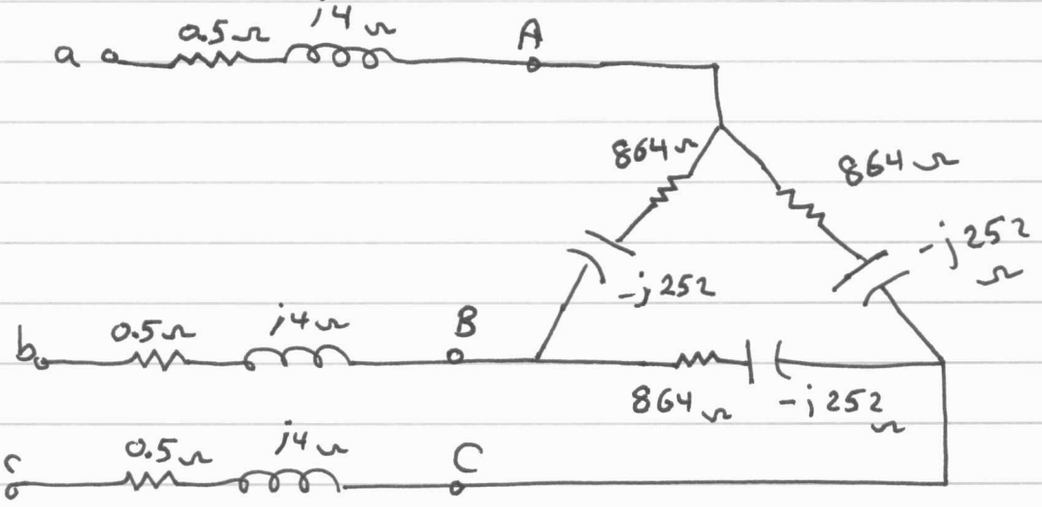
Homework Solutions Ch. 11 EE 231

11.14



$\overrightarrow{V_{AB}} = 69\angle 0^\circ \text{ KV}$

$\overrightarrow{I_{AB}} = \dfrac{69\angle 0^\circ \text{ KV}}{864 - j252} = 76.67\angle 16.26^\circ \text{ A}$

$\therefore \overrightarrow{I_{BC}} = 76.67\angle -103.74^\circ \text{ A}$

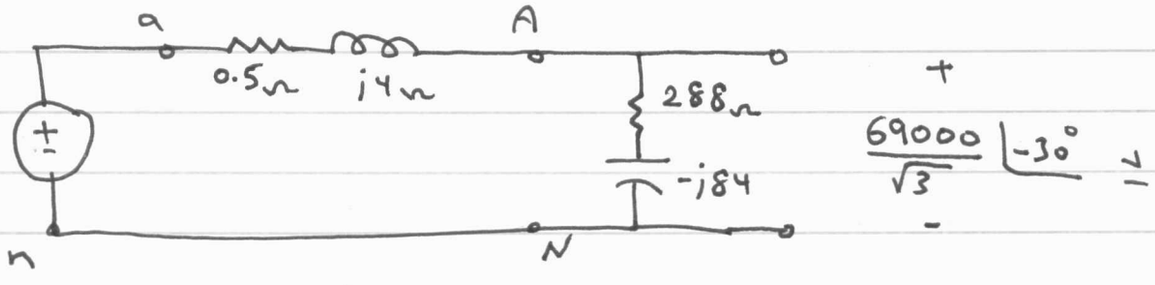
$\overrightarrow{I_{CA}} = 76.67\angle 139.26^\circ \text{ A}$

$\overrightarrow{I_{aA}} = \sqrt{3}\angle -30^\circ \; \overrightarrow{I_{AB}} = 132.79\angle -13.74^\circ \text{ A}$

$\overrightarrow{I_{bB}} = 132.79\angle -133.74^\circ \text{ A}$

$\overrightarrow{I_{cC}} = 132.79\angle 106.76 \text{ A}$

Single phase equivalent circuit



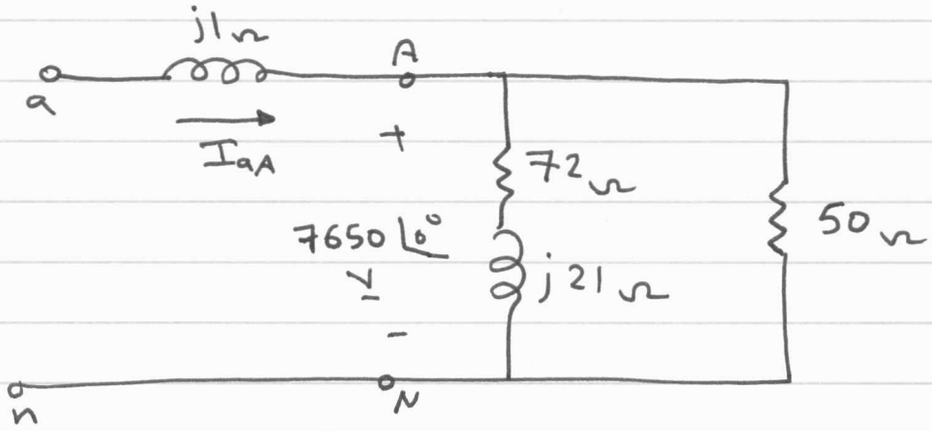
$\overrightarrow{V_{an}} = (0.5 + j4)\overrightarrow{I_{aA}} + \dfrac{69000}{\sqrt{3}}\angle -30^\circ = 39755.7\angle -29.24^\circ \text{ V}$

