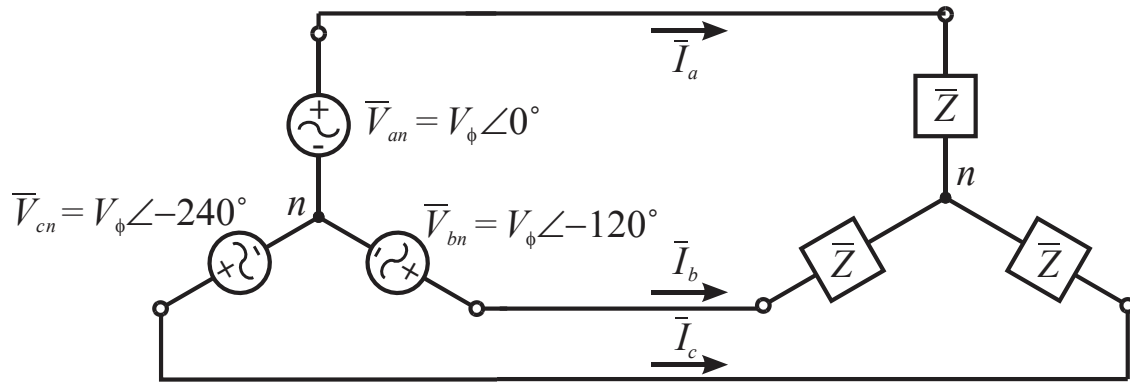


EE 330 Energy Systems (Fall 2026) Quiz #3

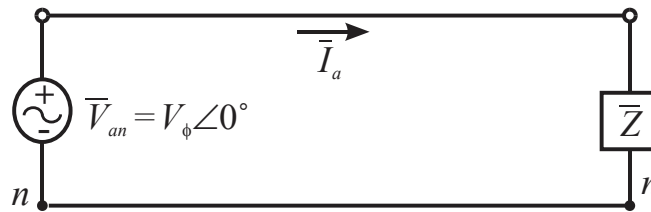
Name KEY A

Instructions: Open book & notes. Place answers in indicated spaces and show all work for credit.

For the balanced three-phase system shown, the phase voltage is measured to be $120 \text{ V}_{\text{rms}}$ and the load impedance is $9 - j6 \Omega$. Determine the RMS line current I_L and RMS line-to-line voltage V_{LL} . Then, calculate the real power P , reactive power Q , and apparent power S supplied by the source as well as the power factor PF.



Since it is a balanced Y-Y system, use a per-phase equivalent circuit:



By Ohm's Law, $\bar{I}_a = \bar{V}_{an} / \bar{Z} = (120 \angle 0^\circ) / (9 - j6) = 11.094 \angle 33.69007^\circ \text{ A}_{\text{rms}}$.

Per $\theta = \theta_V - \theta_I = 0 - 33.69007^\circ \Rightarrow \underline{\theta = -33.69007^\circ}$.

Per (1-62), the power factor is $\text{PF} = \cos(\theta) = \cos(-33.69007^\circ) \Rightarrow \underline{\text{PF} = 0.83205 \text{ leading}}$.

Per (2-10), $I_L = I_\phi \Rightarrow I_L = I_a = 11.094 \Rightarrow \underline{I_L = 11.094 \text{ A}_{\text{rms}}}$.

Per (2-11), $V_{LL} = \sqrt{3} V_\phi = \sqrt{3} (120) \Rightarrow \underline{V_{LL} = 207.846 \text{ V}_{\text{rms}}}$.

Per (2-29), the power is

$$P = \sqrt{3} V_{LL} I_L \cos \theta = \sqrt{3} (207.8461) 11.094 \cos(-33.69007^\circ) \Rightarrow \underline{P = 3323.08 \text{ W}}$$

Per (2-30), the reactive power is

$$Q = \sqrt{3} V_{LL} I_L \sin \theta = \sqrt{3} (207.8461) 11.094 \sin(-33.69007^\circ) \Rightarrow \underline{Q = -2215.38 \text{ VAR}}$$

Per (2-31), the apparent power is $S = \sqrt{3} V_{LL} I_L = \sqrt{3} (207.8461) 11.094 \Rightarrow \underline{S = 3993.84 \text{ VA}}$.

$$I_L = \underline{11.094 \text{ A}_{\text{rms}}} \quad V_{LL} = \underline{207.846 \text{ V}_{\text{rms}}} \quad P = \underline{3323.08 \text{ W}}$$

