Department of Electrical Engineering
Assignment
Date: 20/04/2020

Course Details

Course Title: Power System Analysis
Module: 6th
Instructor:
Total Marks: 30

Student Details

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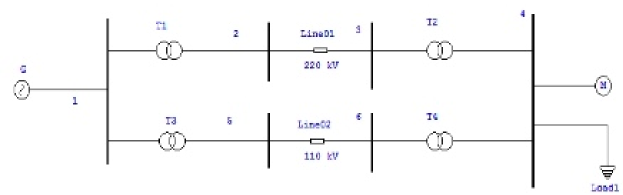
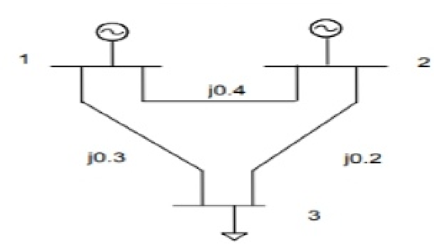
Q1.	(a)	A 3Φ transformer is connected with a residential load of 28.56 KV; the primary side of a transformer is connected with 130 KV feeder while secondary side is stepped down to 10 KV. The transformer is rated with 30 MVA. Find impedance Z_b.	Marks 05 CLO 1
	(b)	Find the Per Unit equivalent impedence of an 11/132 KV transformer having 10 Ω and 1440 Ω, the equivalent impedence. The primary and secondary currents are 909 Amp and 75.75 Amps respectively.	Marks 05 CLO 1
.Q2	(a)	Single line diagram of a 3Φ power system is shown in the below figure. Draw an impedance and reactance diagram in P.U.	Marks 10 CLO 2



Q3	(a)	For the single line diagram shown below, Generators are connected to high tension buses 1 and 2 and supply to load connected at bus 3. Find the reactance diagram, then convert it into equivalent current sources and shunt admittances. Then find the admittance matrix and find the total current.	Marks 10 CLO 2



Q1

(A). A 3ϕ T/F is connected with a residental load of 28.56 KV, the Primary side of T/F is connected with 130 KV Feeder while Secondary side is stepped down to 10 KV. The T/F is rated with 30 MVA.

Find impedance Z_b.

Solution=>

Primary = 130 KV
Secondary = 10 KV
T/F Rated = 30 MVA

Z_b across V_{base_1} (130 KV)

$$Z_b = \frac{(130 \times 10^3)^2}{30\ MVA} = \frac{1690\cancel{0000000}}{30\cancel{000000}}$$

$$\boxed{Z_b = 56.33}\ Ans$$

(B) Find the per unit equivalent impedance of an 11/132 KV Transformer having 10 Ω and 1440 Ω. The equivalent impedance. The Primary and Secondary current are 909 Amp and 75.75 Amps repectively.

Solution =>

primary 11 / 132 KV secondary

we know that for S_{base_1}

$$I_{base_1} = \frac{S_{base_1}}{V_{base_1}}$$

$$S_{base_1} = V_{base_1} \times I_{base_1}$$

$$= 11 \times 10^3 \times 909_{Amp}$$

$$S_{base_1} = 9999000$$

=> Z_b across V_{base2} (10 kV)

$$Z_b = \frac{(10 \times 10^3)^2}{30 \text{ MVA}}$$

$$= \frac{100000000}{30000000}$$

$$\boxed{Z_b = 3.33}$$ Ans=

Now S_{base_2}

$$S_{base_2} = V_{base_2} \times I_{base_2}$$

$$= 132 \times 10^3 \times 75.75 \text{ Amp}$$

$$S_{base_2} = 9999000$$

Now Z_{base_1} =

$$Z_{base_1} = \frac{(V_{base_1})^2}{S_{base_1}} = \frac{(11 \times 10^3)^2}{9999000} = 12.101$$

$$Z_{base_1} = 12.101$$

Now Z_{base_2}

$$Z_{base_2} = \frac{(V_{base_2})^2}{S_{base_2}} = \frac{(132 \times 10^3)^2}{9999000} = 1742.574$$

