پاسخ نامه تکلیف سری ۳
مدار الکتریکی ترم ۴۰۲۲

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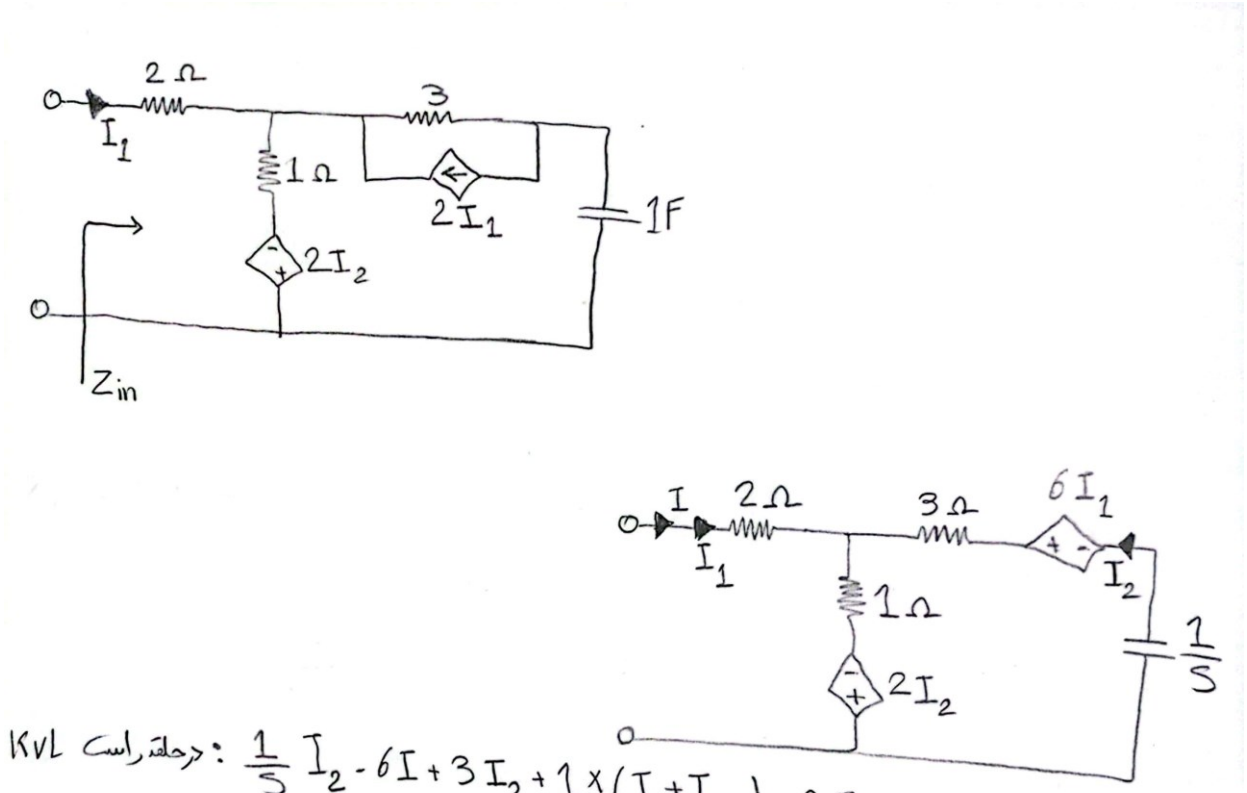
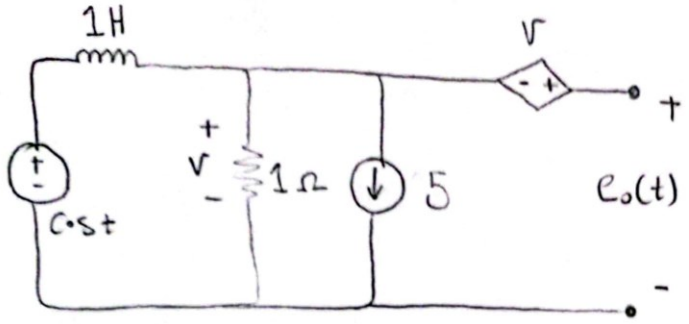


KVL حلقه راست: $\frac{1}{S} I_2 - 6I + 3I_2 + 1 \times (I + I_2) - 2I_2 = 0$

$I_2 = \frac{5S}{2S+1} I$

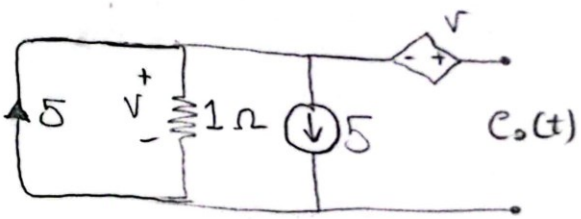
KVL حلقه چپ: $V = 2I + 1 \times (I + I_2) - 2I_2 \rightarrow V = 3I - I_2$

$V = \left(3 - \frac{5S}{2S+1}\right) I \rightarrow \frac{V}{I} = \frac{S+3}{2S+1}$



