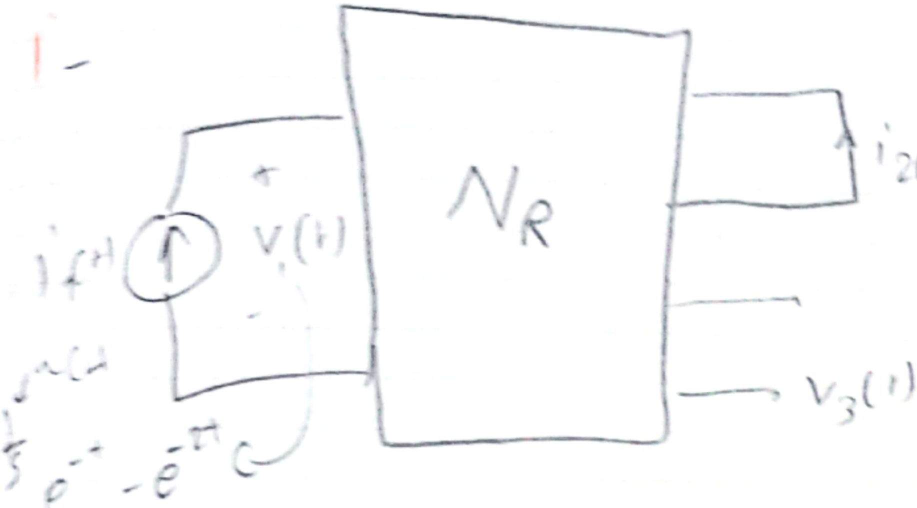
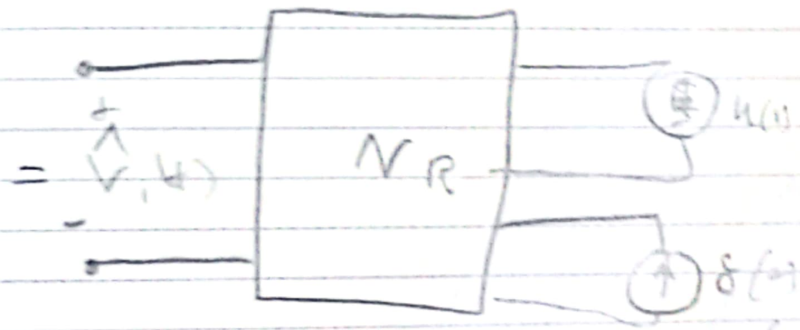
1 -



$e^{-t} = \frac{1}{s+1}$

$v_3(t) = e^{-t} + e^{-2t} \to \frac{s}{s+1} + \frac{s}{s+2}$



$u(t) \to \frac{1}{s}$

$\hat{V}_1 = \hat{V}_{11} + \hat{V}_{12}$

$H_1 = \frac{\frac{1}{s+1}}{\frac{1}{s}} = \frac{s}{s+1}$ $\quad H_2 = \frac{L\{\hat{V}_1(t)\}}{\frac{1}{s}} = s\hat{V}_1(s)$

$H_1 = H_2$

$s\hat{V}_{11}(s) = \frac{s}{s+1} \Rightarrow \hat{V}_{11}(s) = \frac{1}{s+1} \xRightarrow{L^{-1}} \boxed{e^{-t}}$

$H_2 = \frac{L\{v_3\}}{L\{u(t)\}} = \frac{L\{v_{12}(t)\}}{L\{\delta(t)\}} \Rightarrow \frac{\frac{1}{s+1} + \frac{1}{s+2}}{\frac{1}{s}} = s\left(\frac{1}{s+1} + \frac{1}{s+2}\right) = V_{12}(t)$

$L\{\delta(t)\} = 1$

$V_{12}(t) = \frac{s}{s+1} + \frac{s}{s+2} \xRightarrow{L^{-1}} \boxed{2\delta(t) - 2e^{-2t} - e^{-t}}$

$V_1(t) = \hat{V}_{11} + \hat{V}_{12} = 2\delta(t) - 2e^{-2t} \cancel{- e^{-t}} \cancel{+ e^{-t}} = 2(\delta(t) - e^{-2t})$

2)

$v_1 = \delta'(t)$ $\quad v_2 = \delta(t)$ $\quad I_2 = e^{-t} u(t) \to \frac{1}{s+1}$

$\hat{V}_1 = 0$ $\quad \hat{I}_1 = \cos(t)\, u(t)$ $\quad \hat{I}_2 = \sin(t)\, u(t)$