$$Z_{base_2} = 1742.574$$

=> Now Per unit equivalent impedance For Z_{base1}

=> Z_{base1} eq. p.u $= \dfrac{Z_{eq1}}{Z_{base1}} = \dfrac{10\,\Omega}{12.101}$

Z_{base1} eq. p.u $= 0.826$

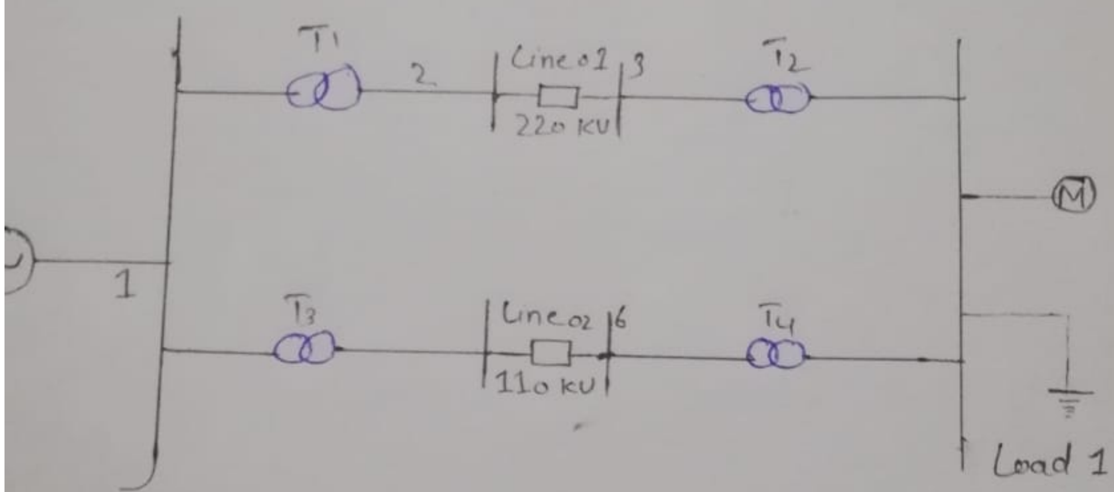
=> For Z_{base2}

$Z_{base2}^{eq.p.u} = \dfrac{Z_{eq2}}{Z_{base2}} = \dfrac{1440\,\Omega}{1742.574} = 0.826$

Z_{base2} eq. p.u $= 0.826$

Q(2)

(a) Single line diagram of a 3ϕ power system is shown in the below figure. Draw an impedance and reactance diagram in p.u.



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=> Impedance diagram =>

=> When we convert an single line diagram ~~convert~~ into impedance diagram so we remove circuit Breaker and draw resistor and Inductor in impedance diagram instead of circuit Breaker and also generator (G) convert into EMF (E).

