جواب تمرینات سری پنجم

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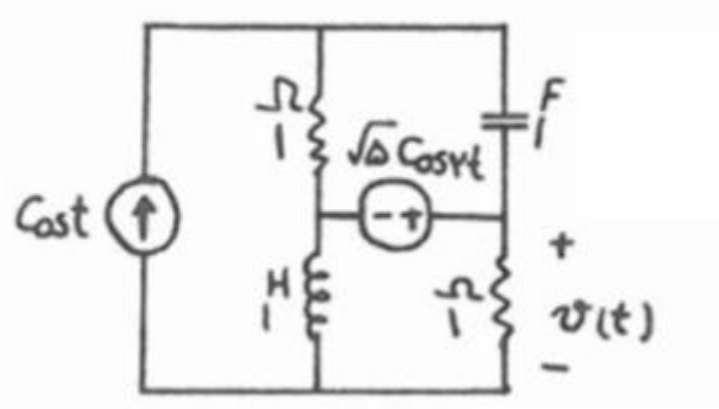
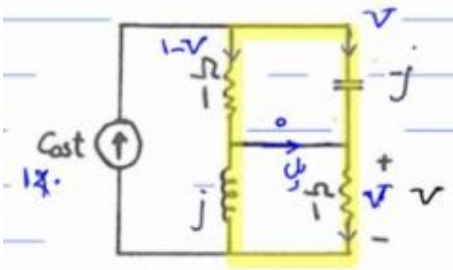


منابع ورودی غیرهم فرکانس ← جمع آثار

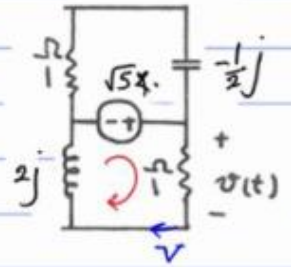
$\omega = 1$



$1 \times 1 = -j \times j$ ← دو شاخه متقارن

$1 - V + j(1-V) = V(1-j)$

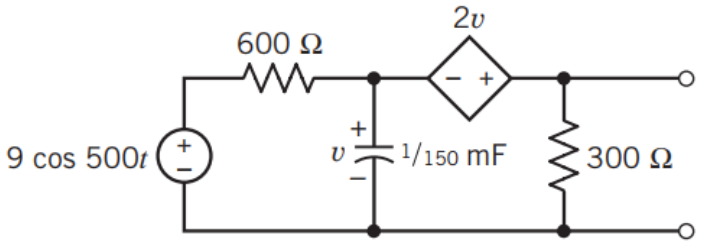
$2V = 1 + j \rightarrow V = \frac{1+j}{2} = \frac{\sqrt{2}}{2}\angle 45$



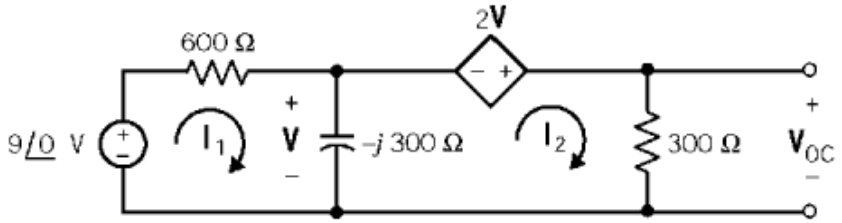
$V + 2jV = \sqrt{5} \rightarrow V = \frac{\sqrt{5}}{1+2j} = \frac{\sqrt{5}}{\sqrt{5}\angle \tan^{-1}2}$

$V = 1\angle -\tan^{-1}2$

$v(t) = \frac{\sqrt{2}}{2}\cos(t+45) + 1\cos(2t - \tan^{-1}2)$



First, determine $\mathbf{V}_{oc}$:



The mesh equations are

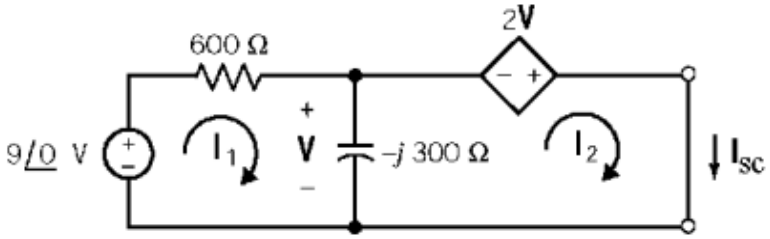
$$600\mathbf{I}_1 - j300(\mathbf{I}_1 - \mathbf{I}_2) = 9 \quad \Rightarrow \quad (600 - j300)\mathbf{I}_1 + j300\mathbf{I}_2 = 9\angle 0°$$

$$-2\mathbf{V} + 300\mathbf{I}_2 - j300(\mathbf{I}_1 - \mathbf{I}_2) = 0 \quad \text{and} \quad \mathbf{V} = j300(\mathbf{I}_1 - \mathbf{I}_2) \quad \Rightarrow \quad j3\mathbf{I}_1 + (1 - j3)\mathbf{I}_2 = 0$$

