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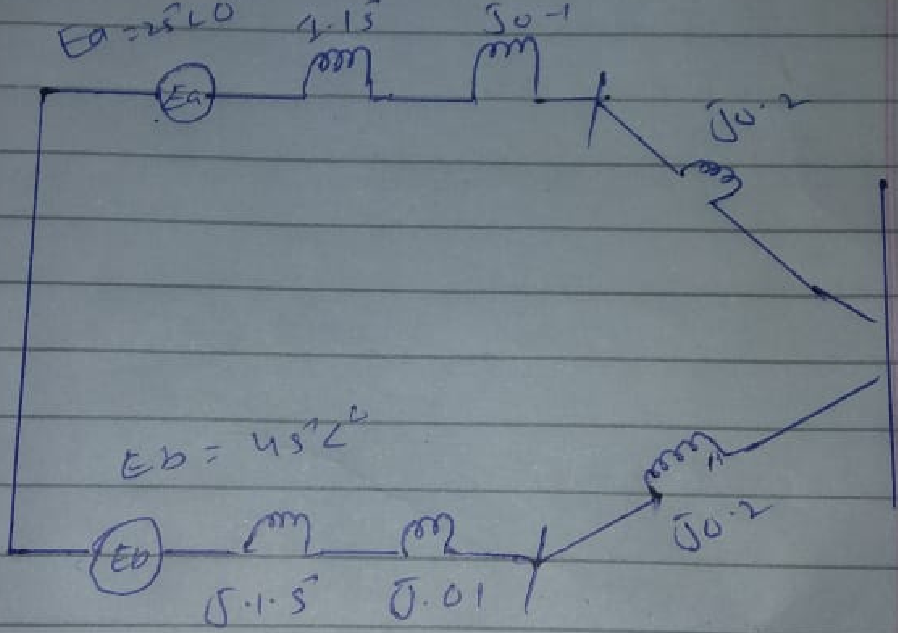
Q1

Ans

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

$$E_b = 4.5 \angle 0^\circ$$

=> In per unit




$$I_1 = I_2 = \frac{25 \angle 0^\circ}{j0.2}$$

$$I_2 = \frac{45 \angle 0^\circ}{j0.2}$$

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

$$V_1 = Z_{11} j_1 + Z_{12} I_2 + Z_{13} I_3 \quad (1)$$

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

$$V_3 = Z_{31} j_1 + Z_{32} I_2 + Z_{33} I_3 \quad (3)$$

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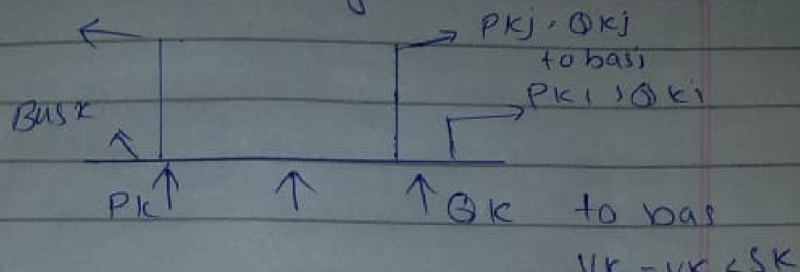
Similarly reactive power injection is $Q_K = Q_{GK} - Q_K$

Then the diagram become as




⇒ Now will say the injection into the 11 kV busbar rather saying the generation and loads. If a particular busbar there is no generation input and only load is connected then the injection to that 11 kV busbar will be

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

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

So Load can be consided as negative injection

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

∴ All angles $\delta_K$ with $V_K$
$\delta_n$ with $V_n$
$\theta_{Kn}$ with $Y_{Kn}$
all Negative b/c of Conjugates
we Can separate out the real & Imaginary Parts. Then wen can write the real Power injection into Bus K as

$$P_K = V_K \sum_{N=1}^{N} Y_{Kn} V_n \cos(\delta_K - \delta_n - \theta_{Kn})$$ eq (4)

Similarly the Reactive power injective n

$$Q_K = V_K \sum_{n=1}^{N} Y_{Kn} V_n \sin(\delta_K - \delta_n - \theta_{nK})$$ → (5)

So we can see that these injection is related to the voltage magnitude and angle at remain bus bar, Eq (4) and (5) is said as The power flow equation for the Power Network

