Hilal al 6966

Question = 03

Solution #

(*) A generator in connected of 10kw which inject ~~that~~ P calc, Q calc to the bus bar.

(*) A load of 20kw is connected which take P L.lc, Q L.lc from the BusBar.

(*) A load connected which take P L.lc, Q L.lc from Busbar

** This bus bar connected to other bus bar i.e to bus and through lines.

Voltage at the bus bar v/c, is equal to the magnitude v/c and the angle δ/a.

(i) One thus we see that generator injects P_{Gk} and Q_{Gk} while load takes P_{Lk} from the bus bar then we can take P_{Lk} and Q_{Lk} from the bus bar then we can't take the algebraic sum of generation and loads i.e substracting the loads from generations.

i-e

$P_k = P_{Gk} - P_{Lk}$

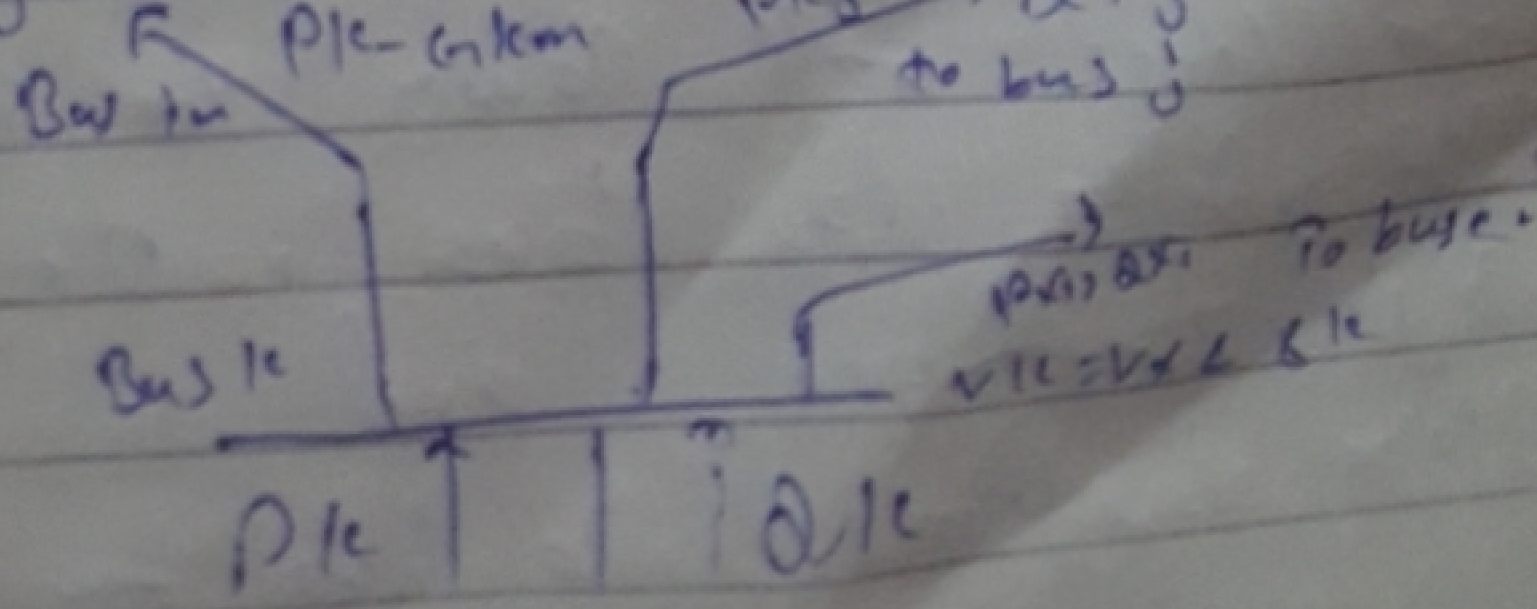
= Real Power injection

Similarly Reactive Power injection

~~$Q_k = G$~~

$Q_k = Q_{Gk} - Q_{Lk}$

Diagram ⇒



(*) Now we will say injection into bus bar rather saying the Generation and loads if at particular bus bar load is connected the the net injection to that bus bar 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

2) From the diagram we see that. a three lines one going to bus bar, 2nd to j and 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 bar m.

Hilal   04

* Same of these power. a reverse direction. i.e. they may be coming from bus j to bus k in that case the value of P_{kj}, Q_{kj} will negatives so.

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

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

∴ Real. are Reactive Powe equal. algebraic sum of P & Q. Powe going out

* <u>Power Flow Equation</u>

we should that power flow eq are coming the Network equations.

