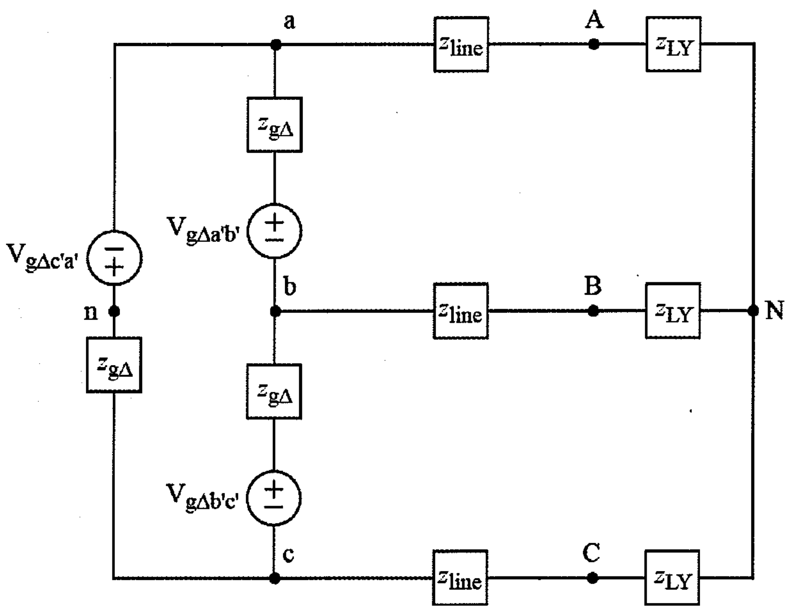
FINAL EXAM prob 4 solution

Ex:

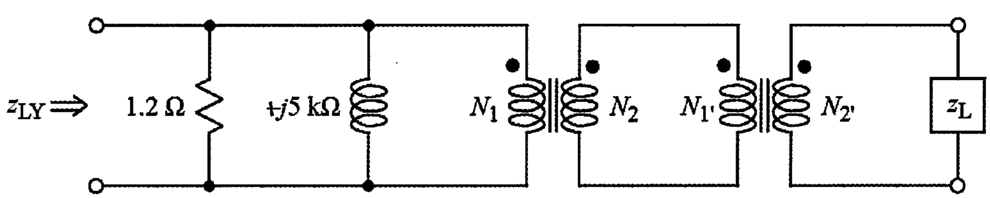


$V_{g\Delta a'b'} = 194\angle 0°$ V $\qquad z_{g\Delta} = j1.5\ \Omega$

$V_{g\Delta b'c'} = 194\angle{+120°}$ V $\qquad z_{line} = j1.1\ \Omega$

$V_{g\Delta c'a'} = 194\angle{-120°}$ V $\qquad z_{LY} = 1.2\ \Omega$

a) For the above 3-phase balanced circuit, find the numerical value of the phasor current $\mathbf{I}_{AN}$.



$N_1/N_2 = 5 \qquad N_{1'}/N_{2'} = 1/2$

b) Find the value of load impedance, z_L, that makes $z_{LY} = 1.2\ \Omega$ for the above circuit. Note that z_{LY} is the equivalent impedance of the entire circuit.

sol'n: a) We convert the delta generator to a Y configuration.

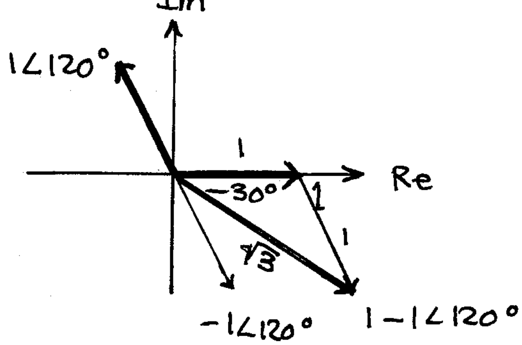
$$Z_{gY} = \frac{Z_{g\Delta}}{3} = j\frac{1.5\,\Omega}{3} = j\,0.5\,\Omega$$

$$V_{g\Delta a'b'} = V_{gYa'n} - V_{gYb'n}$$

or $V_{g\Delta a'b'} = V_{gYa'n} - V_{gYa'n}(1\angle 120°)$

or $V_{g\Delta a'b'} = V_{gYa'n}(1 - 1\angle 120°)$

We calculate $1 - 1\angle 120°$ graphically.



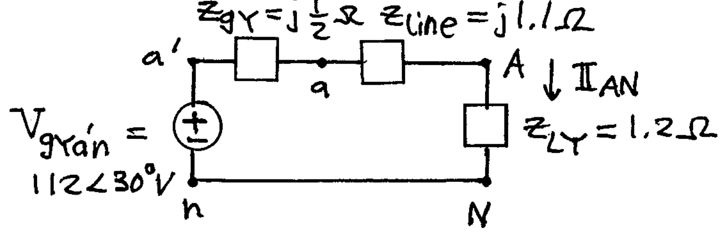
$$1 - 1\angle 120° = \sqrt{3}\angle -30°$$

So $V_{g\Delta a'b'} = V_{gYa'n}\sqrt{3}\angle -30°$

$$V_{gYa'n} = \frac{V_{g\Delta a'b'}}{\sqrt{3}\angle -30°} = \frac{194\angle 0°}{\sqrt{3}\angle -30°}$$

$$V_{gYa'n} \doteq 112\angle 30°\ \text{V}$$

Single-phase model:



$$\mathbb{I}_{AN} = \frac{\mathbb{V}_{gYa'n}}{Z_{gY} + Z_{line} + Z_{LY}}$$

$$'' = \frac{112\angle 30^\circ\ V}{j0.5 + j1.1 + 1.2\ \Omega}$$

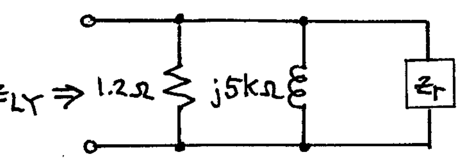
$$'' = \frac{112\angle 30^\circ\ V}{1.2 + j1.6\ \Omega}$$

$$'' \doteq \frac{112\angle 30^\circ\ V}{2\angle 53^\circ\ \Omega}$$

$$\mathbb{I}_{AN} \doteq 56\angle -23^\circ\ A$$

b) We use the idea of reflected impedance twice.

model:



$$= \left(\frac{N_1}{N_2}\right)^2 \left(\frac{N_1'}{N_2'}\right)^2 Z_L$$

$$Z_r = 5^2 \left(\frac{1}{2}\right)^2 Z_L = \frac{25}{4} Z_L$$

We want $Z_r = -j5k\Omega$ so that we have a parallel resonance that looks like an open.

So $Z_L = \frac{4}{25} Z_r = \frac{4}{25}(-j5k\Omega) = -j800\,\Omega$.

$$Z_L = -j800\ \Omega$$