=> So Now we explain that with the help of diagram

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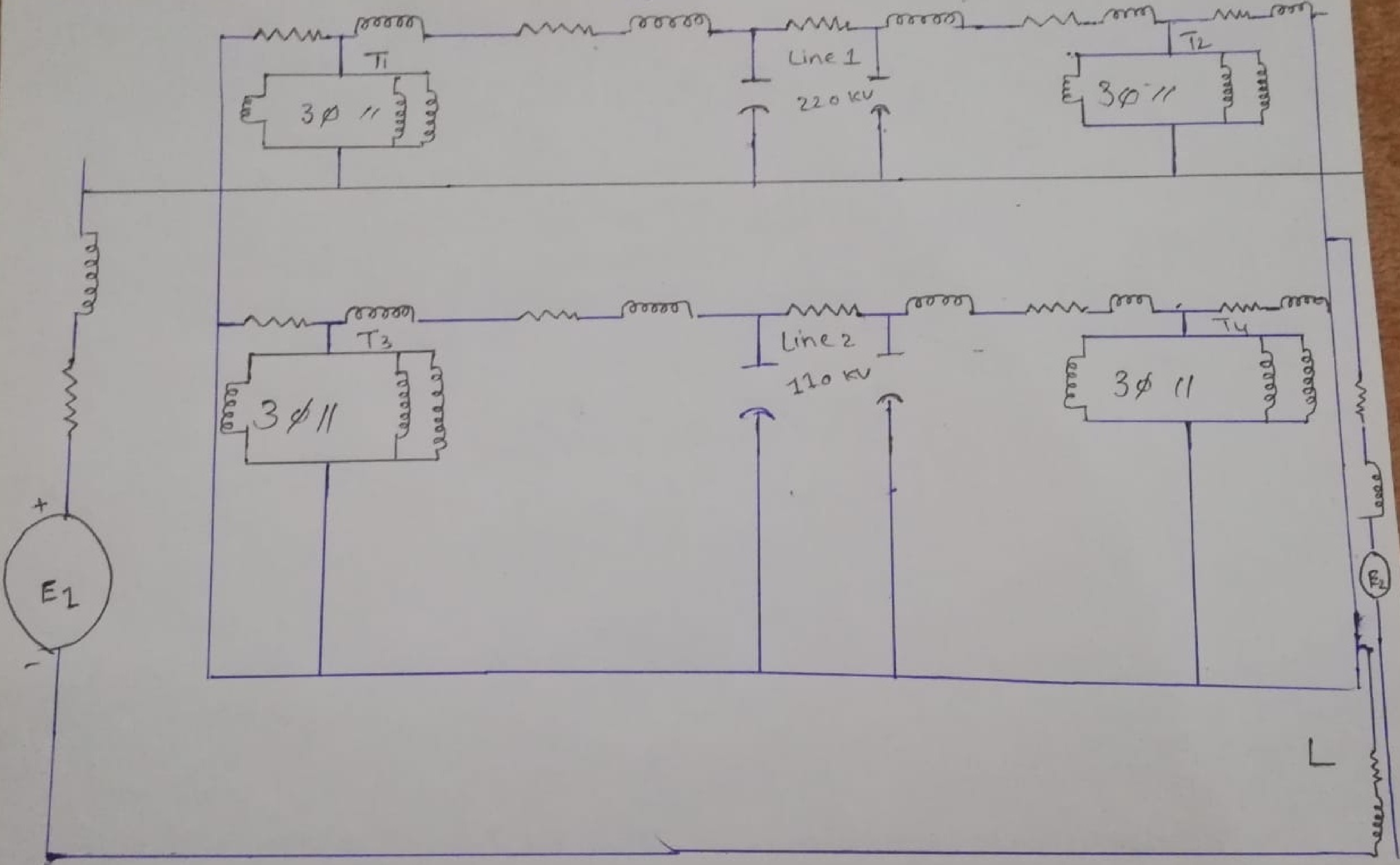
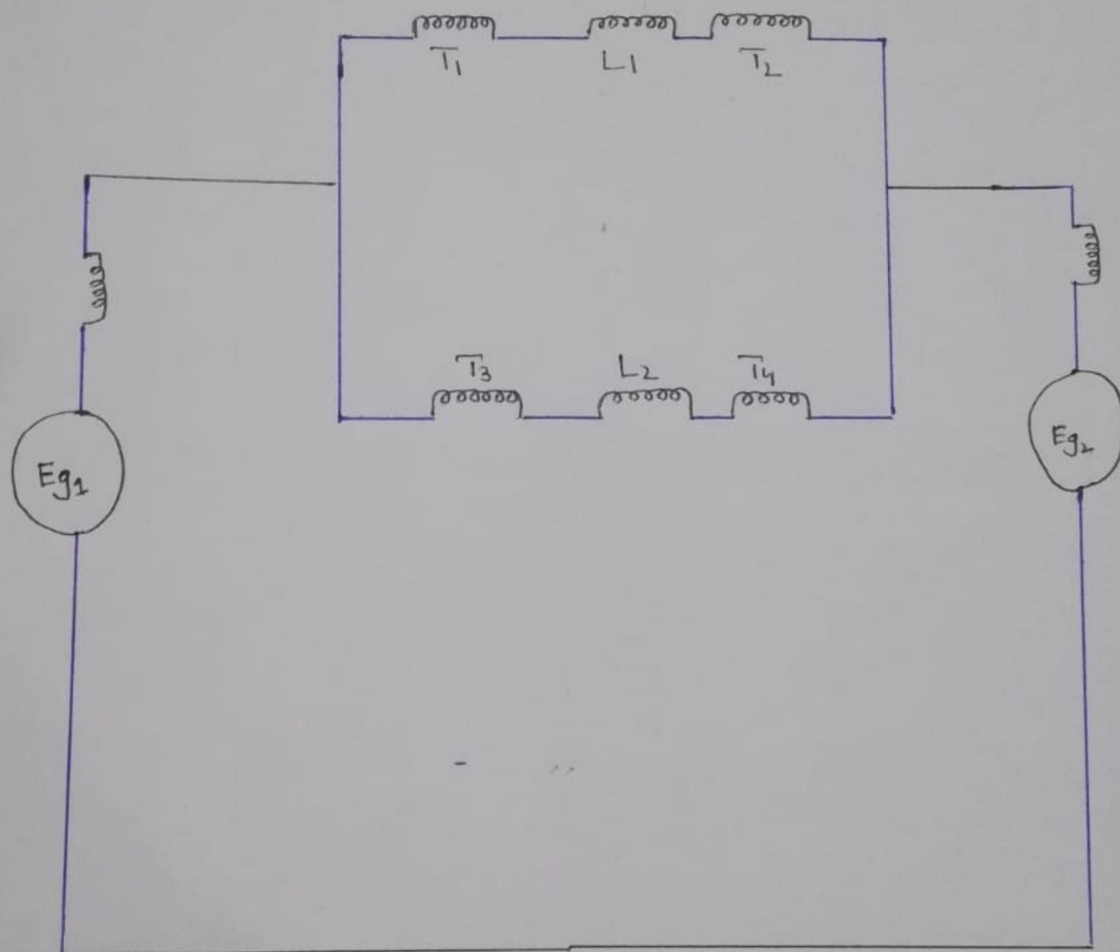
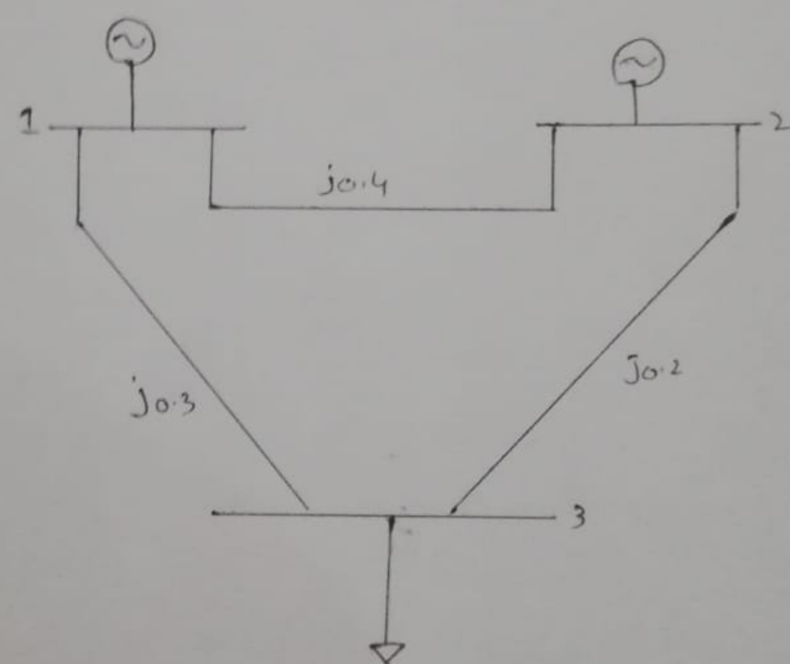