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

I_{Bus} In the vector of current injection into the Bus bars Y_{Bus} is the n×n matrix of the admittance. V_{Bus} voltage phase bases of power system

Hitesh 05

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

N = no of bus bar,

Y_{kn} = addmittance of the kn element,

V_n = voltage ll ler phase at bus n.

$S_k = P_k + jQ_k = V_k I_k^* \rightarrow (3)$

now we know the values.

eq (2) substitution I_k in eq (3)

$P_k + jQ_k = V_k \left[\sum_{n=1}^{N} Y_{kn} V_n \right]^*$ where $k = 1, 2, \ldots$

V_n is a phase which has a magnitude and an angle

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

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

Substiating V_n and Y_{kn} value 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 angles δ_k with V_k

δ_n with V_n

θ_{kn} with Y_{kn}

Hilal 06

All negative ble of Conjugate, we Can separate out the act & ~~languag~~ injection Point. Then we can write the real Powe ~~for~~ injection into Bus k. an

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

Similing the Reactive Power injection in

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

(So) we can see that these injection is related to the voltage magnitude and angle at various bus bas.

Eq (4) & (5) in said on ~~the~~ the Power flow equations for the Power Network

Question. 05

Answer:- **Gauss-Seidal**

This is the first ~~impedance~~ interactive method to find out the power flow equation for these method & we gain start ~~who~~ with the bases of Network equation.

(i.e) I Bus = Y Bus = V Bus

and for any particular bus k

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

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

From Complex Power.

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

(*) Also

$$I_k = \sum_{n=1}^{n} y_{kn} V_n \quad \text{or}$$

$$I_k = y_{k1}V_1 + y_{k2}V_2 + \ldots y_{kk}V_k + y_{kn}V_n.$$

(*) 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)

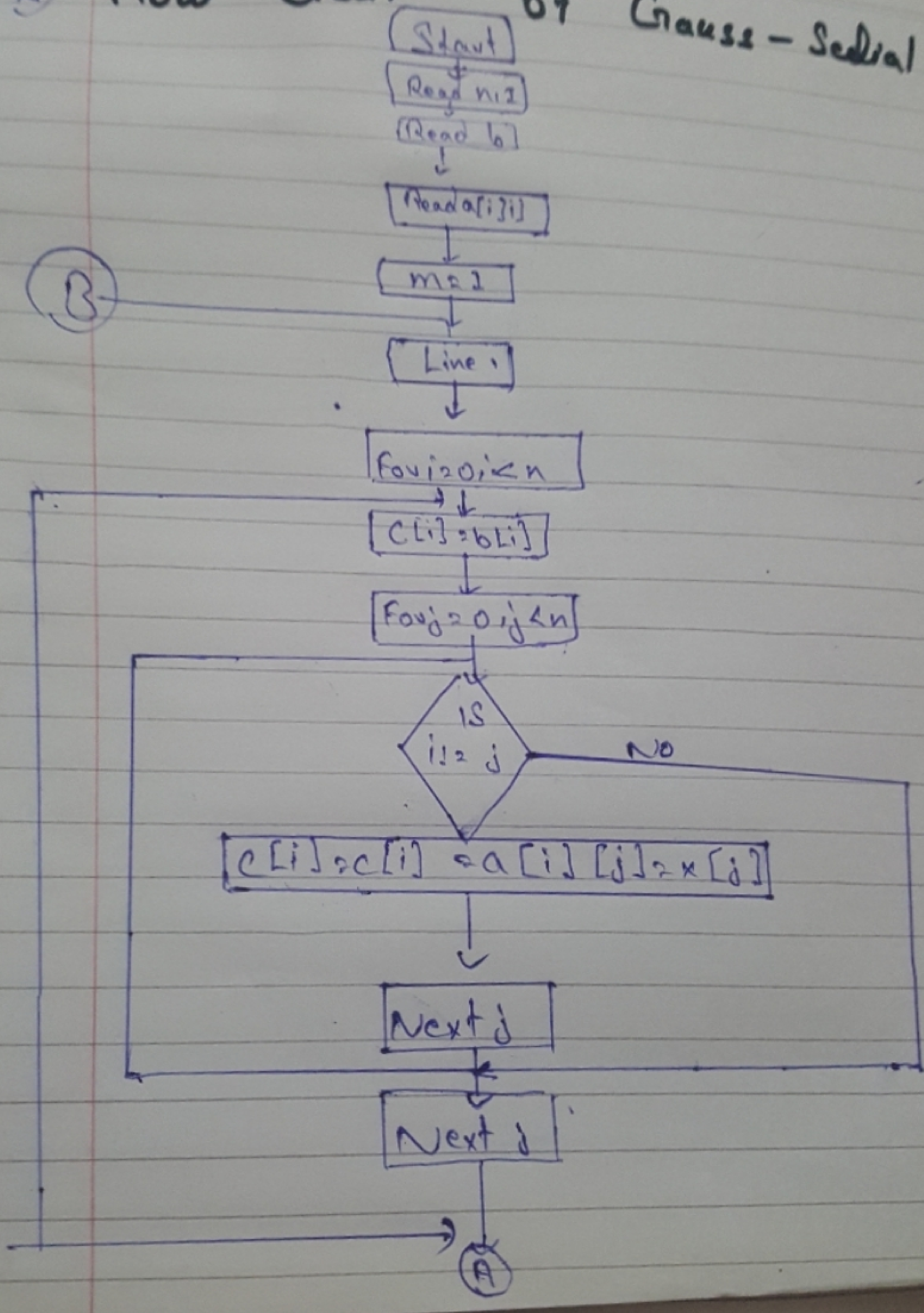
$$V_k = \frac{1}{y_{kk}} \left[\frac{P_k - jQ_k}{V_k} - \left(\sum_{n=1}^{k-1} y_{kn} V_n + \sum_{n=k+1}^{n} y_{kn} V_n \right) \right.$$

