2017320114_ 최재원

Example

Sinusoidal 일때는

$A\cos(\omega t+\theta) \rightarrow$ ang. freq. $=\omega$

$f=\frac{\omega}{2\pi}$ $T=\frac{2\pi}{\omega}$

D4.1. Given the voltage $v(t) = 120\cos\left(314t + \frac{\pi}{4}\right)$ V, determine the frequency of the voltage in Hertz and the phase angle in degrees.

$f=\frac{314}{2\pi} = 49.97\text{ Hz}$ phase angle $= 45^\circ$

D4.3. Convert the following voltage functions to phasors.

$$v_1(t) = 12\cos(377t - 425^\circ)\text{ V}$$
$$v_2(t) = 18\sin(2513t + 4.2^\circ)\text{ V}$$

$360+65$

$V_1(t) = 12\cos(377t-65^\circ)$

$\cos(\theta-90^\circ) = \sin\theta$

$V_2 = 18\cos(2513t-85.8^\circ)$

$V_1 = 12\angle -65^\circ$ V $V_2 = 18\angle -85.8^\circ$ V

D4.4. Convert the following phasors to the time domain if the frequency is 400 Hz.

$V_1 = A\cos(2\pi f t + \phi)$ $A=10$ $\phi = 20^\circ$

$$\mathbf{V}_1 = 10\angle 20^\circ$$
$$\mathbf{V}_2 = 12\angle -60^\circ$$

$V_1 = 10\cos(800\pi t+20^\circ)$

$V_2 = 12\cos(800\pi t-60^\circ)$

Example

D4.5. Compute the impedance $\mathbf{Z}_T$ in the network in Figure D4.5.

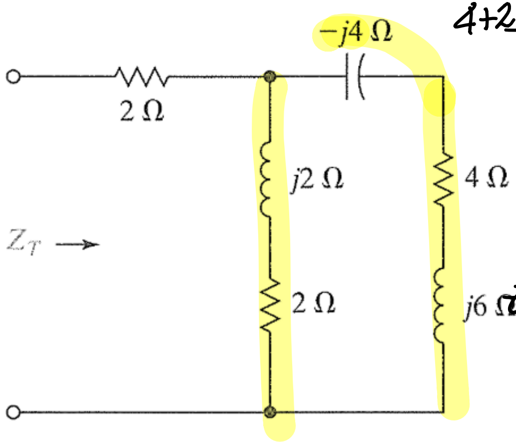


FIGURE D4.5

$4+2j$

$$\frac{1}{2+2j} + \frac{1}{4+2j} =$$

$$\frac{2-2j}{4+4} + \frac{4-2j}{20} =$$

$$Z_T = \frac{2-2j}{8} + \frac{4-2j}{20} = \boxed{\frac{9}{20} - \frac{7}{20}j}$$

Example

D4.6. Determine $\mathbf{Z}_{eq}$ at the terminals $A - B$ of the network shown in Figure D4.6.

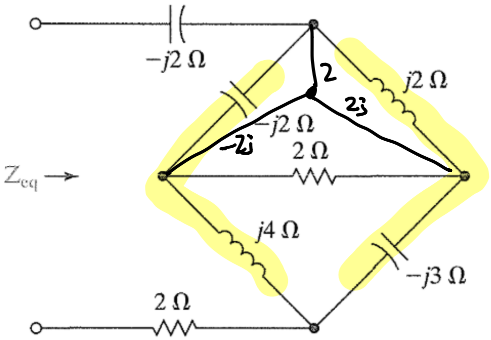


FIGURE D4.6

$$\frac{1}{\frac{1}{2j}+\frac{1}{-j}} = -2j$$

$$Z_{eq} = 4 - 4j\,\Omega$$

Example

D4.8. Use nodal analysis to find $\mathbf{I}_0$ in the circuit in Figure D4.8.

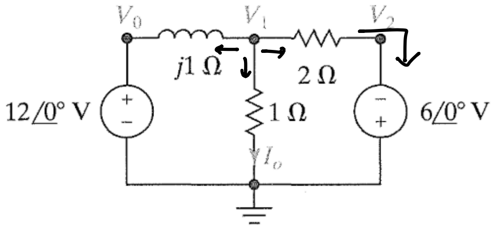


FIGURE D4.8

at node V_1 KCL

I_0

$$\frac{V_1 - V_0}{j} + \frac{V_1 - V_2}{2} + \frac{V_1}{1} = 0$$

$V_0 = 12\angle 0°$ V

$V_2 = -6\angle 0°$ V

$$-j(V_1 - V_0) + \frac{3}{2}V_1 - \frac{V_2}{2} = 0$$

$$V_1\left(+\frac{3}{2} - j\right) + V_0 \cdot j - \frac{V_2}{2} = 0$$

$$V_1\left(+\frac{3}{2} - j\right) + 12\angle 0° \cdot j + 3\angle 0° = 0$$

$$V_1 = \frac{12\cancel{\angle 0°} j + 3\cancel{\angle 0°}}{\frac{3}{2} - j}$$

$$V_1 = \frac{30}{13} - \frac{84}{13}j$$

$I_0 = V_1$

$$\boxed{I_0 = \left(\frac{30}{13} - \frac{84}{13}j\right)\cdot A}$$

Example

$V = I \times R$

D4.9. Use mesh equations to find $\mathbf{V}_0$ in the network in Figure D4.9.

