-*.......Pepper........*

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Program ....B-thec (Electrical)

Subject .... Power system analysis

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Q No :- 1

Ans :-

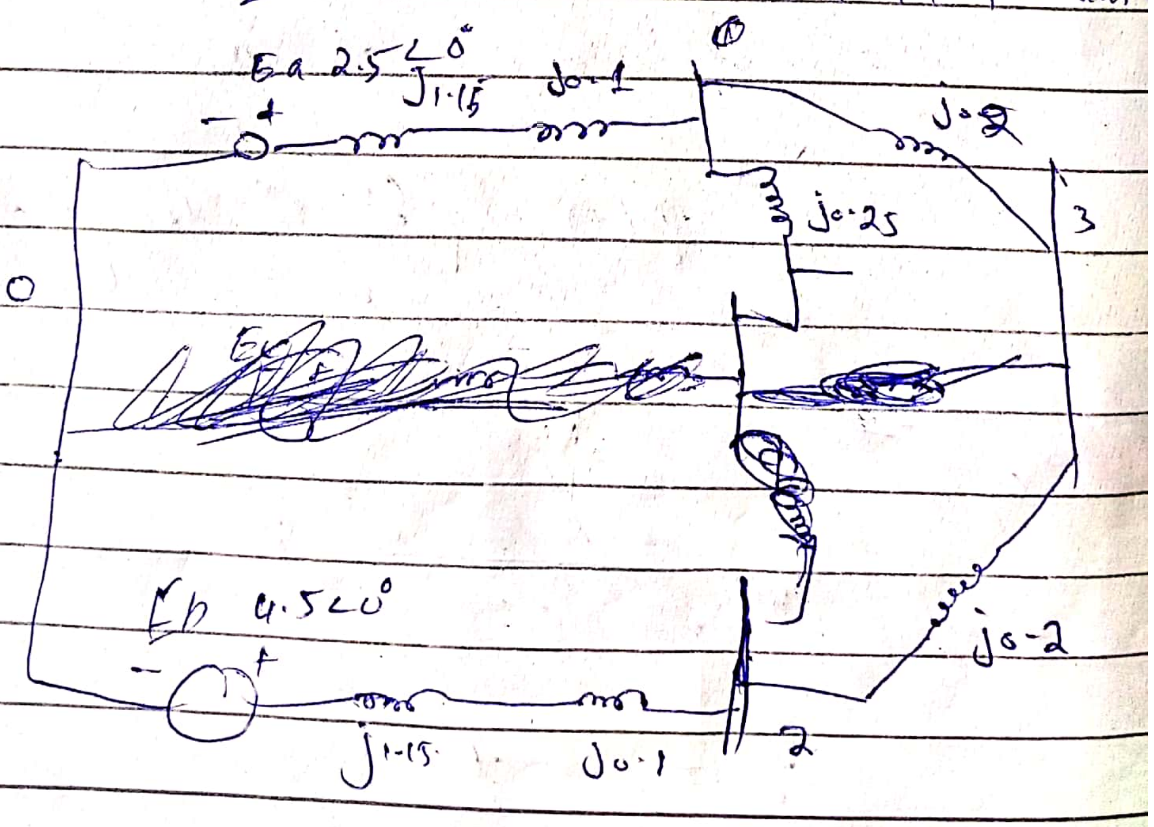
~~when~~

Write in matrix from the node equation necessary to solve for the voltage of the numbered buses of Figure shown network of equivalent an follows are