when $k = 1, 2, \ldots N$.

(A) Flow Chart

(09)

07 Gauss - Sedial.



Question 04

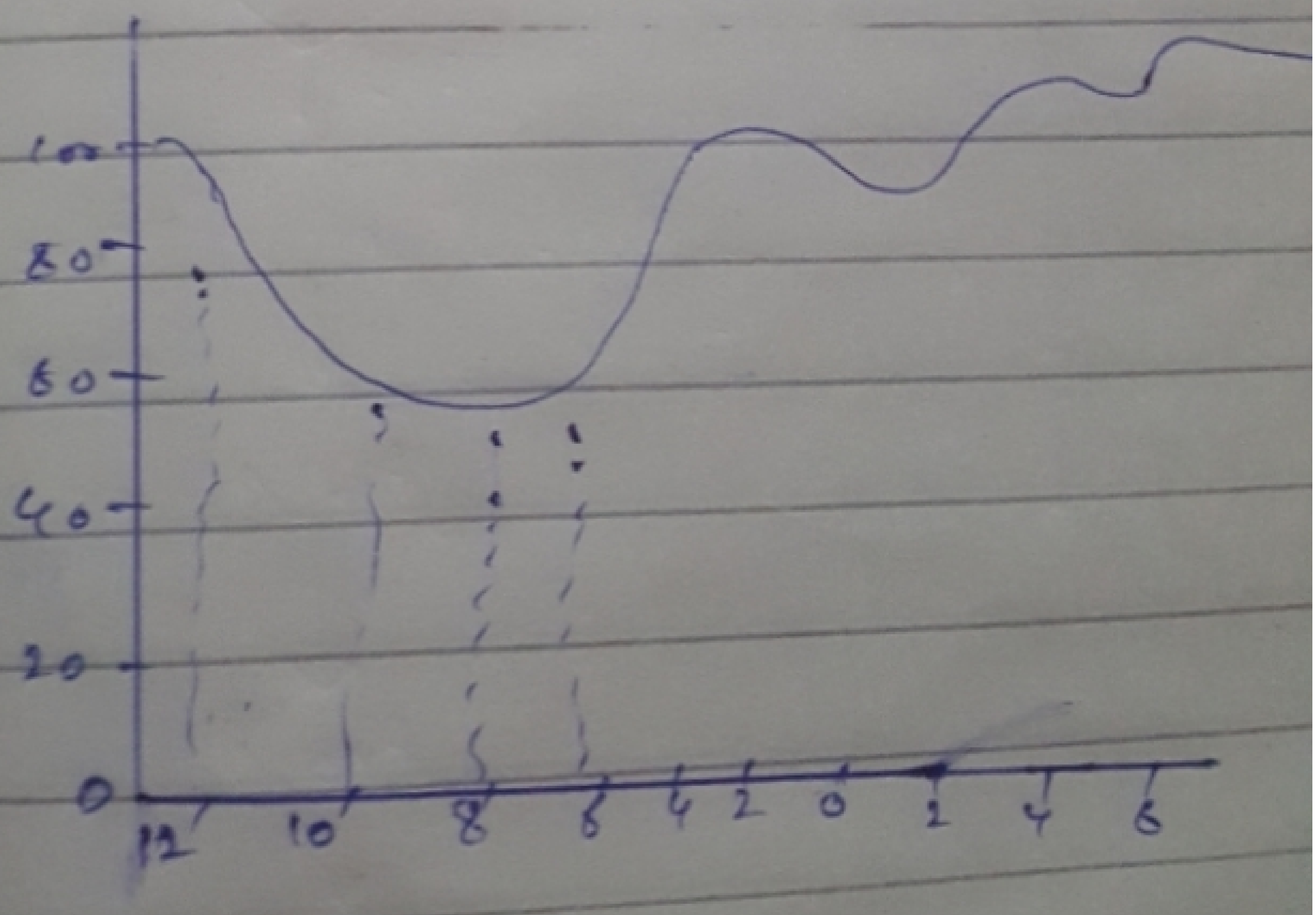
Answer (04)

