EE 460
Solution of Home Work #2a

5.1 (a) $\overline{A} = \overline{D} = 1.0\angle 0°\ \text{pu};\ \overline{C} = 0.\ \text{S}$

$$\overline{B} = \overline{Z} = (0.19 + j0.34)25 = 9.737\angle 60.8°\ \Omega$$

(b) $$\overline{V}_R = \frac{33}{\sqrt{3}}\angle 0° = 19.05\angle 0°\ \text{kV}_{\text{LN}}$$

$$\overline{I}_R = \frac{S_R\ \angle -\cos^{-1}(pf)}{\sqrt{3}\,V_{R\,L\text{-}L}} = \frac{10}{\sqrt{3}(33)}\angle -\cos^{-1}(0.9)$$

$$= 0.175\angle -25.84°\ \text{kA}$$

$$\overline{V}_S = \overline{A}\overline{V}_R + \overline{B}\overline{I}_R = (1.0)(19.05) + (9.737\angle 60.8°)(0.175\angle -25.84°)$$

$$= 20.45 + j0.976 = 20.47\angle 2.732°\ \text{kV}_{\text{L-N}}$$

$$V_{S_{L\text{-}L}} = 20.47\sqrt{3} = 35.45\ \text{kV}$$

(c) $$\overline{I}_R = 0.175\angle 25.84°$$

$$\overline{V}_S = \overline{A}\overline{V}_R + \overline{B}\overline{I}_R = (1.0)(19.05) + (9.737\angle 60.8°)(0.175\angle 25.84°)$$

$$= 19.15 + j1.701 = 19.23\angle 5.076°\ \text{kV}_{\text{L-N}}$$

$$V_{S_{L\text{-}L}} = 19.23\sqrt{3} = 33.3\ \text{kV}$$

5.7 $V_S = \dfrac{3300}{\sqrt{3}} = 1905.3\,\text{V}$ (Line-to-neutral)

$0.5\angle 53.13° = 0.5(0.6 + j0.8) = 0.3 + j0.4$

$$I = \frac{(900/3)10^3}{0.8 \times V_R} = \frac{375 \times 10^3}{V_R}\,\text{A}$$

From the phasor diagram drawn below with $\bar{I}$ as reference,

$$V_S^2 = (V_R \cos\phi_R + IR)^2 + (V_R \sin\phi_R + IX)^2 \quad (1)$$

$$(1905.3)^2 = \left(0.8V_R + \frac{375 \times 10^3 \times 0.3}{V_R}\right)^2 + \left(0.6V_R + \frac{375 \times 10^3 \times 0.4}{V_R}\right)^2$$

From which one gets $V_R = 1805\,\text{V}$

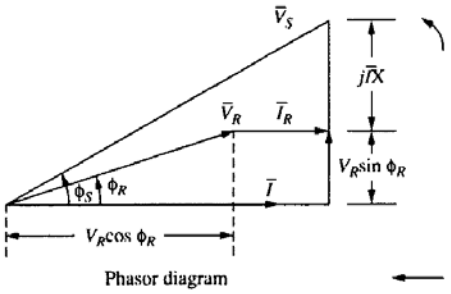
(a) Line-to-line voltage at receiving end $= 1805\sqrt{3}$

$= 3126\,\text{V}$ ←

$= 3.126\,\text{kV}$

(b) Line current is given by

$$I = \underline{375 \times 10^3} = 207.76\,\text{A} \leftarrow$$



Phasor diagram ←

5.14 (a) $\bar{Z}_C = \sqrt{\dfrac{\bar{z}}{\bar{y}}} = \sqrt{\dfrac{0.03 + j0.35}{4.4\times10^{-6}\angle 90^\circ}} = 282.6\angle -2.45^\circ\ \Omega$

(b) $\bar{\gamma} l = \sqrt{\bar{z}\,\bar{y}}\,(l) = \sqrt{(0.35128\angle 85.101^\circ)(4.4\times10^{-6}\angle 90^\circ)}\,(400)$

$= 0.4973\angle 87.55^\circ = 0.02126 + j0.4968$ pu

(c) $\bar{A} = \bar{D} = \cosh\bar{\gamma} l = \cosh(0.02126 + j0.4968)$

$= (\cosh 0.02126)(\cos 0.4968 \text{ radians}) + j(\sinh 0.02126)(\sin 0.4968 \text{ radians})$

$= (1.00023)(0.87911) + j(0.02126)(0.47661)$

$= 0.87931 + j0.01013 = 0.8794\angle 0.66^\circ$ pu

$\sinh\bar{\gamma} l = \sinh(0.02126 + j0.4968)$

$= \sinh(0.02126)\cos(0.4968 \text{ radians}) + j(\cosh 0.02126)(\sin 0.4968 \text{ radians})$

$= (0.02126)(0.87911) + j(1.00023)(0.47661)$

$= 0.01869 + j0.4767 = 0.4771\angle 87.75^\circ$

$\bar{B} = \bar{Z}_C \sinh(\bar{\gamma} l) = (282.6\angle -2.45^\circ)(0.4771\angle 87.75^\circ)$

$= 134.8\angle 85.3^\circ\ \Omega$

$\bar{C} = \dfrac{1}{\bar{Z}_C}\sinh(\bar{\gamma} l) = \dfrac{0.4771\angle 87.75^\circ}{282.6\angle -2.45^\circ} = 1.688\times10^{-3}\angle 90.2^\circ \text{ S}$