$\overrightarrow{V_{ab}} = \sqrt{3}\angle +30^\circ \; \overrightarrow{V_{an}} = 68858.88\angle 0.76^\circ \text{ V}$

$\overrightarrow{V_{bc}} = 68858.88\angle -119.24^\circ \text{ V}$

11.15

Single-phase equivalent Circuit



$$\vec{I}_{aA} = \frac{7650\angle 0^\circ}{50} + \frac{7650\angle 0^\circ}{72+j21} = 252.54\angle -6.49^\circ \text{ A}$$

$$|I_{aA}| = 252.54 \text{ A}$$

$$\vec{I}_{AB} = \frac{\vec{V}_{AB}}{150} = \frac{7650\sqrt{3}\angle 30^\circ}{150} = 88.33\angle 30^\circ \text{ A}$$

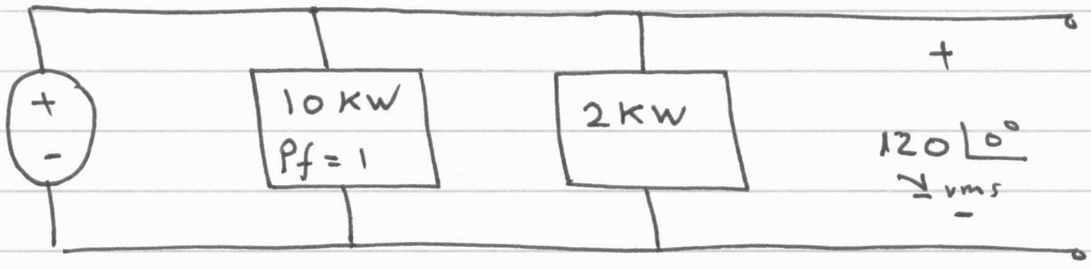
$$\vec{I}_{AN} = \frac{\vec{V}_{AN}}{72+j21} = 102\angle -16.26^\circ \text{ A}$$

$$\vec{V}_{an} = (j1)\,\vec{I}_{aA} + 7650\angle 0^\circ = 7682.66\angle 1.87^\circ \text{ V}$$

$$|V_{ab}| = \sqrt{3}\ 7682.66 = 13306.76 \text{ V}$$

11.23

Single-phase equivalent circuit



$$S_{g\phi} = 20\angle 53.13^\circ \text{ KVA}$$

$$S_{g\phi} = 12000 + j\,16000$$

$$S_{g\phi} = S_{1\phi} + S_{2\phi}$$

$$\therefore S_{2\phi} = 2000 + j\,16000$$

$$S_{2\phi} = \frac{|V_{rms}|^2}{Z_2^*}$$

$$\therefore Z_2^* = 0.11 - j\,0.89 \ \Omega$$

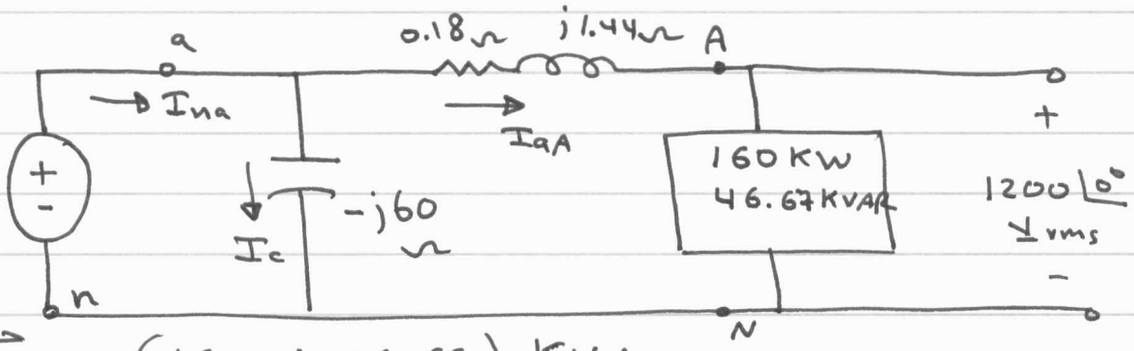
$$\therefore Z_2 = 0.11 + j\,0.89 \ \Omega$$