$\downarrow \quad\quad \downarrow \quad\quad \downarrow$

$0 \quad\quad \frac{s}{s^2+1} \quad\quad \frac{1}{s^2+1}$

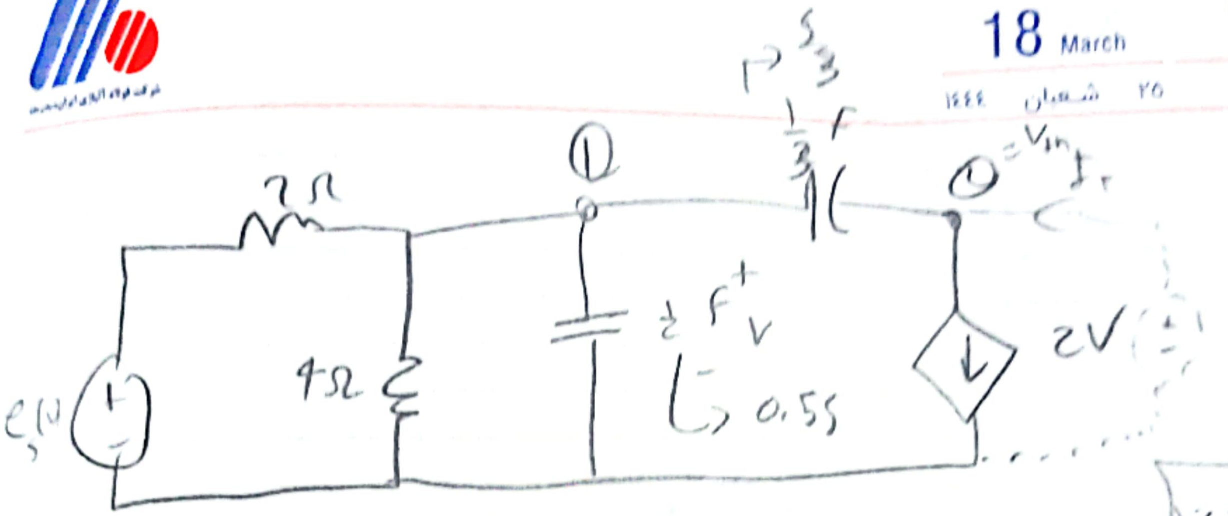
$\boxed{?\ Z_2}$

$$\sum v_k \hat{i}_k = \sum \hat{v}_k i_k \Rightarrow v_1 \hat{i}_1 + v_2 \hat{i}_2 = \hat{v}_1 i_1 + v_2 i_2 + \cancel{\not{}}$$

$$\Rightarrow \frac{-s^2}{s^2+1} - \frac{1}{s^2+1} = 0 = \hat{V}_2 \frac{1}{s^2+1}$$

$$\frac{1}{s^2+1}(s^2+1) = \hat{V}_2 \frac{1}{(s+1)} \Rightarrow \boxed{\hat{V}_2 = s+1 \stackrel{L}{=} \delta'(t) + \delta(t)}$$

$$\boxed{Z(s) = \frac{V_2(s)}{I_2(s)} = \frac{s+1}{\frac{1}{s^2+1}} = (s^2+1)(s+1)}$$



$\boxed{V=\frac{e_1}{\frac{1}{0.5s}}}$

KCL ① $\frac{e_1-e_s}{2}+\frac{e_1}{4}+\frac{e_1}{\frac{1}{0.5s}}+\frac{(e_1-e_2)}{\frac{1}{\frac{s}{3}}}=0$

$\frac{3e_1}{4}+\left(\frac{-e_s}{2}\right)+\frac{e_1 s}{2}+\frac{e_1 s}{3}-\frac{e_2 s}{3}=0$ ✱

$e_1\left(\frac{3}{4}+\frac{5}{6}s\right)=\frac{e_2 s}{3}+\frac{e_s}{2}\xrightarrow{\times 12}\boxed{e_1(9+10s)=4se_2+6e_s}$

KCL ② $\frac{e_2-e_1}{\frac{1}{\frac{1}{3}s}}+2se_1-I_{th}=0\Rightarrow\boxed{\frac{e_2 s}{3}+2e_1-\frac{e_1 s}{3}-I_{th}=0}$

