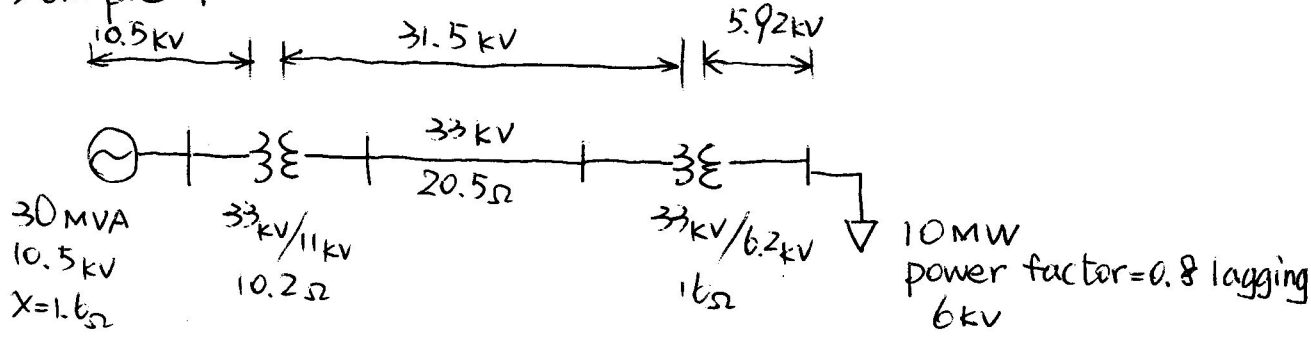
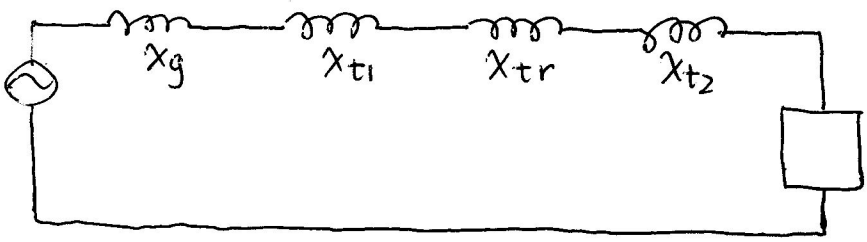
EE491 . xxTxxx24thxx **Two Examples**

Example 1



MVA Base = 30 MVA



Gen: Base Imp $= \frac{(10.5)^2}{30} = 3.675\Omega$

$\Rightarrow X_g = \frac{1.6}{3.675} = 0.4354$ p.u

Transformer 1: Base Imp $= \frac{(31.5)^2}{30} = 33.1\Omega$

$\Rightarrow X_{t_1} = \frac{10.2}{33.1} = 0.3084$ pu.

Transformer 2: Base Imp $= \frac{(31.5)^2}{30} = 33.1\Omega$

$\Rightarrow X_{t_2} = \frac{16}{33.1} = 0.4837$ pu

Transmission Line: Base Imp $= \frac{(31.5)^2}{30} = 33.1\Omega$

$\Rightarrow X_{tr} = \frac{20.5}{33.1} = 0.6198$ pu.

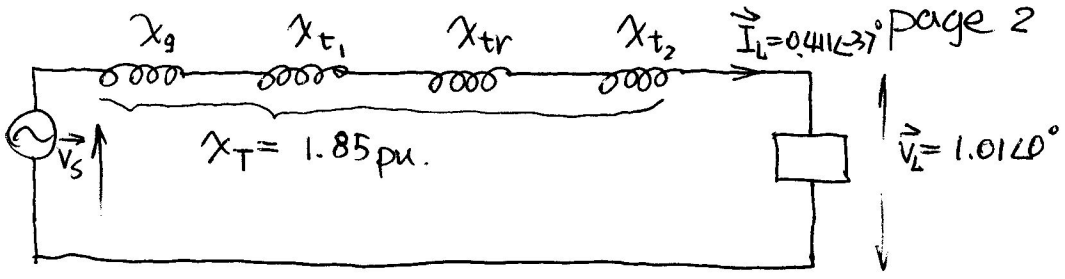
Load: 10MW @ 0.8 pf lagging at 6kv

Base KV = 5.92kv $\Rightarrow |V_L| = \frac{6}{5.92} = 1.0135$ pu

$P_L = \frac{10}{30} = \frac{1}{3}$ pu $= |V_L| \cdot |I_L| \cdot \cos\varphi$

$\Rightarrow |I_L| = \frac{\frac{1}{3}}{|V_L| \cdot 0.8} = 0.4111$ pu.