There is one proble in doing power flow for solution that we can not know all the generation - All the load are known to us but Generation are is our contract and one can ~~so~~ say that all generation known to us but there is one problem The problem is still all the the generation are available we dont know what is the Loss in the system we cannot know the Loss in the system and where. and How much the Loss.

Solution To overcome the we choose one bus on a reference bus which takes up all these

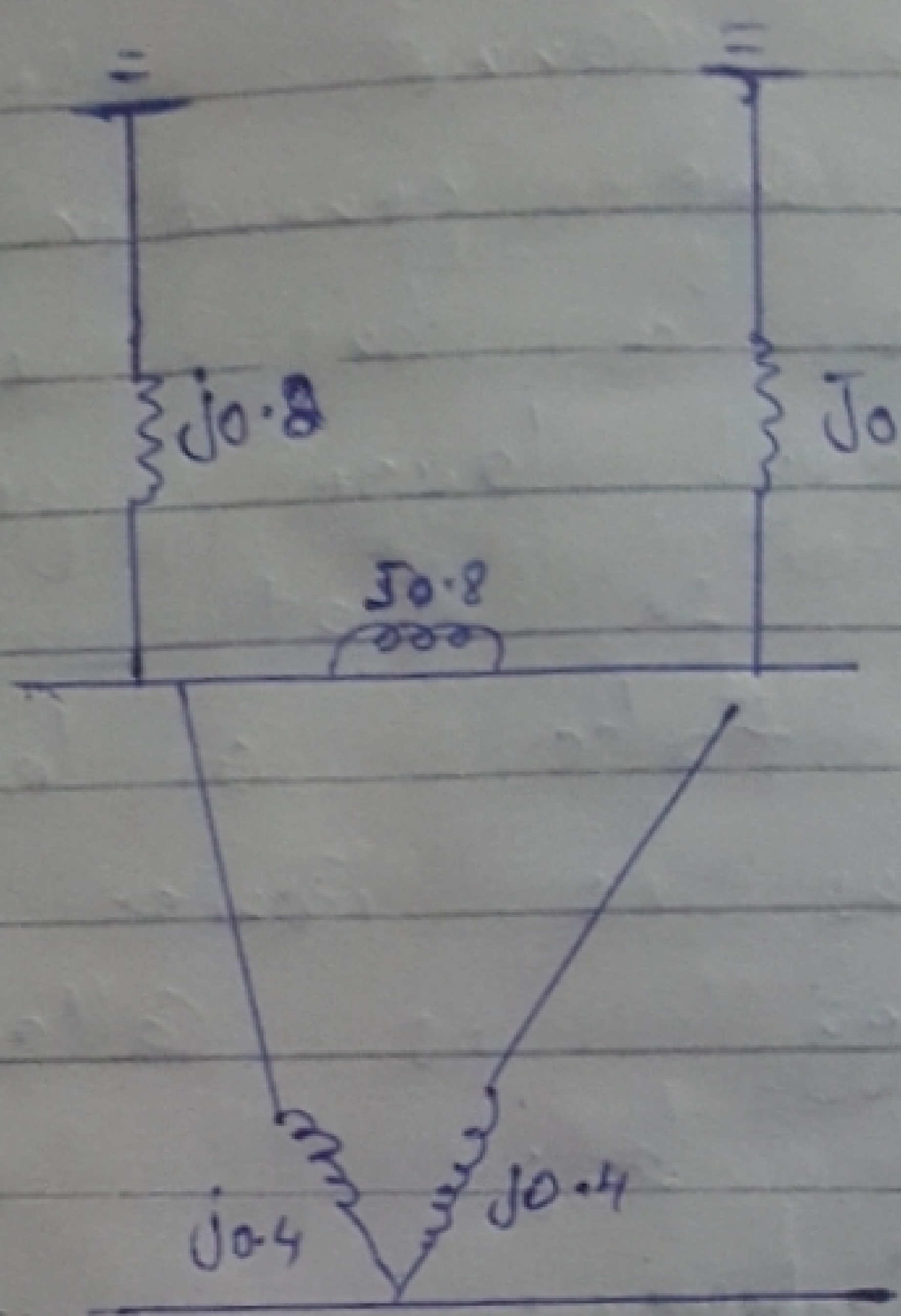
~~lines~~ losses which can find after solution at once bus we cannot ~~spf~~ a specify. the generation Generally this is a bus which have very large generation available so that there. it to take a losses. this bus is power system terminology is called slack bus.