✱✱

$\frac{e_2 s}{3}+e_1\left(2-\frac{s}{3}\right)-I_{th}=0$

✱ $\Rightarrow e_1=\frac{4se_2+6e_s}{9+10s}$

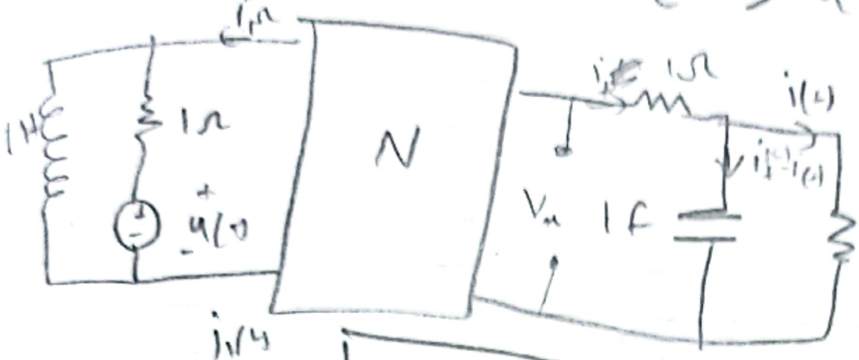
$\Rightarrow\frac{e_2 s}{3}+\frac{4se_2+6e_s}{9+10s}\left(2-\frac{s}{3}\right)-I_{th}=0$

$e_2=V_{th}\Rightarrow$

$V_{th}\left(\frac{s}{3}+\frac{4se_2\left(2-\frac{s}{3}\right)}{9+10s}\right)=\frac{-6e_s}{9+10s}\left(2-\frac{s}{3}\right)+I_{th}$

$V_{th}=\frac{\left(\frac{-6e_s}{9+10s}\left(2-\frac{s}{3}\right)+I_{th}\right)}{\left(\frac{s}{3}+\frac{4se_2\left(2-\frac{s}{3}\right)}{9+10s}\right)}$

4) $i(t) = (2e^{-t} - e^{-2t} - e^{-3t})\,u(t)$



$\Rightarrow V_o(t) = i_1(t)\cdot 1 + i(t)$

$i_1(t) - i(t) = i_C \Rightarrow i_C = C\frac{dv_c}{dt} = \frac{di(t)}{dt}$

$= (-2e^{-t} + 2e^{-2t} + 3e^{-3t})u(t) + \cancel{(2e^{-t} - e^{-2t} - e^{-3t})\delta(t)}\big|_{t=0}$

$= (2e^{-t} + 2e^{-2t} + 3e^{-3t})u(t) \Rightarrow i_1 = (e^{-2t} + 2e^{-3t})u(t)$

$\Rightarrow V_o = (2e^{-t} - \cancel{e^{-2t}} - \cancel{e^{-3t}})u(t) + (\cancel{e^{-2t}} + \cancel{2}e^{-3t})u(t)$

$i_1 = (2e^{-t} + e^{-3t})u(t) \xRightarrow{\text{وارون}} V_1 = i_{R_1} = (e^{-3t} + 2e^{-t})u(t)$

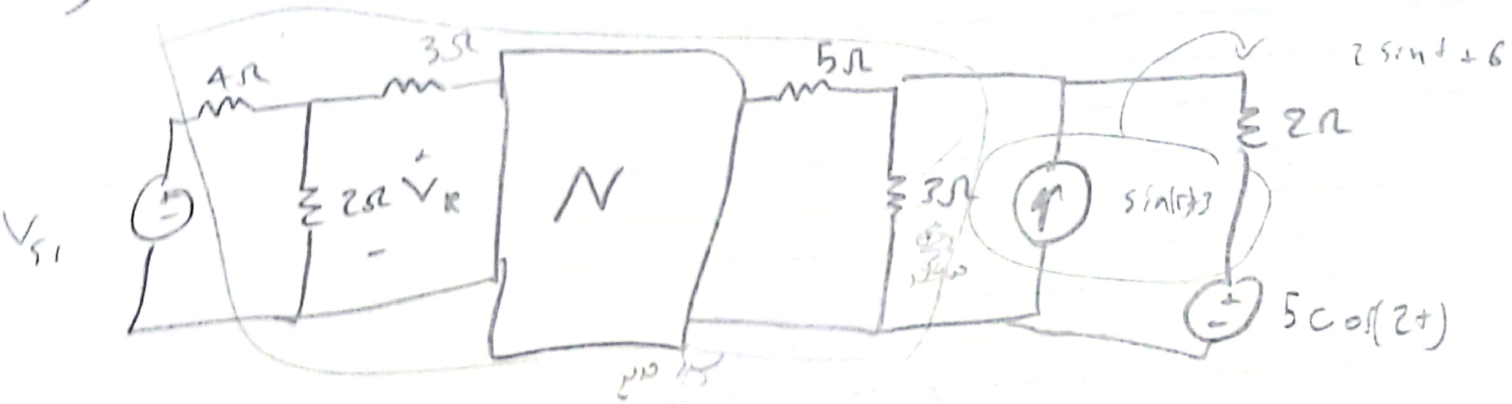
$\Rightarrow i_{R}\times 1 = V_{L_1} = (e^{-3t} + 2e^{-t})u(t) \Rightarrow i_L(t) = \frac{1}{L}\int_0^t (2e^{-t} + e^{-3t})u(t)$