$\rightarrow V_L = 1.0135\angle 0° \Rightarrow I_L = 0.4111\angle -37°$

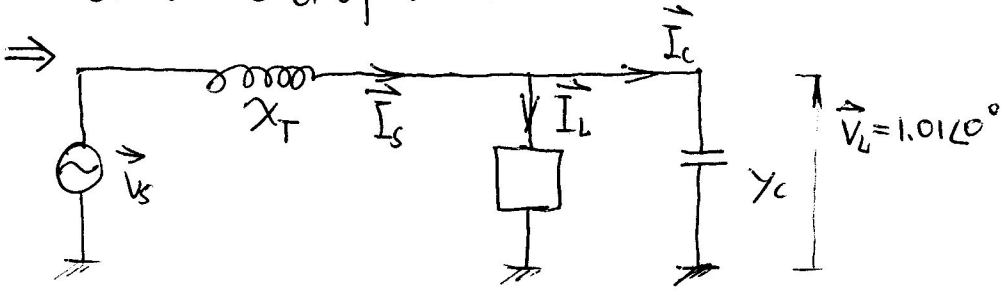


$$\therefore \vec{V}_g = \vec{V}_L + \vec{I}_L \cdot jX_T = 1.59\angle 22.5°$$

$$\therefore |V_g| = 16.7 \text{ kV (L-L)}$$

The Source voltage is too high

$\Rightarrow$ Switch in a Capacitor bank which supplies 5 MVAR at the end of the load.



5 MVAR @ 6 kV.

$$\Rightarrow Q_C = \frac{5}{30 \text{ MVA}} = \frac{1}{6} \text{ pu.}$$

$$\Rightarrow Q_C = |V_L| \cdot |I_C| = 1.01 \cdot |I_C| = \frac{1}{6}$$

$$\Rightarrow |I_C| = \frac{\frac{1}{6}}{1.01} \Rightarrow \vec{I}_C = 0.164\angle 90°$$

$$\Rightarrow \vec{I}_S = \vec{I}_C + \vec{I}_L = 0.339\angle -14°$$

$$\Rightarrow \vec{V}_S = \vec{V}_L + jX_T \cdot \vec{I}_S = 1.31\angle 27.5°$$

$$\Rightarrow |V_S| = 13.75 \text{ kV}$$

Repeat with 10 MVAR Cap bank

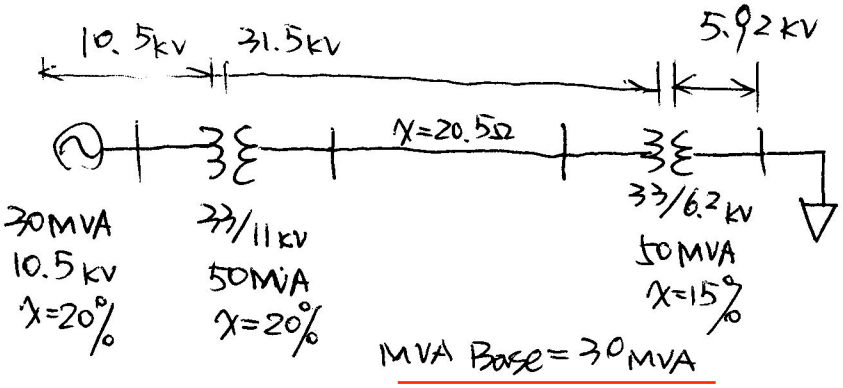
$$Q_C = \frac{1}{3} \Rightarrow \vec{I}_C = \frac{\frac{1}{3}}{1.01}\angle 90° = 0.329\angle 90°$$

$$\Rightarrow \vec{I}_S = 0.339\angle 14°$$

$$\Rightarrow \vec{V}_S = 1.05\angle 35°$$

$$\Rightarrow |V_S| = 11 \text{ kV.}$$ acceptable

Example 2.



MVA Base = 30 MVA

Gen: 20% with own rating

$$Z_{rating} = \frac{(\text{kv rating})^2}{(\text{MVA rating})^2} = \frac{(10.5)^2}{30} = 3.675\Omega$$

$$\Rightarrow X = 3.675 \times 0.2 = 0.735\Omega$$

$$Z_{Base} = \frac{kV_{base}}{MVA_{base}} = \frac{(10.5)^2}{30} = 3.675\Omega$$

$$\Rightarrow x_g = \frac{0.735}{3.675} = 0.2 \text{ pu.}$$

Transformer 1: $Z_{rating} = \frac{33^2}{50} = 21.78\Omega$

$$X = 21.78 \times 0.2 = 4.36\Omega$$

$$\Rightarrow Z_{base} = \frac{(31.5)^2}{30} = 33.1\Omega$$

$$\Rightarrow x_{t1} = \frac{4.36}{33.1} = 0.1318 \text{ pu.}$$

Transmission Line: No Change $x_{tr} = 0.6188$ pu.

Transformer 2: $Z_{rating} = \frac{(33)^2}{50} = 21.78$

$$X = 0.15 \times 21.78 = 3.27\Omega$$

$$Z_{base} = \frac{(31.5)^2}{30} = 33.1\Omega$$

$$\Rightarrow x_{t2} = \frac{3.27}{33.1} = 0.099 \text{ pu}$$