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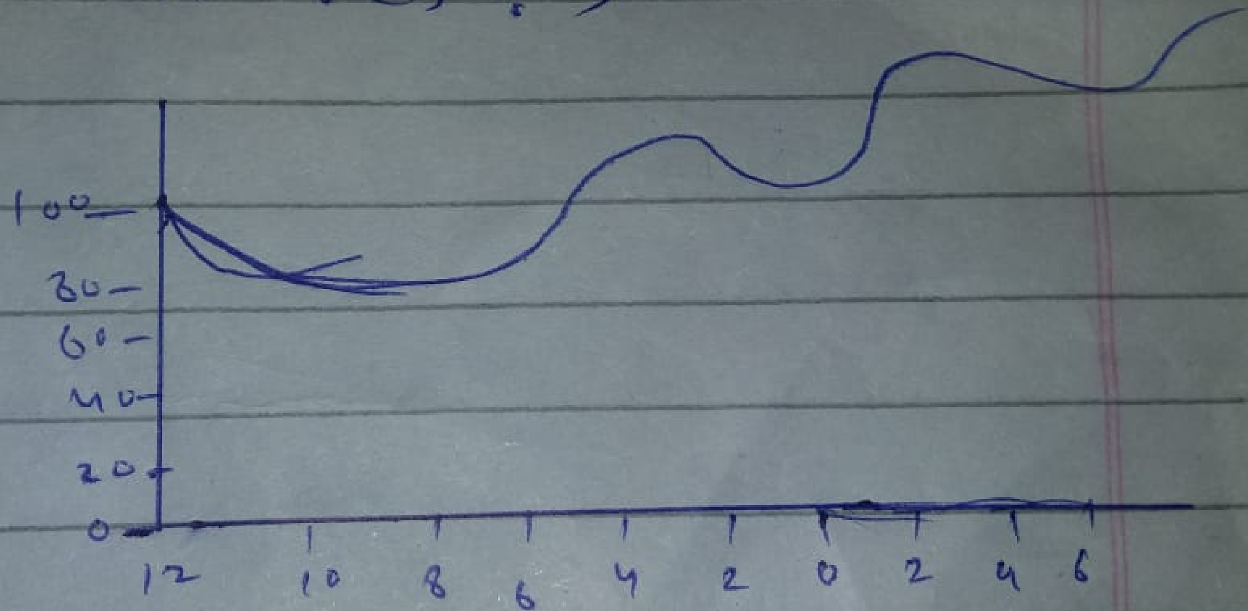
Load Curves :->



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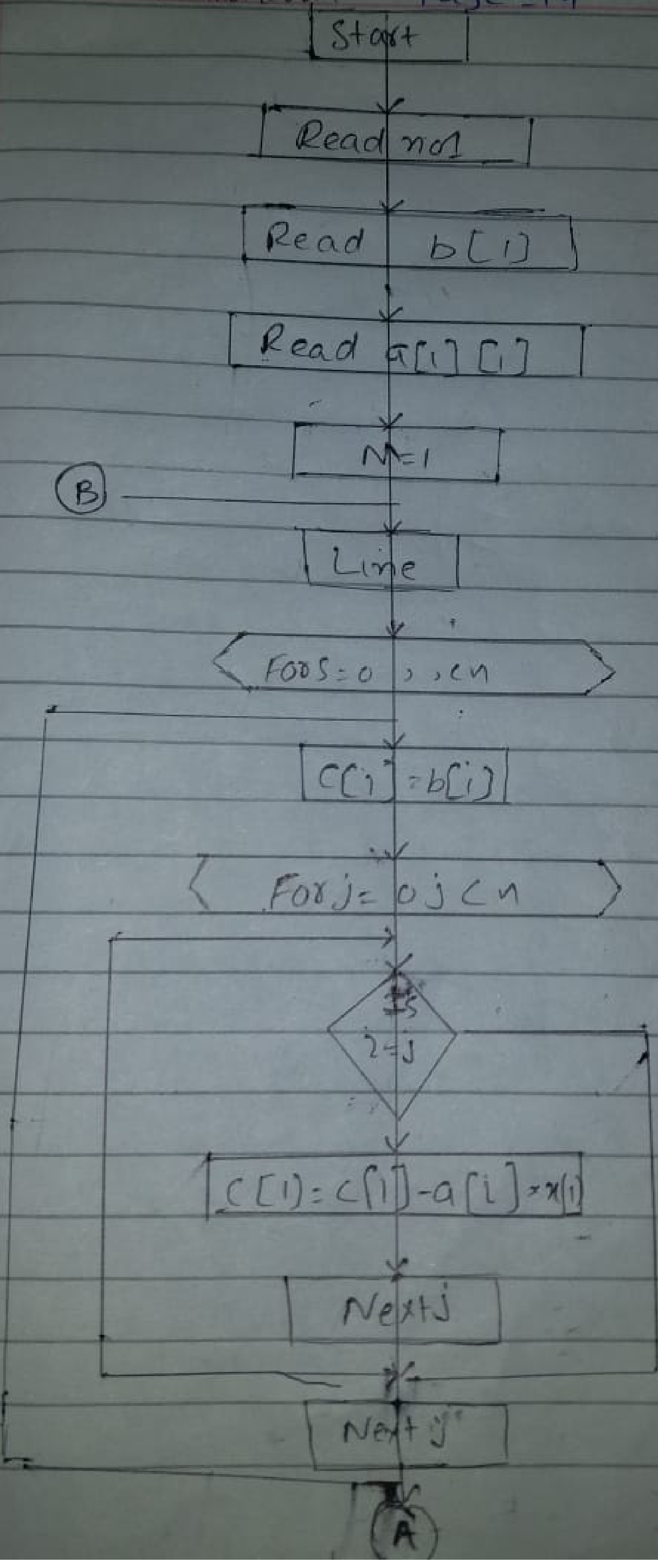