the EMFs shown in figure

a) $E_a = 2.5\angle 0^\circ$

b) $E_b = 4.5\angle 0^\circ$ all in per unit



Sol

the current Source are

$$I_1 = I_3 \; \frac{2.5 \angle 0^\circ}{j1.25}$$

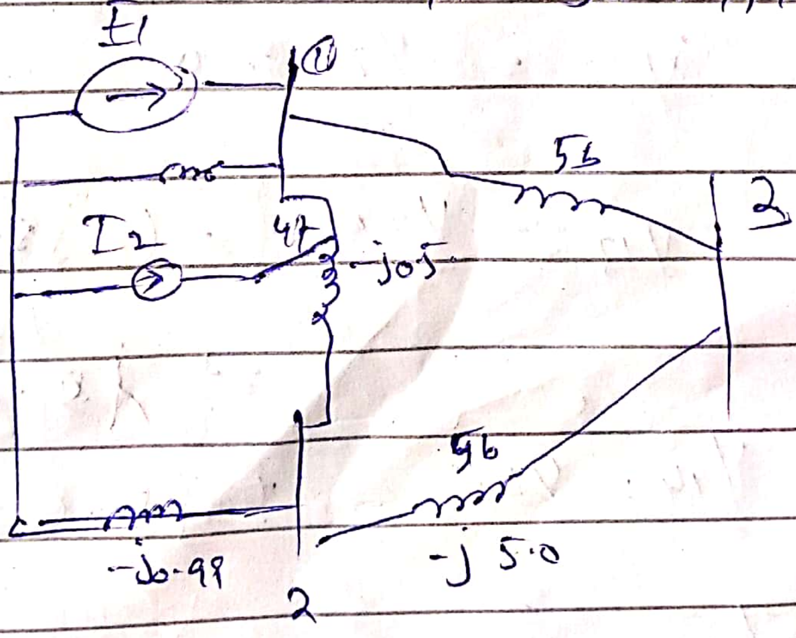
$$= 1.2 \angle -90$$

$$= 0 - j1.26 \text{ P.U}$$

$$I_2 = \frac{4.5 \angle 0^\circ}{j1.25}$$

$$= 1.3 \angle -1\cancel{36}.87^\circ$$

$$= 0.91 - j0.99 \text{ P.U}$$



Self - admittance in p.u are:

$Y_{11} = -j0.99 - j0.5$

$Y_{11} = -j0.94$

$Y_{22} = -j0.5 - j2.7$

$Y_{22} = -j1.2$

$Y_{33} = j4.0 - j2.5$

$Y_{33} = j15.3$

$Y_{12} = Y_{21} = 0$

$Y_{13} = Y_{31} = -(-j5.0)$

$= +j5.0$

$Y_{14} = Y_{41} = +j5.0$

$Y_{23} = Y_{32} = +j2.7$

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$Y_{24} = Y_{42} = + j5.0$

$Y_{34} = Y_{43} = + 9.0$

The node equation in matrix from are

$$\begin{bmatrix} 0 - j1.50 \\ -0.94 - j0.06 \\ 0 - j1.20 \end{bmatrix} = \begin{bmatrix} -9.8 & j0.0 & j4.0 \\ j0.0 & -j8.3 & j.25 \\ j4.0 & j2.5 & -j15.3 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

Multiply b/s of matrix by the Inverse of bus admittance matrix

i.e $A^{-1} = \frac{1}{\det A} \operatorname{adj} A$

$$\begin{bmatrix} j0.4774 & j0.376 & j0.4020 \\ j0.3706 & j0.4872 & j0.3922 \\ j0.4142 & j0.3422 & j0.4558 \end{bmatrix} \begin{bmatrix} 0 - j1.20 \\ 0.96 - j0 \\ 0 - j1.20 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

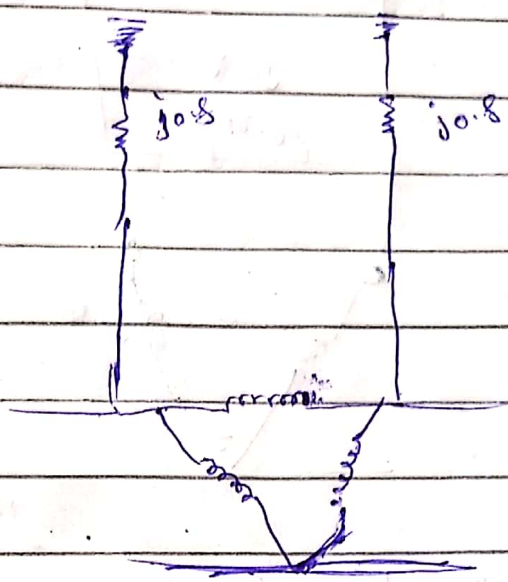
$V_1 = 0.2668^\circ$ P.U

$V_2 = 0.3508^\circ$ P.U

$V_3 = 1.36^\circ$ PU

Q No:- 2

Ans Solution



Z-base

$$Z_{base} = Y_{bus}$$

$$Z_{base} \begin{bmatrix} Z_{11} & Z_{12} & Z_{13} \\ Z_{21} & Z_{22} & Z_{23} \\ Z_{31} & Z_{32} & Z_{33} \end{bmatrix}$$

