Name	=	M. Usama
ID	=	14150
subject	=	Power system Analysis
Semesster	=	6Th
Submitted to	=	Engr: Aamir Aman.
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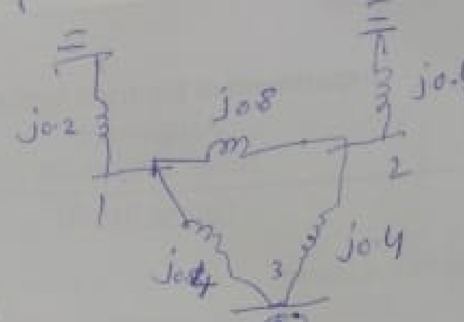
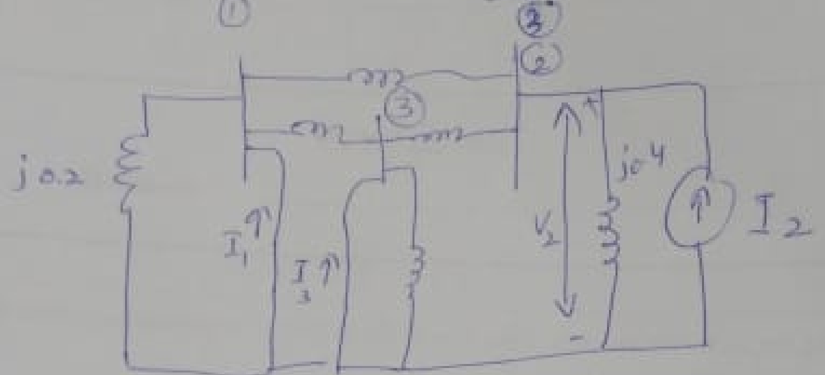
Question 2





$$Z_{bus} = \begin{bmatrix} Z_{11} & Z_{12} & Z_{13} \\ Z_{21} & Z_{22} & Z_{23} \\ Z_{31} & Z_{32} & Z_{33} \end{bmatrix}, \quad I = Y_{bus} V \; \text{—(A)}$$

Diagonal elements:

Z_{11} & Z_{22}, Z_{33} are driving point impedances of node while transfer impedances are $Z_{12}=Z_{21}$, $Z_{13}=Z_{31}$, $Z_{23}=Z_{32}$.

$$Z_{bus} = \begin{bmatrix} j(0.2+0.8+0.4) & -j0.8 & -j0.4 \\ -j0.8 & j(0.4+0.8+0.4) & -j0.4 \\ -j0.4 & -j0.4 & j(0.4+0.4) \end{bmatrix}$$

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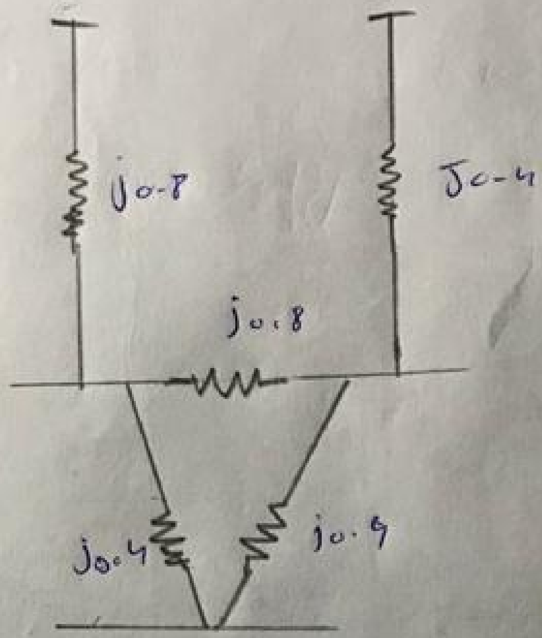
Q = 2