Load Curves.



Question = 02

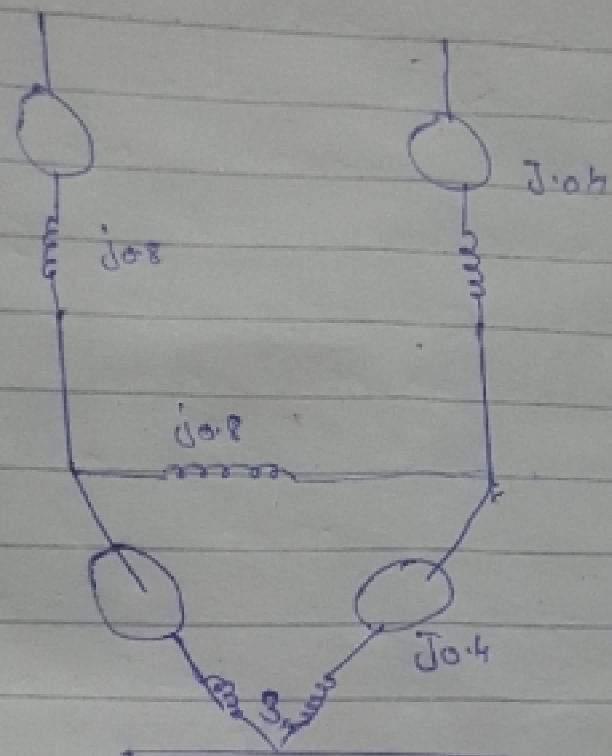
Solution =>



Z base

Z base = y - bus

$$Z\ base \begin{bmatrix} Z_{11} & Z_{12} & Z_{3} \\ Z_{21} & Z_{22} & Z_{23} \\ Z_{31} & Z_{32} & Z_{33} \end{bmatrix}$$



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

$V_2 = Z_{11} \cdot I_1 = Z_{12_2} - Z_{13} \quad I_3$ ...... (1)

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

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

Question:. 01

Solution: The Current Source,

$$I_1 = I_3 = \frac{2.5 \angle 0^\circ}{j\,1.25}$$

$$= 1.2 \angle -90^\circ$$

$$= 0 - j\,1.20 \text{ P.U}$$

$$I_2 = \frac{2.5 \angle -36.87}{j\,1.25}$$

$$= 1.2 \angle -126.87$$

$$= 0.72 - j\,0.96 \text{ P.U}$$

(*) Self admittance in P.U.

$$y_{11} = -j5.0 - j4.0\ j0.8$$

$$y_{11} = -j.9.8$$

$$y_{22} = j50 - j2.5 - j0.8$$

$$y_{22} = j8.3$$

$$y_{33} = y40 - j2.5 - j.80$$

Halal.

$y_{44} = -j18.0$
and the mutual admittances in p.u

$y_{12} = y_{21} = 0$
$y_{13} = y_{31} = -(-j4.0)$
$= +j40$

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

$y_{23} = y_{32} = +y_{2}.5$

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

$y_{34} = y_{43} = +j8.0$

The node equation is Matrix from.

$$\begin{bmatrix} 0-j1.20 \\ 0.72-j-0.76 \\ 0-j1.20 \end{bmatrix} = \begin{bmatrix} -j9.8 & j0.0 & j4.0 & j5.0 \\ j0.0 & j8.3 & j2.5 & j5.0 \\ j4.0 & j2.5 & j15.3 & j8.0 \\ j5.0 & j5.0 & j8.0 & j18.0 \end{bmatrix}$$