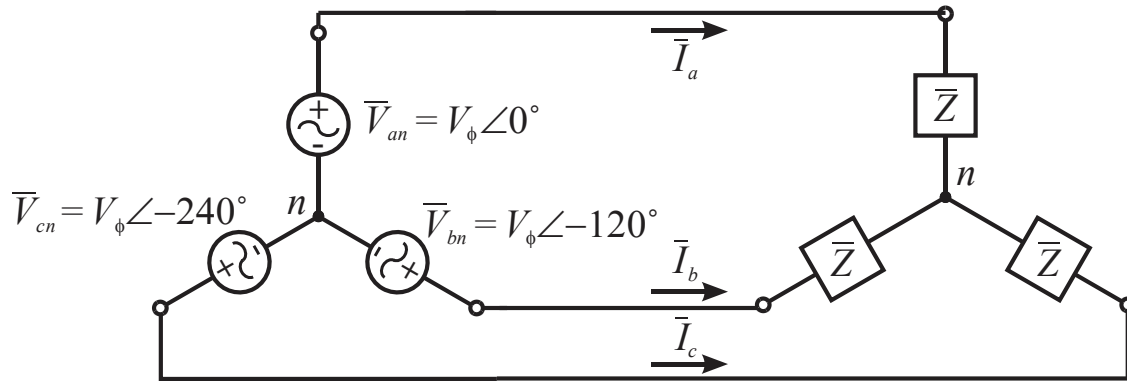
$$Q = \underline{-2215.38 \text{ VAR}} \quad S = \underline{3993.84 \text{ VA}} \quad \text{PF} = \underline{0.83205 \text{ leading}}$$

EE 330 Energy Systems (Fall 2026) Quiz #3

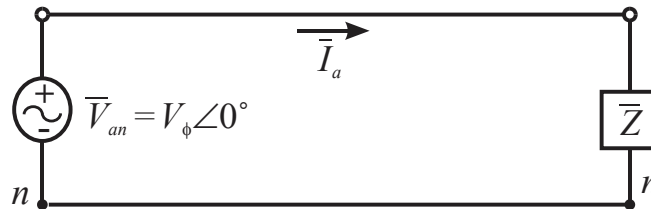
Name KEY B

Instructions: Open book & notes. Place answers in indicated spaces and show all work for credit.

For the balanced three-phase system shown, the phase voltage is measured to be 125 V_{rms} and the load impedance is $9 - j7 \Omega$. Determine the RMS line current I_L and RMS line-to-line voltage V_{LL} . Then, calculate the real power P , reactive power Q , and apparent power S supplied by the source as well as the power factor PF.



Since it is a balanced Y-Y system, use a per-phase equivalent circuit:



By Ohm's Law, $\bar{I}_a = \bar{V}_{an} / \bar{Z} = (125 \angle 0^\circ) / (9 - j7) = 10.96322524 \angle 37.874984^\circ \text{ A}_{\text{rms}}$.

Per $\theta = \theta_V - \theta_I = 0 - 37.875^\circ \Rightarrow \underline{\theta = -37.875^\circ}$.

Per (1-62), the power factor is $\text{PF} = \cos(\theta) = \cos(-37.875^\circ) \Rightarrow \underline{\text{PF} = 0.78935 \text{ leading}}$.

Per (2-10), $I_L = I_\phi \Rightarrow I_L = I_a = 10.96322524 \Rightarrow \underline{I_L = 10.963 \text{ A}_{\text{rms}}}$.

Per (2-11), $V_{LL} = \sqrt{3} V_\phi = \sqrt{3} (125) \Rightarrow \underline{V_{LL} = 216.506 \text{ V}_{\text{rms}}}$.

Per (2-29), the power is

$$P = \sqrt{3} V_{LL} I_L \cos \theta = \sqrt{3} (216.506) 10.963 \cos(-37.875^\circ) \Rightarrow \underline{P = 3245.19 \text{ W}}$$

Per (2-30), the reactive power is

$$Q = \sqrt{3} V_{LL} I_L \sin \theta = \sqrt{3} (216.506) 10.963 \sin(-37.875^\circ) \Rightarrow \underline{Q = -2524.04 \text{ VAR}}$$

Per (2-31), the apparent power is $S = \sqrt{3} V_{LL} I_L = \sqrt{3} (216.506) 10.963 \Rightarrow \underline{S = 4111.21 \text{ VA}}$.

$$\begin{array}{lll} I_L = \underline{10.963 \text{ A}_{\text{rms}}} & V_{LL} = \underline{216.506 \text{ V}_{\text{rms}}} & P = \underline{3245.19 \text{ W}} \\ Q = \underline{-2524.04 \text{ VAR}} & S = \underline{4111.21 \text{ VA}} & \text{PF} = \underline{0.78935 \text{ leading}} \end{array}$$