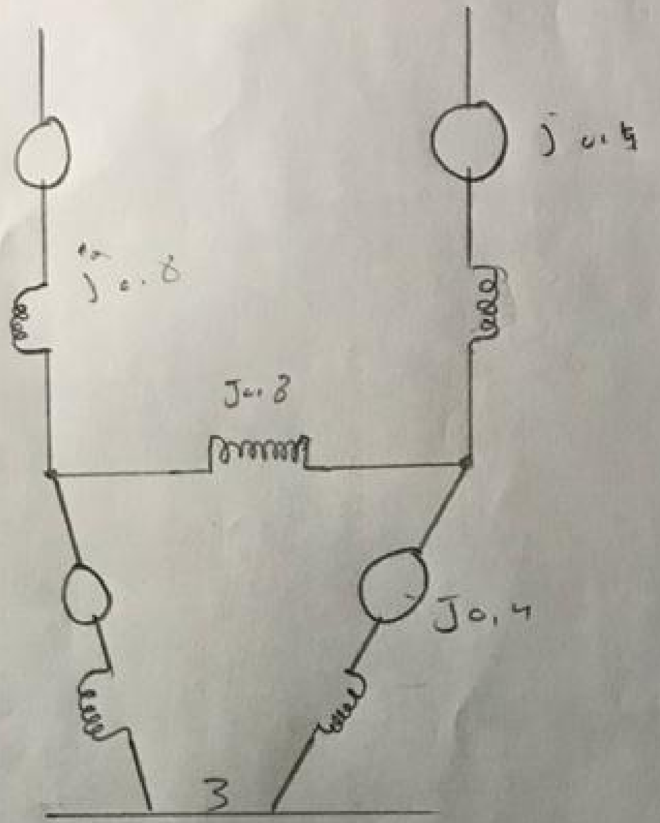
Ans



Zbase

Zbase = Ybase

$$Z\,base \quad \begin{vmatrix} Z_{11} & Z_{12} & Z_{13} \\ Z_{21} & Z_{22} & Z_{23} \\ Z_{31} & Z_{32} & Z_{33} \end{vmatrix}$$



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

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

$V_2 = Z_{21} I_1 + Z_{22} + Z_{23} I_3 \; \ldots\ldots$ (2)

$V_3 = Z_{31} I_1 + Z_{32} + 3_{33} I_3 \; \ldots\ldots$ (3)

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Q = 3

Ans A 10kW generator is converted which inject P_{GK}, Q_{GK} To The "11kV" Busbar. A 90kW Load is conected which takes P_{LK}, Q_{LK} from The 11kV Busbar. This 11kV Busbar is conected to other Busbar i.e to bus ij and on Through lines. The ~~[illegible]~~ voltage at 11kV, Busbar is Vc. Wher V_K is equal to The magnitude V_K and The angle δK.

⇒ one Think we see That injects P_{GK} & Q_{GK} while Load takes P_{LK} & Q_{LK} from The Busbar Then we Can take The algebric sum of generation, and Load, i-e Subtraction The Loads from The generation

i.e = $P_K = P_{GK} - P_{LK}$ ∵ Real Power injection

From the diagram we see that we have three lines one going to 11kV busbar, 2nd to, and the third one to mm. These lines will carry the power P_{Ki}, Q_{Ki} to bus i, P_{Kj}, Q_{Kj} to bus m

~~and P_{Km} Q_{Km} to bus~~

=> Some of these power may be in the reverse direction i-e bus k, in that case The value of Pk, Qk will be negative.

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

$Q_k = Q_{ki} + Q_{kj} + Q_{km}$

∴ Real and Realitive power is equal to the algebric sum P, & Q power going out.

Power flow equation => we showed that, Power flow equation are coming from the network equation.

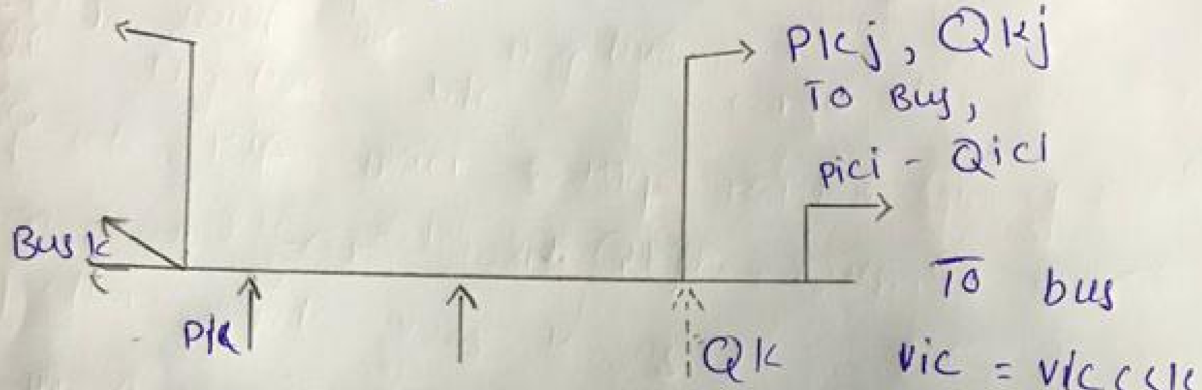
i-e $I_{Bus} = Y_{Bus} V_{Bus}$ — (1)

when I_{Bus} is the vector of

Similarly reactive power injection is

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

Then the diagram became as



=> Now will say the injection into the 11 kV busbar. rather saying the generation and loads. If a particular generation input in only load is connected then the injection to that 11 kV busbar will be :

$P_K = 0 - P_{LK}$

$P_K = P_{LK}$

&

$Q_K = 0 - Q_{LK}$

$Q_K = - Q_{LK}$

So, Load can be considered as Negative injection.