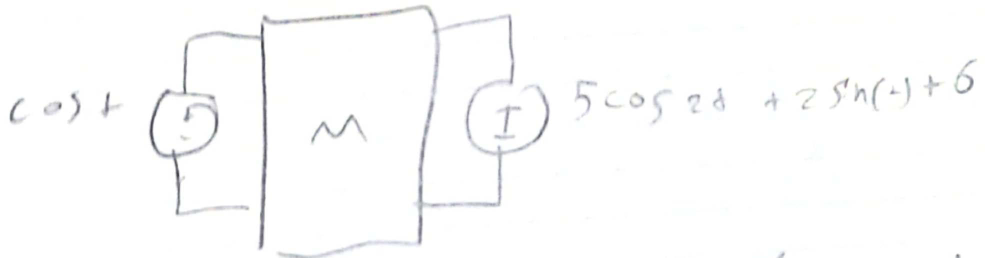
$i_L = (-2e^{-t} - \frac{1}{3}e^{-3t} + \frac{7}{3})u(t)$

$i_1(t) = i_{L_1} + i_R = (-2e^{-t} - \frac{1}{3}e^{-3t} + \frac{7}{3})u(t) + (2e^{-t} + e^{-3t})u(t)$

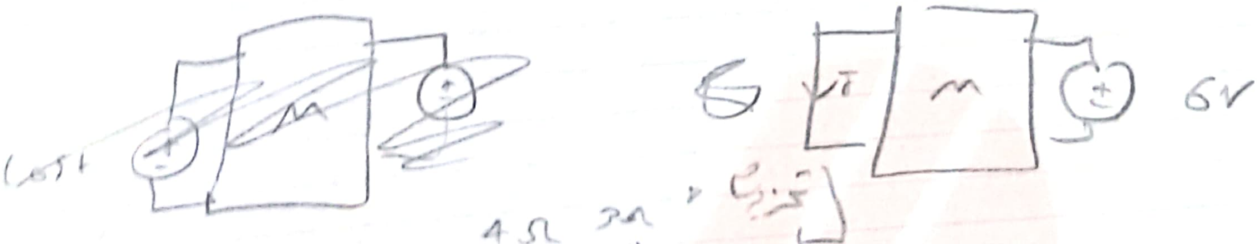
$\Rightarrow i_1(t) = \frac{2}{3}e^{-3t}u(t) + \frac{7}{3}u(t)$

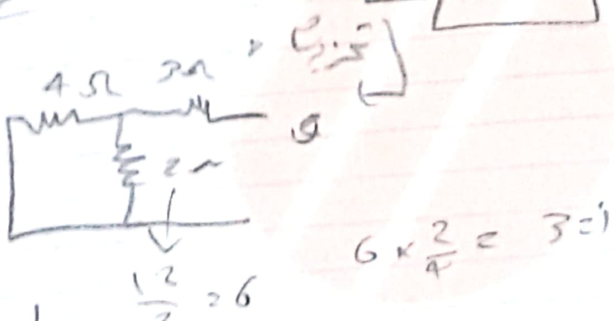
5) $V_{s1} = \cos t \qquad V_{s2} = 5\cos(2t) \qquad I_s = \sin t + 3$





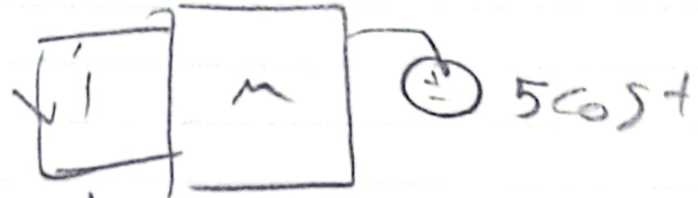
برای محاسبه فقط به DC کار داریم و منابع ac را در نظر نمی‌گیریم





$$H(s) = \frac{i_1(s)}{V(s)} = \frac{\frac{3}{s}}{\frac{6}{s}} = \frac{1}{2}$$

حال مقادیر $\sin(t)+5$ در V_{s1} حذف می‌شوند



$$i = \mathcal{L}^{-1}\left\{\hat{V}_1(s)\right\} = \frac{5}{2}\,\frac{s}{s^2+4} \overset{\mathcal{L}^{-1}}{=} \boxed{\frac{5}{2}\cos 2t = i_1}$$

$$\downarrow \qquad \downarrow$$

$$\frac{1}{2} \qquad \frac{5s}{s^2+4}$$

i

$$4 \times \frac{5}{2}\cos 2t = 10\cos 2t \Rightarrow \boxed{K = 10}$$