Using Cramer's rule: $\mathbf{I}_2 = 0.0124\angle -16° \text{ A}$

Then $\mathbf{V}_{oc} = 300\mathbf{I}_2 = 3.71\angle -16° \text{ V}$

Next, determine $\mathbf{I}_{sc}$:

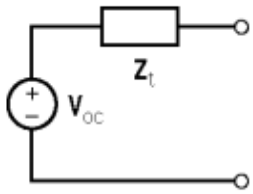


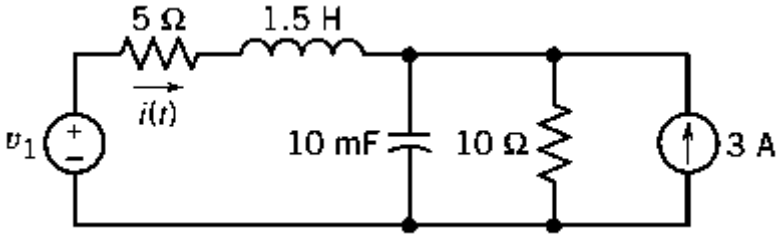
$$-2\mathbf{V} - \mathbf{V} = 0 \quad \Rightarrow \quad \mathbf{V} = 0 \quad \Rightarrow \quad \mathbf{I}_{sc} = \frac{9\angle 0°}{600} = 0.015\angle 0° \text{ A}$$

The Thevenin impedance is

$$\mathbf{Z}_T = \frac{\mathbf{V}_{oc}}{\mathbf{I}_{sc}} = \frac{3.545\angle -16°}{0.015\angle 0°} = 247\angle -16° \ \Omega$$

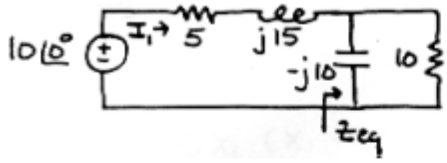
The Thevenin equivalent is





$v_1(t)=10\cos(10t)$ V

Use superposition. First, find the response to the voltage source acting alone:



$$\mathbf{Z}_{eq}=\frac{-j10\cdot 10}{10-j10}=5(1-j)\ \Omega$$

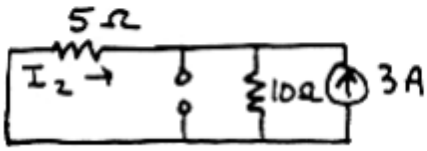
Replacing the parallel elements by the equivalent impedance. The write a mesh equation :

$$-10+5\,\mathbf{I}_1+j15\,\mathbf{I}_1+5(1-j)\,\mathbf{I}_1=0 \ \Rightarrow\ \mathbf{I}_1=\frac{10}{10+j10}=0.707\angle -45^\circ\ \text{A}$$

Therefore:

$$i_1(t)=0.707\cos(10t-45^\circ)\ \text{A}$$

Next, find the response to the dc current source acting alone:



Current division: $I_2=-\frac{10}{15}\times 3=-2\ \text{A}$

Using superposition:

$$i(t)=0.707\cos(10t-45^\circ)-2\ \text{A}$$

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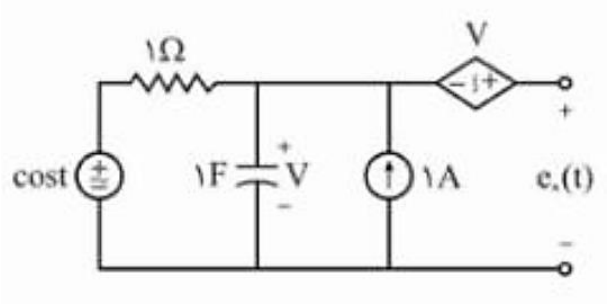
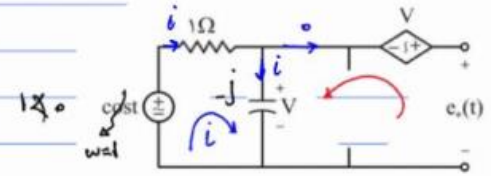