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Also

$$I_K = \sum_{n=1}^{N} Y_{Kn} V_n \text{ or}$$

$$I_K = Y_{K1} V_1 + Y_{K2} V_2 + Y_{KK} V_K + Y_{KN} V_N$$

From the above eq

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

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 $K = 1, 2, \dots N$

Q.5;

Ans:-> This is the first interative method to find out Power flow eavuation for this method we again Start with the basic of network eavuations For this we again Start with basic of Network eavuation

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

and for any particular busk

$$I_K = \sum_{N=1}^{N} Y_{Kn} V_n$$

the Complex power

$$S_K = P_K + jQ_K = V_K I_K^*$$

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

where $K = 1, 2 \ldots\ldots N$

From Complex Power

$$I_K \quad \frac{P_K - jQ_K}{V_K}$$

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bus bars Y Bus is the matrix of x admittance and V-Bus in the voltage phaser at the is busbar of $K_L$ power system

=> For a particular bus K we can write the equation as, $I_K = \sum_{n=1}^{N} Y_{knn} V_n$ — (2)

where N = no of busbar $Y_{kn}$ = admittance of the kn element

$V_n$ = voltage phaser at bus n

From equation we can write the Complex power injection at bus bar k is $S_K = P_K + jQ_K = V_K I_K$ → (3)

Now we know The value of $I_K$ from eq (2) substitute $I_K$ in eq (3) $P_K + jQ_K = V_K \sum_{n=1}^{N} Y_K V_n$

where $K = 1, 2, - N$

$V_n$ is a phaser, which angle

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

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

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

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 genaration are in our Control and one can say that all generation know to us. but there is one problem. the problem is still all the genaration are avaliable we dont know what is 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 generation.

Solution:=> To overcome the we chose one bus on a referance bus which takes up all these loses which can find after Solution

P.T.O ~>

So at one bus we Cannot specify the generation Generally this is a 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

From the diagram we see that we have three lines one going to 11 kv busbar and to j and the 3rd one to m. these lines will carry the power $P_{ki}$, $Q_{ki}$ to bus i, $P_{kj}$, $Q_{kj}$ to bus j and $P_{km}$ $Q_{km}$ to bus m

=> Same of these power may be in the reverse direction i-e bus k, in that case the value of $P_{kj}$ $Q_{kj}$ will be negative.

So $P_K = P_{Ki} + P_{kj} + P_{km}$

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

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

Power Flow equation :-> we showed that power flow equation are coming from the Network equation

i-e I Bus = YBas VBus — (1)

when I Bus is the vector of current injection into The

P.to →

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Q3

Ans:-> A 10 kw generator is Conveted which inject PGk QGk to the 11 kv Busbar

=> A 20 kw Load is Connected which takes PLk, QLk from the 11 kv Busbar. this 11 kv busbar is Connected to other busbar i-e to bus i and on Through Lines. the voltage at 11 kv busbar is vk where vk is equal to the magnitude vk and the angle δk

=> one think we see that injects PGk and QGk while load takes PLk and QLk from the busbar then we can take the algebric Sum of generation and load i-e Subtract the loads from the generation

$$i-e \quad = P_K = P_{GK} - P_{LK}$$

of Real power injection

P.T.O ->

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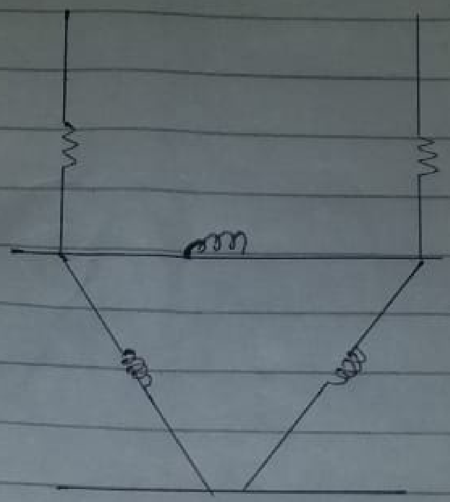
Q-2



Z bas

Zbas = Y bas

$$Z\,bas = \begin{bmatrix} Z_{11} & Z_{12} & Z_{13} \\ Z_{21} & Z_{22} & Z_{23} \\ Z_{31} & Z_{32} & Z_{33} \end{bmatrix}$$