Single line diagram converi To impedance diagram



Single Line diagram convert into Reactance diagram.

(a) Find the reactance diagram, then convert it into equivalent current source and shunt admittances. Then find that admittance matrix and find the total current.

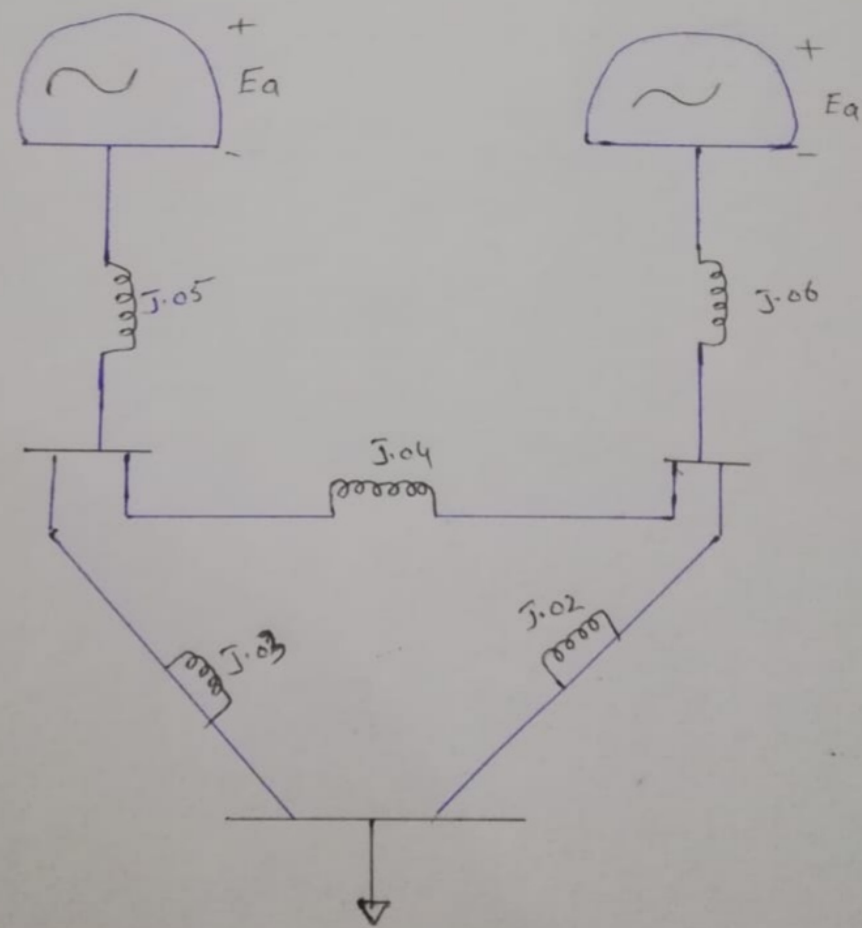


=> Reactance diagram =>

=> When we convert an single-line diagram into reactance-diagram so all the resistance capacitor we remove. only Inductor we draw in Reactance diagram.

=> Now we explain an Reactance diagram with the help of diagram

Solution=)