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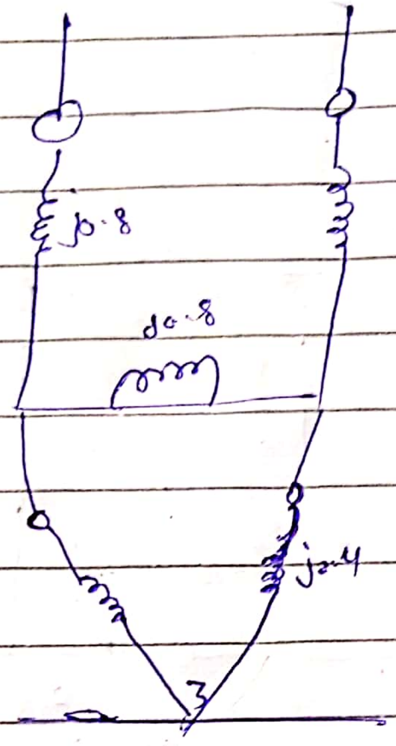

$$\begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} & Z_{13} \\ Z_{21} & Z_{22} & Z_{23} \\ Z_{31} & Z_{32} & Z_{33} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix}$$

$$V_1 = Z_{11} I_1 + Z_{12} + Z_{13} I_3 \text{ --- } (1)$$

$$V_2 = Z_{21} + I_1 + Z_{22} I_2 + Z_{23} I_3 \text{ --- } (2)$$

$$V_3 = Z_{31} I_1 + Z_{32} I_2 + Z_{33} I_3 \text{ --- } (3)$$

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Q No:- 3

Ans :-

* A generator of 10 KW Feeding to connected in 11 KV Bus bar injecting real power P_{GK} and reactive Power Q_{GK}
* A 20 KW load are connected which take P_{LK}, Q_{LK} from the 11 KV bus bar.
* this 11 kV bus bar is connected to other 11 kV bus bar i, j and through lines

⇒ the voltage at bus bar is V_K where V_K is equal to the megintude V_K and the angle δ_K

⇒ one think we see that 10 KW generator injections P_{GK} and Q_{GK} while 20 KW load takes P_{LK} and Q_{LK} From the bus bar, then we can take the algebric sum of generation and 20 kw loads. i.e Subtracts the 20 KW loads from

11 kV genration

i.e.

$$P_K = P_{GK} - P_{LK}$$

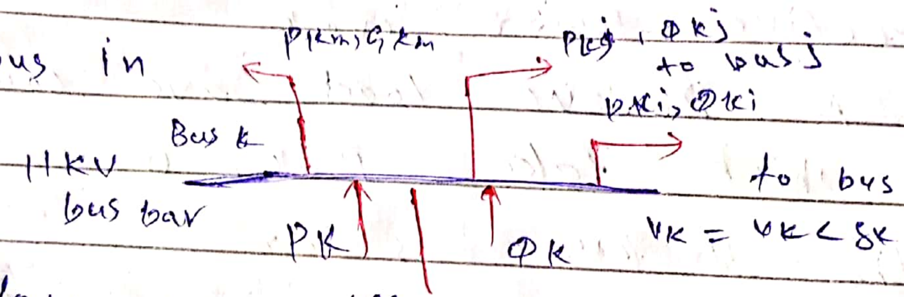
∵ Real power injecting

Similarly Reactive Power injecting is

$$Q_K = Q_{GK} - Q_{LK}$$

then the ~~B~~ diagram becames

a bus in



Now we will say the injecting into the bus bar rather saying the 11 KV generation and 20kW load

If at a Particullar bus bar there is no generation 11kv input and only 20kW load in Connected then the injecting

$$\therefore P_K = 0 - P_{LK}$$

$$P_K = -P_{LK}$$

$$\therefore Q_K = 0 - Q_{LK}$$

$$Q_K = -Q_{LK}$$

So, load can be considered as Negetive injection

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⇒ From the diagram we see that we have three line, one going to bus bar i, 2nd to j and 3rd one to m there line will carry the power P_{ki}, Q_{ki} to ~~will~~ bus i, P_{kj}, Q_{kj} to bus j and P_{km}, Q_{km} to bus m

⇒ Some of there power may be in the reverse directions i.e they may be coming from bus j to bus k, in that case the value of P_{kj}, Q_{kj} will be negative

So, $$P_k = P_{ki} + P_{kj} + P_{km}$$
$$Q_k = Q_{ki} + Q_{km}$$

∴ Real and Reactive power is equal to the algibraic sum of P, & Q power going out

Power Flow equation :-

we Showd that power Flow equation are comming from the Network equation

i.e $I_{bus} = Y_{Bus} \cdot V_{Bus} \rightarrow ①$

where I Bus is the vector of current injection into the bus bars YBus is the nxn matrix of the admittance and V Bus is the 20 Voltage Power at the n buses of the power system

=> for a particular bus k, we can write the equation as,

$$I_k = \sum_{n=1}^{N} Y_{kn} V_n \rightarrow (2)$$

where N = no of bus bars.
Y_{kn} = addmittance of the kn element

from equation we can write the complex Power injection at bus bar k is

$$S_K = P_K + jQ_K = V_K I_K^* \rightarrow (3)$$

$$P_K + jQ_K = V_K \left[\sum_{n=1}^{N} Y_{kn} V_n \right]^*$$

where K = 1, 2, ... N

V_n is a phaser which has a magnitude and an agle

$$V_n = V_n e^{j\delta_n}$$

and $Y_{kn} = Y_{kn} e^{j\theta_{kn}}$, K, n = 1, 2, ... N

Substituting V_n and Y_{kn} value in eq (3)

$$P_K + jQ_K = V_K \sum_{n=1}^{N} Y_{kn} V_n e^{j(\delta_k - \delta_n - \theta_{kn})}$$