11.30

$|S_L| = 500\ KVA$, $pf = 0.96$ lag

$\therefore P_L = 480\ KW$, and $Q_L = 140\ KVAR$

Single-phase equivalent Circuit



$\vec{S}_{L\phi} = (160 + j\,46.67)\ KVA$

$\vec{S}_{L\phi} = \vec{V}_{AN} \cdot \vec{I}_{aA}^{\,*}$

$\therefore \vec{I}_{aA} = 133.3 - j\,38.9\ \ A\ rms$

$\vec{V}_{an} = (0.18 + j\,1.44)\,\vec{I}_{aA} + 1200\angle 0°$

$\vec{V}_{an} = 1280 + j\,185\ \ V\ rms$

$\vec{I}_c = \dfrac{\vec{V}_{an}}{-j60} = -3.1 + j\,21.3\ \ A\ rms$

$\vec{I}_{na} = \vec{I}_c + \vec{I}_{aA} = 131.4\angle -7.68°\ \ A\ rms$

$\vec{S}_{g\phi} = \vec{V}_{an} \cdot \vec{I}_{na}^{\,*} = 163472 + j\,46567\ \ VA$

139.7

$\therefore \vec{S}_{gT} = 3\,\vec{S}_{g\phi} = (490.4 + j\,132.7)\ KVA$

$\therefore P_{deliv} = 490.4\ KW$

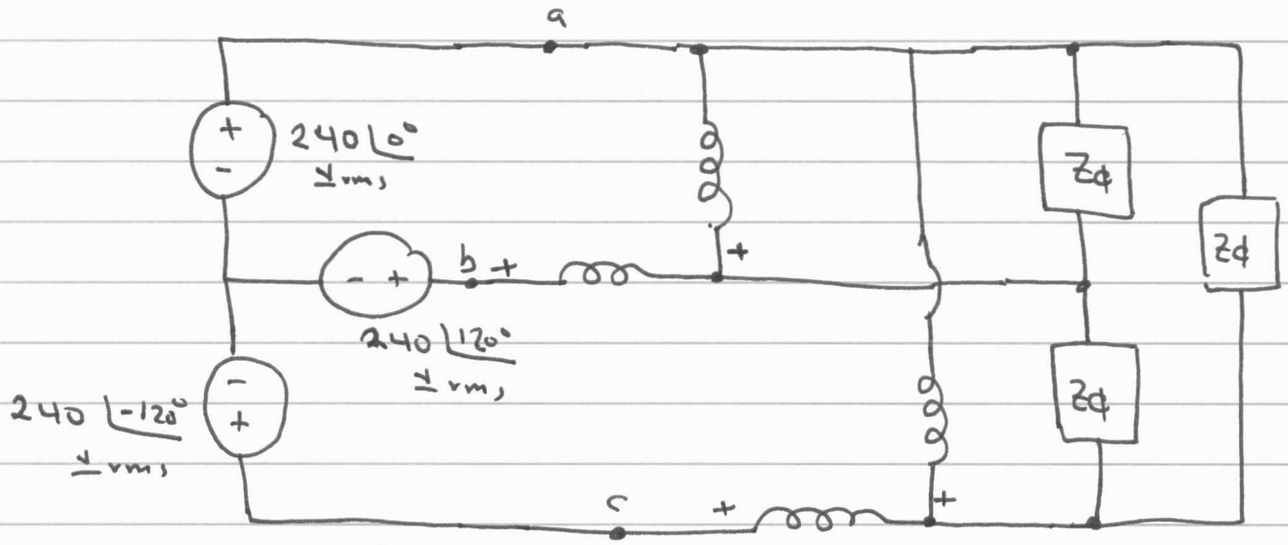
$P_{abs} = (3)(160\ KW) + (3)(|I_{aA}|^2)\cdot(0.18) = 490.4\ KW$

$Q_{deliv} = (3)|I_c|^2(60) + 139.7\ KVAR = 223.3\ KVAR$

$Q_{abs} = (3)(46.67)\ KVAR + (3)(|I_{aA}|^2)(1.44)$

$= 223.3\ KVAR$

11.46



$Z_\phi = 40\angle -30^\circ\ \Omega$, negative sequence

$W_1 = V_{BA} I_{bB} \cos\theta_1$

$\vec{V}_{an} = 240\angle 0^\circ$ V rms

$\vec{V}_{ab} = \sqrt{3}\,240\angle -30^\circ$ V rms

$\therefore \vec{V}_{BA} = \sqrt{3}\,240\angle 150$ V rms

$\vec{I}_{aA} = \dfrac{240\angle 0^\circ}{\frac{40}{3}\angle -30^\circ} = 18\angle 30^\circ$

$\therefore W_1 = (240\sqrt{3})(18)\cos(150-150)$

$\therefore W_1 = 7482.46\ W$

$W_2 = V_{cA} I_{cc} \cos\theta_2$

$\vec{V}_{cA} = \sqrt{3}\,240\angle -150^\circ$ V rms

$\vec{I}_{cc} = 18\angle -90^\circ$

$W_2 = (\sqrt{3}\,240)(18)\cos(-150+90^\circ) = 3741.23\ W$

$\therefore W_1 + W_2 = 11223.69\ W$

$P_\phi = V_{AB} I_{AB} \cos\theta_z$

$P_\phi = (\sqrt{3}\,240)\left(\frac{18}{\sqrt{3}}\right)\cos(-30^\circ) = 3741.23\ W$

$\therefore P_T = 3P_\phi = 11223.69\ W$