$$RC + jQ_k = V_k \sum_{n=1}^{N} y_{kn} \; v_n \; e^{j(\delta_k - \delta_n - Q_{kn})}$$

so All angles δ_k with V_k δ_n with V_n

Q_{kn} with y_{km}

all Negative b/c of conjugates we can separete out the real & imaginary Parts. Then we can write the real power injection into Bus K as

$$P_k = V_k \sum_{n=1}^{n} y_{kn} \; v_n \; \cos(\delta_k - \delta_n - Q_{km}) \; eq \; (4)$$

Similarly the reactive Power injective

$$Q_k = V_k \sum_{n=1}^{N} y_{kn} \; v_n \; \sin(\delta_k - \delta_n - Q_{kn}) \; (5)$$

So, we can see that these injection is related to the voltage magnitude and angle at remain bus bars

Eq (4) and (5) is said as, the Power flow equation for the Power Network.

current injection into the bus bars yBus is the nYn matrix of x. addmittance and V-Bus in the voltage phases at the is busbar of K4 power system

=> For a particular bus k, we can write the equation as, Ik $\sum_{n=1}^{N}$ Yknn Vn → ②

where N = no of bus bar.

Ykn = admittance of the kn element

Vn = voltage phaser at busbar k is

Sk = Pk + jQk = Vk Ik → ③

Now we know the value of Fk from eq ② substituting Ik in eq③

$Pk + jQk = Vk\left[\sum_{n=1}^{N} Ykm\right]^{n}$

where k = 1, 2, N

Vn is a phaser, which has a magnitude and an angles Vn = Vn e^j - δn

and ykn = ykn . e^j Qkn, K&n = 1, 2, N

substituting Vn and Ykn values in eq (b)

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Q = 4

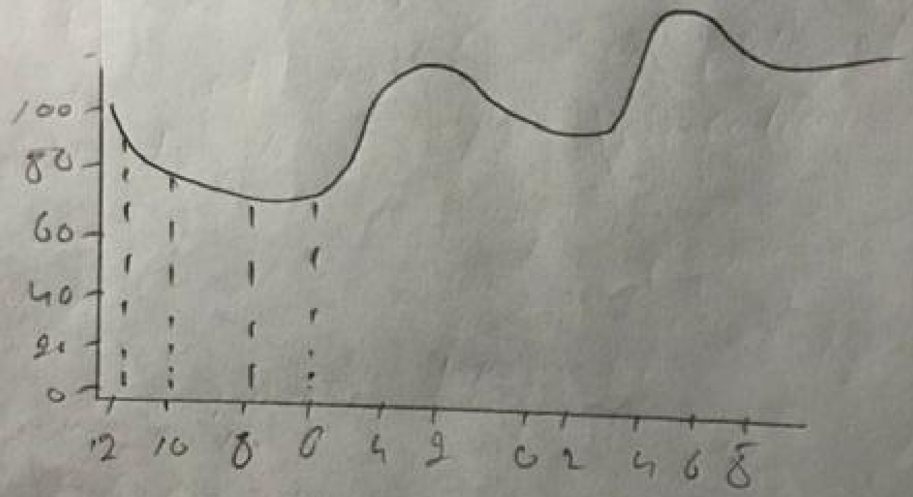
Ans There is one Problem in doing power flow solution That we cannot know all the generations. All the Load are known to us but generation are in our control and one can say That all generations known to us. But Their is one Problem The Problem is still all The generation are available we don't know what is the the loss in The system. since we cannot know the Loss in the system. We cannot know how much generation because The sum of load and the No of Losses must be equal to the total generation.

solution =>

To overcome The we chose one bus on a refrance bus which takes up all These losses which can find after solution. So at one bus we cannot specify the generation. Generally. This is a bus which have very large generation available.

So That Their will be no Problem for it to take a Losses This Bus is Power system terminology is called stack Bus.

Load Curves :-



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Q = 5

Ans This is The fier interative method find-out The Power flow equation for These method we again start with The basic of network equation.

i.e $I_{Bus} = Y_{Bus} - V_{Bus}$

and for any particular Bus is

$$I_k = \sum_{N=1}^{N} \cdot Y_{kn} \cdot V_n$$

The complex power $P_x + jQ_k = V_k I_k$

$$P_k + jQ_k = V_k \left[\sum_{n=1}^{n} \cdot Y_{kn} V_n \right]$$

$$\text{Where } K = [1, 2 \ldots N]$$

from complex power.

$$I_k = \frac{P_k - jQ_k}{V_k}$$

Also $I_k = \sum_{n=1}^{n} Y_{kn} V_n$ or

$$I_k = Y_{k1} V_1 + Y_{k2} V_2 + Y_{kk} V_k + Y_{kn} - V_n.$$

From The above eqn:

$$V_K = \frac{1}{Y_{KK}}\left[I_K - \left(\sum_{n=1}^{K-1} Y_{Kn} V_n + \sum_{n=K+1}^{N} Y_{Kn} V_n\right)\right]$$

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 $K = [1, 2 \cdots\cdots N]$

P. T. O

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(A) Flow countal of Gauss-Seidal.