✓ مدار شامل ۲ منبع مستقل یکی با فرکانس $\omega=0$ و دیگری با فرکانس $\omega=1$ است. باید از جمع آثار استفاده کنیم



۱) اثر فقط منبع cost

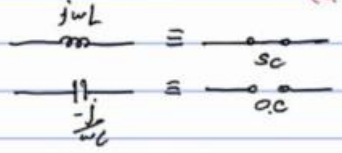
$$1\angle 0 = (1-j)\,I \longrightarrow I = \frac{1}{1-j} = \frac{1}{\sqrt{2}\angle -45^\circ} = \frac{1}{\sqrt{2}}\angle 45^\circ$$

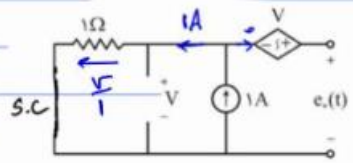
$$-e_o + V + V = 0 \longrightarrow e_o = 2V = \frac{2}{\sqrt{2}}\angle -45^\circ$$

$$V = -jI = -j \times \frac{1}{\sqrt{2}}\angle 45 = \frac{1}{\sqrt{2}}\angle -45^\circ$$

$$e_o(t) = \frac{2}{\sqrt{2}}\cos(t-45^\circ)$$

۲) اثر منبع dc ← $\omega=0$ ← حالت دائمی DC (ثابت)

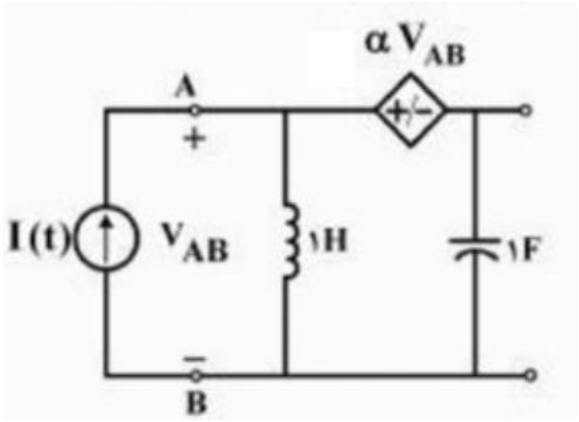


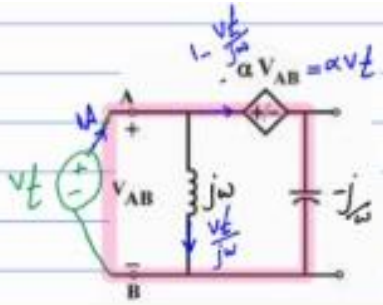


$$\frac{V}{1} = 1 \longrightarrow V = 1$$

KVL: $-e_o + V + V = 0 \longrightarrow e_o = 2V = 2$

پاسخ کامل $\Rightarrow e_o(t) = 2 + \frac{2}{\sqrt{2}}\cos(t-45^\circ)$





$$KVL: V_t = \left(1 - \frac{V_t}{j\omega}\right)\left(\frac{-j}{\omega}\right) + \alpha V_t$$

$$V_t = \frac{\frac{-j}{\omega}}{1 - \alpha - \frac{1}{\omega^2}} = Z_{th}$$

$$Z_{th} = \frac{-\omega j}{\omega^2(1-\alpha) - 1}$$

$$Z_{eq} = \bigcirc\, j + \bigcirc \quad \text{(ω)}$$

$$Z_{th} = \bigcirc + \bigcirc j$$

$$Z = \underset{\text{۲}}{\bigcirc} j \quad \text{طف}$$

$$Z_{th} = \underbrace{\frac{-\omega}{\omega^2(1-\alpha) - 1}}_{\text{حقیقی}} j$$

$$-\frac{\omega}{\omega^2(1-\alpha) - 1} > 0 \longrightarrow \omega^2(1-\alpha) - 1 < 0$$

$$\omega^2(1-\alpha) < 1$$

$$1 - \alpha < \frac{1}{\omega^2}$$

$$\alpha > 1 - \frac{1}{\omega^2} \quad (\omega^2 \to \infty)$$

$\omega \to 0 : \alpha > -\infty$

$\omega \to \infty : \alpha > 1$ ← اشتراک ⇒ $\boxed{\alpha > 1}$

$\omega \to 1 : \alpha > 0$