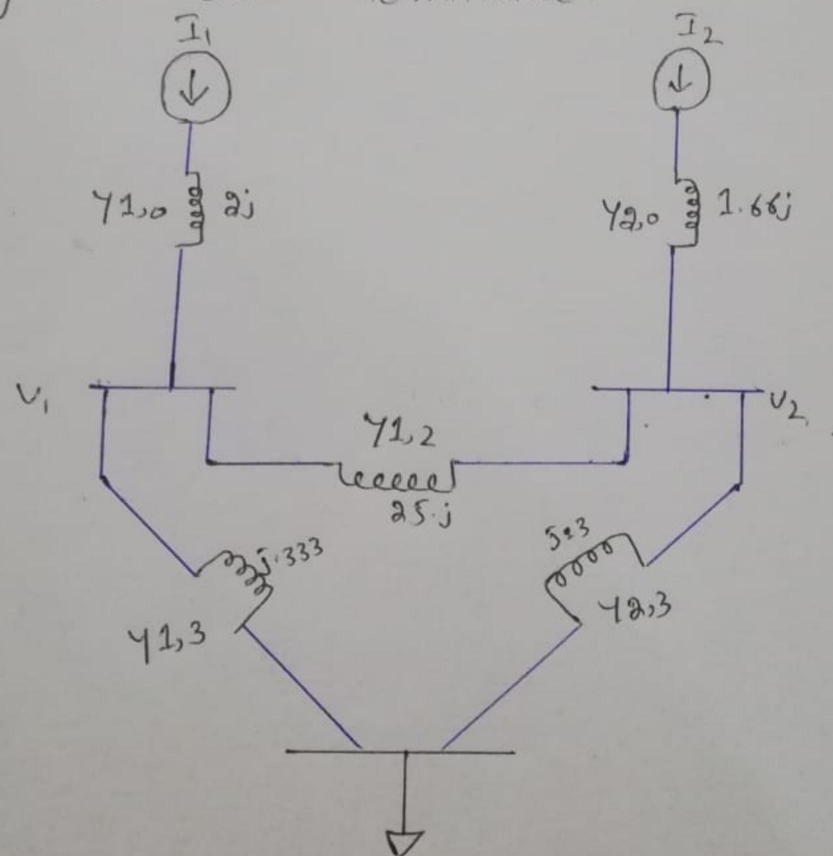


Now Calculation =>

$\frac{1}{J.08} = 160$ $\frac{1}{J.05} = 2$ $\frac{1}{J0.4} = 25$ $\frac{1}{J0.3} = 333$

$\frac{1}{J.0.2} = 5$

=> So Now we convert the reatance diagrame into Admittance.



Now we apply kcl equation.

Node(1)

so

$$I_1 = Y_{1,0} V_2 + Y_{1,2}(V_1 - V_2) + Y_{1,3}(V_1 - V_3)$$

$$[Y_{1,0} V_1 + Y_{1,2} V_1 - Y_{1,2} V_2 + Y_{1,3} V_1$$
$$Y_{1,3} V_3]$$

Now V_1 common =>

$$V_1 = V_1 (Y_{1.0} + Y_{1,2} + Y_{1,3}) - Y_{1,2} V_2 - Y_{1,3} V_3$$

$$I_1 = V_1 [Y_{1,0} + Y_{1,2} + Y_{1,3}] - Y_{1,2} V_2 - Y_{1,3} V_3]$$

→ eq (1)

Now

Node(2)

$$I_2 = Y_{2,0} V_2 + Y_{1,2} (V_2 - V_1 + Y_{2,3} (V_2 - V_3)$$

common → $[-Y_{1,2} V_1]$

$$= -Y_{1,2} V_1 (Y_{2.0} + Y_{1,2} + Y_{2,3}]$$

$$[V_2 - V_{2,3} - V_3]$$

$$I_2 = Y_{1,2} V_1 [Y_{2,0} + Y_{1,2} + Y_{2,3}]$$

$$V_2 - V_{2,3} V_3 \rightarrow eq (2)$$

Now Nod (3)

$$0 = Y_{2,3} [V_3 - V_2] + Y_{1,3} [V_3 - V_1]$$

$$0 = [Y_{2,3} V_3 - Y_{2,3} V_2 + Y_{1,3} V_3 - Y_{1,3} V_1]$$

$\rightarrow$ equation (3)

Now admittance matrix

$$\begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} \begin{bmatrix} Y_{11} & Y_{12} & Y_{13} \\ Y_{21} & Y_{22} & Y_{23} \\ Y_{31} & Y_{32} & Y_{33} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

=> So Y_{11}, Y_{22}, Y_{33} admittance is called self admittance.