با توجه به تقارت مدارهای ما از جمع آثار استفاده می کنیم

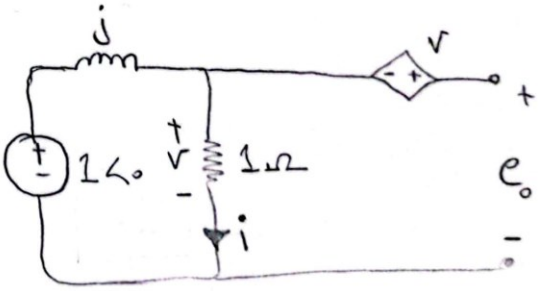
$V=0$, $e_1=0$



$V=i \rightarrow i=\frac{1\angle 0}{1+j}=\frac{1}{\sqrt{2}}\angle -45$

$V=\frac{1}{\sqrt{2}}\angle -45$

$e_2=2V \rightarrow \frac{2}{\sqrt{2}}\angle -45$



$e_o=e_1+e_2 \Rightarrow 0+\frac{2}{\sqrt{2}}\angle -45 \Rightarrow e_o(t)=\frac{2}{\sqrt{2}}\cos(t-45)$

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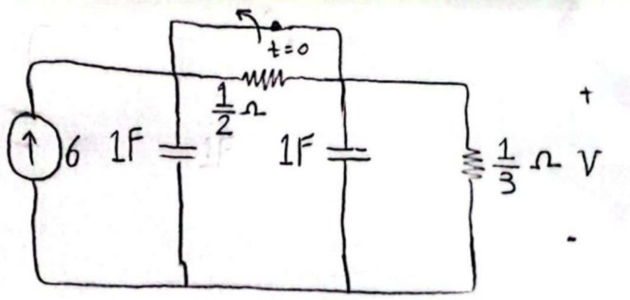
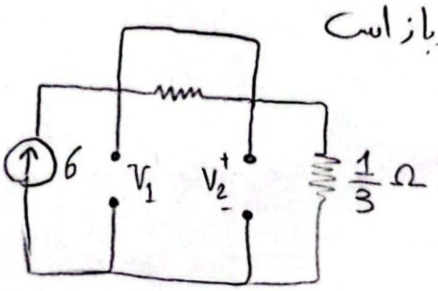
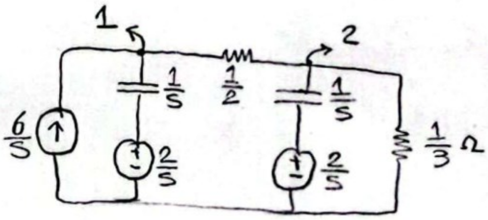


ابتدا شرایط اولیه را در $t<0$ محاسبه می کنیم در این حالت خازن مدار باز است



$V_1(0) = V_2(0) = \frac{1}{3} \times 6 = 2$

سپس با اعمال شرایط اولیه مدار را به حوزه لاپلاس می بریم



$$Kcl(1): s\left(V_1 - \frac{2}{s}\right) + 2(V_1 - V_2) = \frac{6}{s}$$

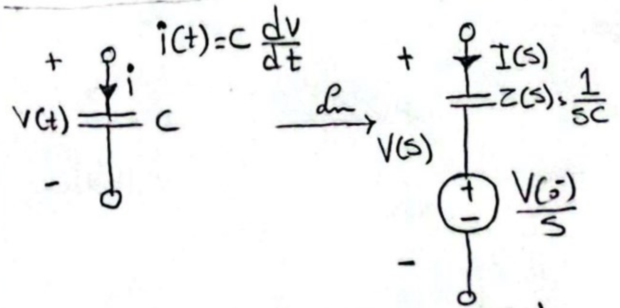
$$(s^2+2s)V_1 - 2sV_2 = 2s+6 \quad (I)$$

$$Kcl(2): 2(V_2 - V_1) + s\left(V_2 - \frac{2}{s}\right) + 3(V_2 - 0) = 0$$

$$-2V_1 + (s+5)V_2 = 2 \quad (II)$$

$$(I),(II) \rightarrow V_2 = \frac{2(s^2+2s) + 2(2s+6)}{(s^2+2s)(s+5) - 4s} = \frac{2s^2+8s+12}{s(s+1)(s+2)}$$

$$V_2 = \frac{2}{s} - \frac{1.2}{s+1} + \frac{1.2}{s+6} \longrightarrow V_2(t) = (2 - 1.2e^{-t} + 1.2e^{-6t})u(t)$$



