2017320114_최재원.

Example

D5.1. Find the average power absorbed by each resistor in the network in Figure D5.1.

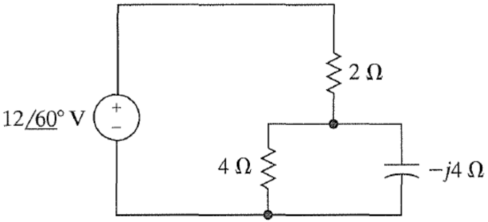


FIGURE D5.1

Ans: $P_{2\Omega} = 7.18$ W, $P_{4\Omega} = 7.14$ W.

$\frac{1}{Z_p} = \frac{1}{4} + \frac{1}{-4j}$ $\quad \frac{1}{4} + \frac{j}{4}$

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

$4-2j = 4.47\angle -26.5°$

$I = \frac{V}{Z} = 2.68\angle 86.5°$

$I_{4\Omega} = I \times \frac{-4j}{4-4j} = I \times \frac{1-j}{2}$

$= 2.68 \times \frac{\sqrt{2}}{2} = 1.9$

$P_{4\Omega} = \frac{1}{2}\times(1.9)^2\times 4 = 7.14W$

$P_{2\Omega} = \frac{1}{2}\times(2.68)^2\times 2 = 7.18W$

$I_{2\Omega} = 2.68 \times 1 = 2.68$

Example

D5.2. Given the network in Figure D5.2, find the average power absorbed by each passive circuit element and the total average power supplied by the current source.

$$I_{3\Omega} + I_{4\Omega} = 10\angle 30^\circ$$

$$I_{3\Omega} = \frac{4+j2}{7+j2} = 6.14\angle 0.71$$

$$I_{4\Omega} = \frac{3}{7+j2} = 4.12\angle 0.245$$

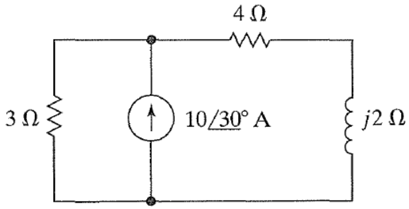


FIGURE D5.2

Ans: $P_{3\Omega} = 56.62$ W, $P_{4\Omega} = 33.95$ W, $P_L = 0$, $P_{cs} = -90.50$ W.

$$P_{3\Omega} = \frac{1}{2} \times (6.14)^2 \times 3 = 56.62\,W$$

$$P_{4\Omega} = \frac{1}{2} \times (4.12)^2 \times 4 = 33.95\,W$$

$$P_L = 0$$

$$P_{cs} = -(56.62 + 33.95) = -90.57\,W$$

Example

D5.3. Compute the rms value of the voltage waveform shown in Figure D5.3.

$\frac{4}{2}$

$V(t) - 0 = 2 \times t$

$V(t) = 2t$

$V(t) = \begin{cases} 2t & 0 < t < 2 \\ 0 & 2 < t < 4 \end{cases}$

$V_{rms} = \sqrt{\frac{1}{T}\int_0^T v^2(t)\,dt}$

$= \sqrt{\frac{1}{4}\left(\int_0^2 (2t)^2\,dt + \int_2^4 0^2\,dt\right.}$

$= \left[\frac{t^3}{2}\right]_0^2 = \sqrt{\frac{8}{3}} = 1.633$

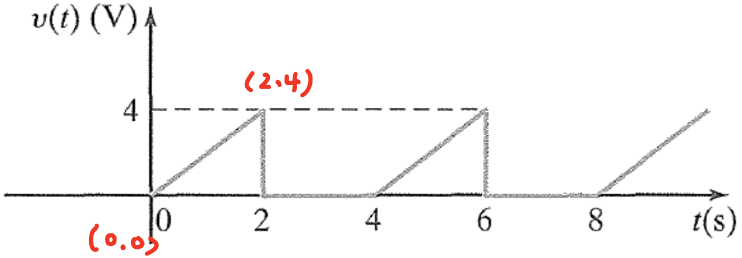


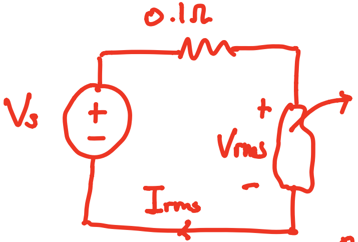
FIGURE D5.3

Ans: $V_{rms} = 1.633$ V rms.

Example

D5.5. An industrial load consumes 100 kW at 0.707 PF lagging. The 60 Hz line voltage at the load is $480\angle 0°$ V rms. The transmission line resistance between the power company's transformer and the load is 0.1 Ω. Determine the power savings that could be obtained if the PF is changed to 0.94 lagging.

Ans: Power saved is 3.771 kW.



$P = 100\,kW = 10^6\,W$

$480 \cdot I_{rms} \times 0.707 = 10^6$

$I_{rms} = 294.67$

① $P_{0.1\Omega} = I_{rms}^2 \times 0.1 = (294.67)^2 \times 0.1 = 8.68 \times 10^3\,W$

$480 \times I_{rms} \times 0.94 = 10^6$

$I_{rms} = 221.63$

② $P_{0.1\Omega} = 221.63^2 \times 0.1 = 4.91 \times 10^3\,W$

$\therefore (8.68 - 4.91) = \boxed{3.77\,kW}$

Example

D5.6. An industrial load operates at 20 kW, 0.8 PF lagging with a line voltage of $220\angle 0^\circ$ V rms. Construct the power triangle for the load.

Ans:

$$P = V_{rms} \cdot I_{rms} \cdot \overset{0.8}{\cos(\theta_v - \theta_i)}$$

$$\theta_v - \theta_i = \cos^{-1} 0.8$$

$$= 36.69^\circ$$

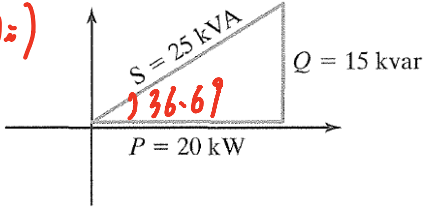


FIGURE D5.6

$$S = 20\,\text{kW} \times \frac{1}{\cos 36.68^\circ} = 25\,\text{kVA}$$

$$Q = 20\,\text{kW} \times \tan 36.64^\circ = 20\,\text{kvar}.$$