$I_o = \sqrt{3} + j$

$2 \times (\cos 30° + \sin 30° \cdot j)$

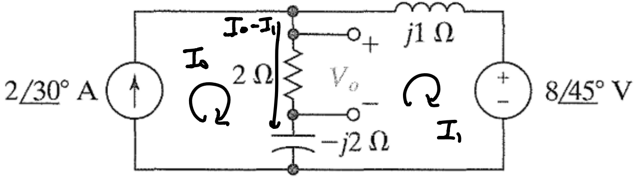


FIGURE D4.9

$V_o = 2 \cdot (I_o - I_1)$

KVL

$(I_1 - 2\angle 30°) \cdot (2 - 2j) + I_1 \cdot j + 8\angle 45° = 0$

$V_o = 0.77 + 7.77\,V$

$(2 - j) I_1 - 4\angle 30° - 4j\angle 30° + 8\angle 45° = 0$

$\cancel{(2-j)} I_1 = \frac{(4+4j)}{2-j}\angle 30° + \frac{8\angle 45°}{2-j}$

Example

D4.10. Using superposition, find $\mathbf{V}_0$ in the network in Figure D4.10.

KCL at V_1

$$\frac{V_1 - 24\angle 0^\circ}{2} + \frac{V_1 - V_0}{-2j} + \frac{V_1 + 12\angle 0^\circ}{2j} = 0$$

$$\Rightarrow V_0 + V_1 j = (-12+24j)\angle 0^\circ$$

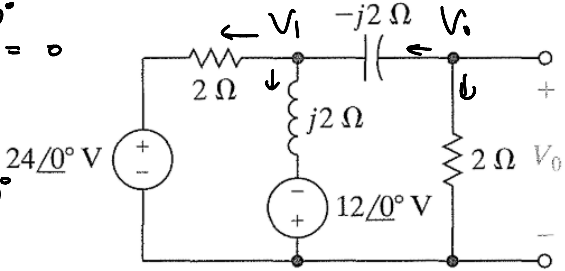


FIGURE D4.10

KCL at V_0

$$\frac{V_0}{2} + \frac{V_0 - V_1}{-2j} = 0$$

$$V_0(j-1) + V_1 = 0$$

$$\boxed{V_0 = 12\angle 90^\circ\ V}$$

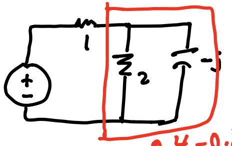
Matrix

$$\begin{bmatrix} 1 & j \\ j-1 & 1 \end{bmatrix} \begin{bmatrix} V_0 \\ V_1 \end{bmatrix} = \begin{bmatrix} -12+24j \\ 0 \end{bmatrix}$$

Example

$\bar{i}_1(t) = \frac{10}{3}$

$8 \cdot e^{j0^\circ}$



$\frac{1}{j\omega C} = \frac{1}{j \cdot 2 \cdot \frac{1}{2}} = -j$

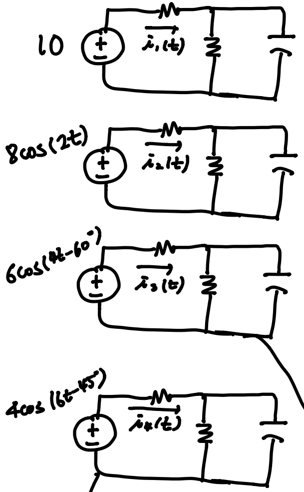
$\frac{1}{Z_p} = \frac{1}{2} + \frac{1}{-j} \qquad Z_p = \frac{-2j\,(2+j)}{(2-j)(2+j)} = 0.4-0.8j$

total imp

$Z = 1.4-0.8j$

D4.14. Determine the expression for the steady-state current $i(t)$ in Figure D4.14 if the input voltage $v_s(t)$ is given by the expression

$$v_s(t) = 10 + 8\cos(2t) + 6\cos(4t - 60^\circ) + 4\cos(6t - 45^\circ)\ \text{V}$$



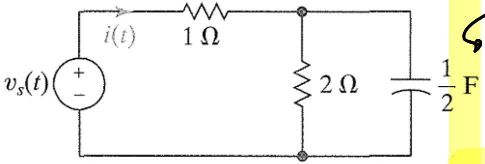


FIGURE D4.14

$\bar{i}(t) = \bar{i}_1(t) + \bar{i}_2(t) + \bar{i}_3(t) + \bar{i}_4(t)$

$= \frac{10}{3} + 4.96\cos(2t+29.7^\circ) + 4.95\cos(4t-37.17^\circ)$

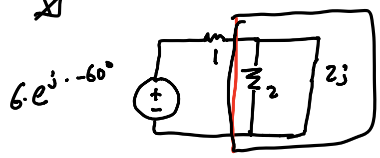
$+ 3.69\cos(6t-27.9^\circ)$

$\frac{8}{Z} = 4.3077 + 2.4615i$

$\omega = 2 \quad \bar{i}_2(t) = 4.96\cos(2t+29.7^\circ)$

$\angle I = \text{angle}(I) \times \frac{180}{\text{pi}} = 29.7^\circ$

$|I| = \text{abs}(I) = 4.96$



$$\frac{1}{Z_p} = \frac{1}{2} + \frac{1}{2}\cdot 4j$$

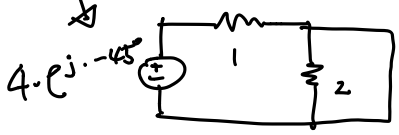
$$= \frac{2}{17}(1-4j)$$

$$j\omega C = j\times 4\times\frac{1}{2}$$

$$Z_p = \frac{2}{17} - \frac{8}{17}j$$

$$I = \frac{6e^{-j60°}}{Z_p}$$

$$= i_3(t) = 4.95\cos(4t - 37.17°)$$



$$j\omega C = j\times 6\times\frac{1}{2} = 3j$$

$$\frac{1}{Z_p} = \frac{1}{2} + 3j = \frac{2}{1+6j} \Rightarrow I = \frac{4e^{j\cdot -45°}}{Z_p} = i_4(t) = 3.69\cos(6t - 27.90°)$$