$$I(s) = sCV(s) - V(0^-)$$

$$V(s) = \frac{I(s)}{sC} + \frac{V(0^-)}{s}$$

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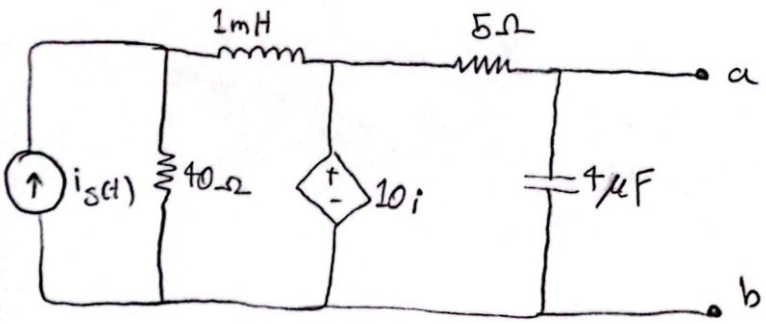
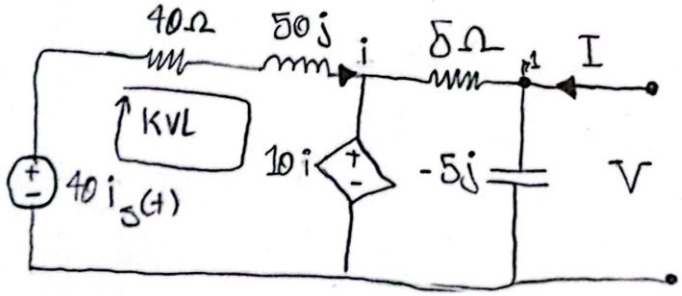


$$i_s(t) = 5\cos(5\times 10^4 t)$$



$$\text{KVL}: \quad -40\, i_s + (40+50j)\, i + 10i = 0 \longrightarrow i = \frac{40 i_s(t)}{50+50j}$$

$$i = \frac{40\times 5}{50+50j} = 2-2j$$

$$\text{KCL}(1): \quad \frac{V-10i}{5} + \frac{V-0}{-5j} - I = 0 \xrightarrow{\times 5} V - 10i - Vj = 5I \longrightarrow$$

$$V - 10(2-2j) - Vj = 5I \rightarrow (1+j)V = 5I + 10(2-2j)$$

$$V = \left(\frac{5}{2} - \frac{5}{2}j\right) I - 20j$$

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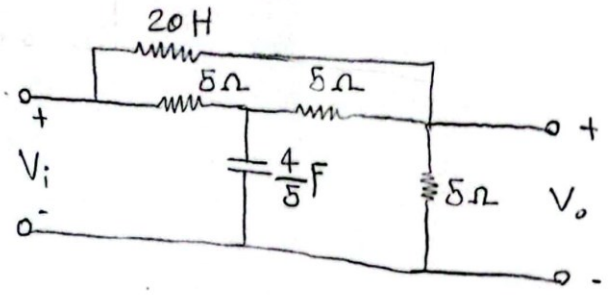

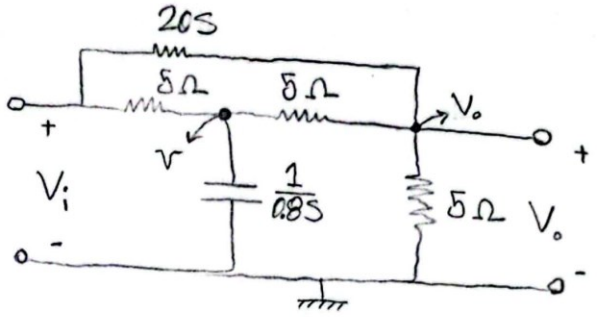

Kcl: $\frac{V-V_o}{5}+\frac{V-V_i}{5}+\frac{V}{\frac{1}{0.8s}}=0 \longrightarrow V=\frac{V_o+V_i}{2+4s}$ (I)

Kcl $\frac{V_o-V_i}{20s}+\frac{V_o-V}{5}+\frac{V_o-0}{5}=0 \xrightarrow{\times 20s} V_o-V_i+4sV_o-4sV+4sV_o=0$

$(1+8s)V_o-V_i+4sV_o=0 \xrightarrow{(I)} (1+8s)V_o-V_i+4s\left(\frac{V_o+V_i}{2+4s}\right)=0$

$(32s^2+16s+2)V_o=(8s+2)V_i$

$\frac{V_o}{V_i}=\frac{8s+2}{32s^2+16s+2}=\frac{4s+1}{16s^2+8s+1}=\frac{4s+1}{(4s+1)^2}\cdot\frac{1}{4s+1}$

$h(t) = -\delta(t) + 2e^{-2t}u(t)$

$e(t) = 1 + \cos 2t + \sin 4t$

$H(s) = -1 + \frac{2}{s+2} \Rightarrow \frac{-s}{s+2}$

$1 \rightarrow H(0) = 0$

$\cos 2t \rightarrow H(2j) = \frac{-2j}{2+2j} = \frac{-1}{2} - \frac{1}{2}j \Rightarrow \frac{\sqrt{2}}{2}\cos(2t - \frac{3\pi}{4})$

$\sin 4t \rightarrow H(4j) = \frac{-4j}{2+4j} = \frac{16}{20} - \frac{8}{20}j \Rightarrow \frac{2\sqrt{5}}{5}\sin(4t - 26.56)$