∴ All angle δ_k with V_k
δ_n with V_n

All Negative b_k of conjugates, we can separate out the real & imaginary path, then we can write the real power injection into Bus k as

$$P_k = V_k \sum_{n=1}^{N} Y_{kn} V_n \cos(\delta_k - \delta_n - \theta_{kn}) \quad (4)$$

Similarly the Reactive power injection is

$$Q_k = V_k \sum_{n=1}^{N} Y_{kn} V_n \sin(\delta_k - \delta_n - \theta_{kn}) \quad (5)$$

So we can see that these injection is related to that the voltage magnitude and angle at V carries bus bar.
Eq (4) & (5) in said as the power flow equation for the Power Network

Q No:— 4

Ans:—

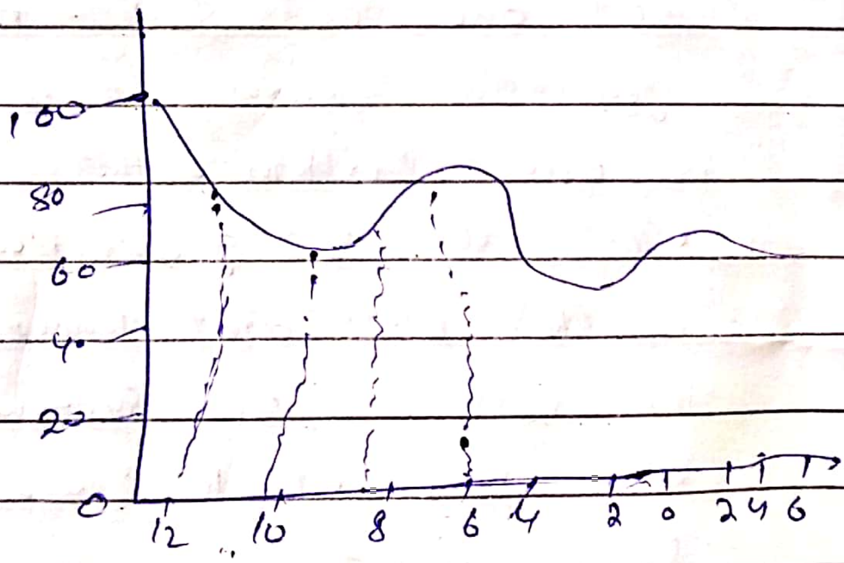
these is one problem in doing power Solution as the load are known to us but generation are in over control and one can Say that all generation know to us but there is one Problem . the problem is still all the generation are available we dont know what is the loss in the system we cannot know how much generation belong losses must be equil to the total generation

Solution:—

the over come the we choose one bus on a reference bay which take up all these losses which can find after solution so at one bus we can not ~~sep~~ sepedfy the generation this is bus which have very

Large generation available so that there will be no Problem for it to take a losses this bus is Power system terminology is called a slack bus

Load curves :-



Q no :- 5

Ans :-

this method we find of the power flow equation for these method start again with the loses of network equation

I.e, I Bus = Y Bus = V Bus

and for any particular Bus is

$$I_{ij} = \sum_{\omega=1}^{\omega} Y_{kn} V_n$$

the computation power $P_K + jQ_K = V_K I_K$

$$P_K + jQ_K = V_K \left\{ \sum_{n=1}^{n} Y_{Kn} V_n \right\}$$

where $K = 1, 2 \ldots N$

From compose power

$$I_K = \frac{P_{IS} - jQ_K}{V_K}$$

$$* \quad I_K = \sum_{r=1}^{n} Y_{kn} V_{in} \ldots$$

$$I_K = Y_{K1} V_1 + Y_{K2} V_2 + V_{K1} \; V_{K+}$$

From the above equation

$$V_k = \frac{1}{Y_{kk}}\left(I_k - \left(\sum_{n=1}^{k-1} Y_{kn}\right] n + \sum_{n=k}^{n} V_{kn} V_n\right.$$

is

or

$$V_k = \frac{1}{Y_{kk}}\left(\frac{P_k - jQ_k}{V_k} - \left[\sum_{n=1}^{k-1} Y_{kn} V_n + \sum_{n=k+1}^{n} Y_{kn} V_n\right)\right.$$

Where $k = 1, 2, \ldots N$

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Flow Chart Gross social