$$

$$\dot{x}_2(0) = -2-3 = -5$$

$$\ddot{x}_2 = \dot{x}_1 - 3\dot{x}_2$$

$$\ddot{x}_2 = -2x_2 - 3\dot{x}_2$$

$$\ddot{x}_2 + 3\dot{x}_2 + 2x_2 = 0.$$

$$s^2X_2(s) - s(1) - (-5) + 3sX_2(s) - 3 + 2X_2(s) = 0.$$

$$X_2(s)\left[s^2+3s+2\right] = s-2.$$

$$X_2(s) = \frac{(s-2)}{(s+1)(s+2)}.$$

$$= \frac{1}{s+2} - \frac{3\left\{s+2-s+1\right\}}{(s+1)(s+2)}$$

$$= \frac{1}{s+2} - 3\left[\frac{1}{s+1} - \frac{1}{s+2}\right].$$

$$= \frac{4}{s+2} - \frac{3}{s+1}$$

$$X_2(S) = \frac{4}{S+2} - \frac{3}{S+1}.$$

$$\boxed{x_2(t) = 4e^{-2t} - 3e^{-t}}$$

$$\dot{x}_1(t) = -2x_2(t)$$

$$= -8e^{-2t} + 6e^{-t}.$$

$$\boxed{x_1(t) = 4e^{-2t} - 6e^{-t}}$$

cross check.

$$x_1(0) = -2 = -2$$

$$x_2(0) = 1 = 1.$$

State Transition

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \underbrace{\begin{bmatrix}0 & -2\\ 1 & -3\end{bmatrix}}_{A}\begin{bmatrix}x_1\\ x_2\end{bmatrix}.$$

$$(SI-A) = \begin{bmatrix}S & +2\\ -1 & S+3\end{bmatrix}$$

$$(SI-A)^{-1} = \frac{1}{S^2+3S+2}\begin{bmatrix}S+3 & -2\\ +1 & S\end{bmatrix}.$$

$$(SI-A)^{-1} = \begin{bmatrix}\left(\frac{S+3}{(S+1)(S+2)}\right) & -\left(\frac{2}{(S+1)(S+2)}\right)\\ \left(\frac{+1}{(S+1)(S+2)}\right) & \left[\frac{S}{(S+1)(S+2)}\right]\end{bmatrix}$$

<u>Where</u>.

$$\frac{S+3}{(S+1)(S+2)} = \frac{2(S+2)-(S+1)}{(S+1)(S+2)} = \frac{2}{S+1} - \frac{1}{S+2}.$$

$$\frac{-2}{(S+1)(S+2)} = \frac{-2}{S+1} + \frac{2}{S+2}.$$

$$\frac{+1}{(S+1)(S+2)} = \frac{-1}{S+2} + \frac{1}{S+1}.$$

$$\frac{S}{(S+1)(S+2)} = \frac{2}{S+2} - \frac{1}{S+1}.$$

(5)

$$(SI-A)^{-1} = \begin{bmatrix} \frac{2}{s+1} - \frac{1}{s+2} & \frac{-2}{s+1} + \frac{2}{s+2} \\ \frac{-1}{s+2} + \frac{1}{s+1} & \frac{2}{s+2} - \frac{1}{s+1} \end{bmatrix}.$$

$$L^{-1}\left[(SI-A)^{-1}\right] = e^{At}.$$

$$= \begin{bmatrix} 2e^{-s} - e^{-2s} & -2e^{-s} + 2e^{-2s} \\ -e^{-2s} + e^{-s} & 2e^{-2s} - e^{-s} \end{bmatrix}$$

State transition matrix ϕ.

$$x(t) = e^{At}x(0) + \int_0^t e^{A(t-\tau)} \cancel{Bu(\tau)\,d\tau}$$
0.

$$\begin{matrix} x_1(t) \\ x_2(t) \end{matrix} = \begin{bmatrix} 2e^{-t} - e^{-2t} & -2e^{-t} + 2e^{-2t} \\ -e^{-2t} + e^{-t} & 2e^{-2t} - e^{-t} \end{bmatrix} \begin{bmatrix} -2 \\ 1 \end{bmatrix}$$

