Problem 9.49

A transmission line with impedance 0.08 – *j* 0.25 Ω is used to deliver power to a load. The load is inductive and the3 load voltage is 220 ∠0° V rms at 60 Hz. If the load requires

Suggested Solution

$Z_{line} = .08 + j.25$

$V_{Load} = 220\angle 0°$ at 60 Hz

$P_{load} = 12kW \quad P_{Line} = 560kW$ Find pf at load.

$P_{line} = 560 = I^2(.08)$ yeilds $I = 83.67A$

$P_{load} = IV\cos\theta = 12kW = (220)(83.67)\cos\theta$

$$\theta = \cos^{-1}\frac{12000}{(220)(83.67)} = \boxed{.65 = pf\ \ lagging}$$

Problem 9.52

Given the network in Fig P 9.52, determine the input voltage Vs.

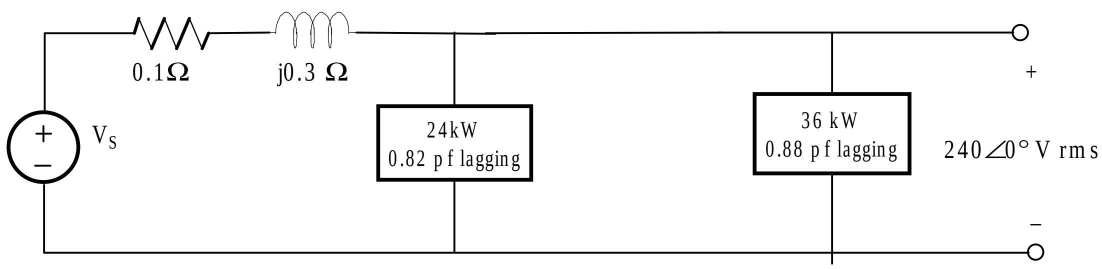
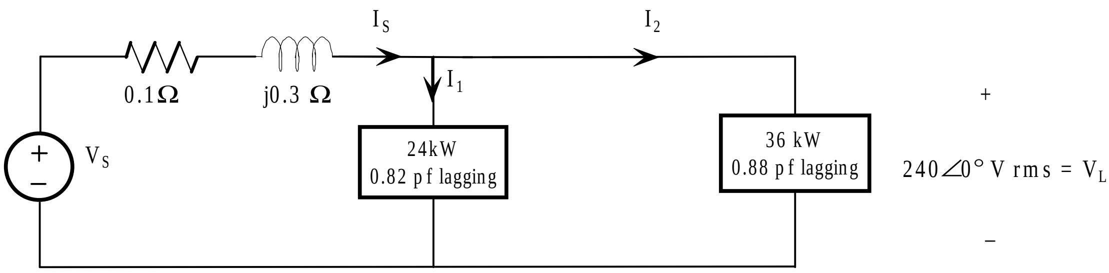


Figure P 9.52

Suggested Solution



$V_S = V_L + I_S\left(.01 + j.03\right)$

$I_S = I_1 + I_2$

Find I_1: $I_1 = \dfrac{P_1}{|V_L|\left(pf_1\right)}\angle -\cos^{-1}(.82) = 121.95\angle -34.92°A_{rms}$

Find I_2: $I_2 = \dfrac{P_2}{|V_L|\left(pf_2\right)}\angle -\cos^{-1}(.88) = 170.45\angle -28.36°A_{rms}$

Find I_S: $I_S = I_1 + I_2 = 250 - j150.76$

$I_S = 291.94\angle -31.09°A_{rms}$

Find V_S: $V_S = V_L + I_S\left(0.1 + j0.3\right) = V_L + I_S\left[0.316\angle 71.57°\right]$

$V_S = 240 + 92.25\angle 40.48°V_{rms}$

$\boxed{V_S = 315.90\angle 10.93°V_{rms}}$

Problem 10.5

A positive-sequence three-phase balanced wye voltage source has a phase voltage of $\mathbf{V}_{an} = 240\angle 90°$ V rms. Determine the line voltages of the source.

Suggested Solution

$\mathbf{V}_{ab} = \sqrt{3}\cdot|\mathbf{V}_{an}|\angle\left(\theta_{\mathbf{V}_{an}} + 30°\right) = 415.7\angle 120°$ V rms

$\mathbf{V}_{bc} = 415.7\angle 0°$ V rms

$\mathbf{V}_{ca} = 415.7\angle -120°$ V rms

Problem 10.19

In a balanced three-phase wye-wye system, the load impedance is $20 + j12\ \Omega$. The source has an *abc*-phase sequence and $\mathbf{V}_{an} = 120\angle 0°$ V rms. If the load voltage is $\mathbf{V}_{AN} = 111.49\angle -0.2°$ V rms, determine the magnitude of the line current if the load is suddenly short circuited.

Suggested Solution

$$\mathbf{I}_{aA} = \frac{111.49\angle -0.2^\circ}{20 + j12} = 4.78\angle -31.16^\circ \text{ A rms}$$

$$\mathbf{V}_{line} = 120\angle 0^\circ - 111.49\angle -0.2^\circ = 8.52\angle 2.62^\circ \text{ V rms}$$

$$\mathbf{Z}_{line} = \frac{\mathbf{V}_{line}}{\mathbf{I}_{aA}} = \frac{8.52\angle 2.62^\circ}{4.78\angle -31.16^\circ} = 1.78\angle 33.78^\circ\ \Omega$$

$$\therefore \qquad \left|\mathbf{I}_{aA_{SC}}\right| = \frac{120}{1.78} = 67.42 \text{ A rms}$$