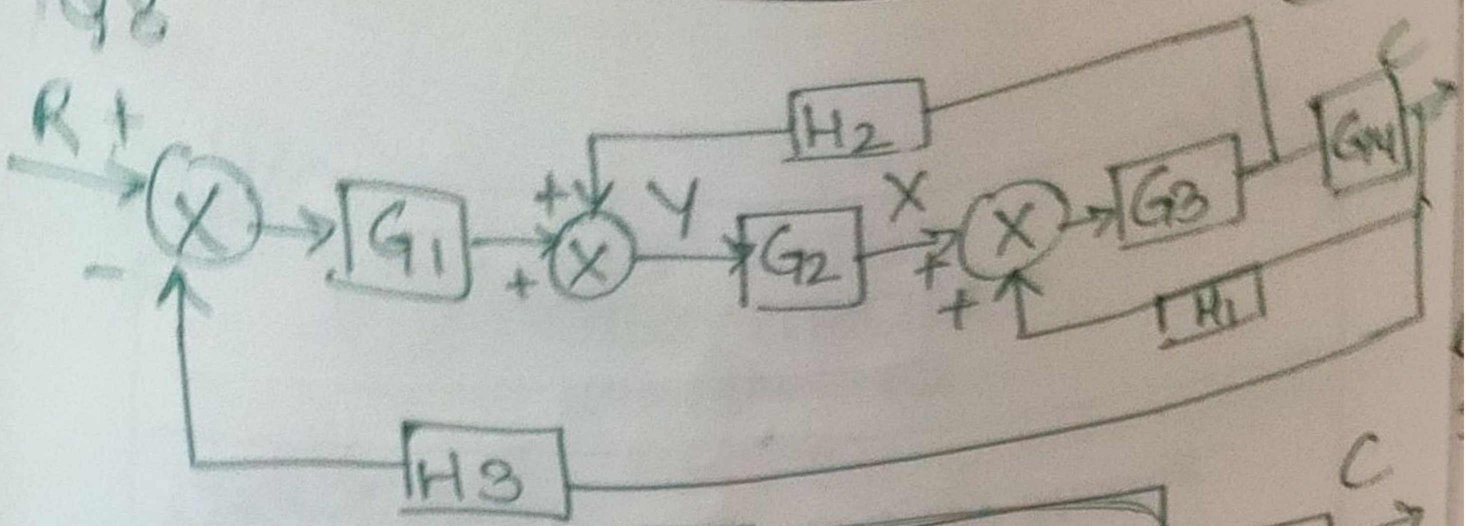
$$x_1(t) = (-4 - 2)e^{-t} + (+2 + 2)e^{-2t} = -6e^{-t} + 4e^{-2t}$$

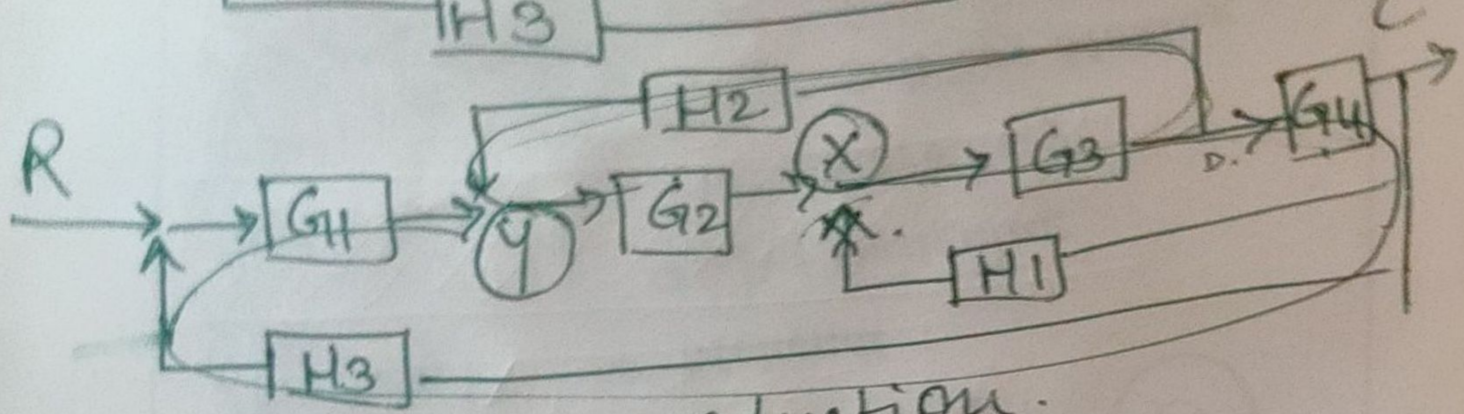
$$x_2(t) = (+2 + 2)e^{-2t} - (+2 + 1)e^{-t} = 4e^{-2t} - 3e^{-t}.$$

$$\therefore \boxed{\begin{aligned} x_1(t) &= 4e^{-2t} - 6e^{-t} \\ x_2(t) &= 4e^{-2t} - 3e^{-t} \end{aligned}}$$

$\cancel{x_1(t) = t_{+2}^{-4} + \frac{2}{-2}}$ =

Q8





Black diagram reduction.

$$R \rightarrow \boxed{\dfrac{G_1G_2G_3G_4}{1 - G_3G_4H_1 + G_2G_3H_2 + G_1G_2G_3G_4H_3}} \rightarrow C.$$

$M_1 = G_3H_2$

$M_2 = G_3G_4H_3G_1.$

$\Delta_1 = 1$

$\Delta_2 = 1.$

$\Delta = 1 - (G_3G_4H_1 + \cancel{G_3H_2G_2} + \cancel{G_3G_4H_3G_1G_2}$

$+ G_3H_2G_2$

$+ G_3G_4H_3G_1G_2).$

$- 0.$

$$T = \frac{M_1 \Delta_1 + M_2 \Delta_2}{\Delta}$$

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$$\frac{Y}{X} = \frac{G_3 H_2 + G_3 H_3 G_1 G_4}{1 - (G_3 G_4 H_1 + G_3 H_2 G_2 + G_3 H_3 G_4 G_1 G_2)}$$

Ans.