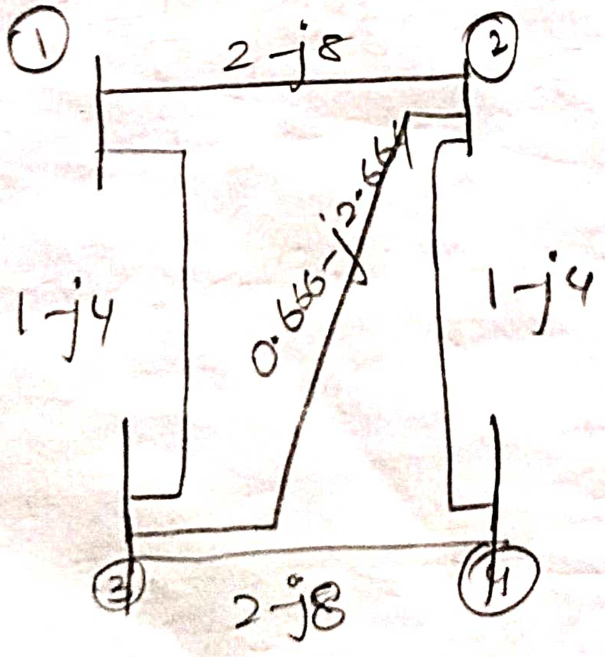
UNIT - III

LOAD FLOW STUDIES.

① The system data for a load flow solution are given in table(1) and table 2. Determine the voltages at the end of first iteration by Gauss-Seidal method. Take $\alpha = 1.6$

Bus code	Admittance
1-2	2-j8
1-3	1-j4
2-3	0.666-j2.664
2-4	1-j4
3-4	2-j8

Bus Code	P	Q	V	Remarks
1	—	—	$1.06\angle 0$	Slack
2	0.5	0.2	—	PQ
3	0.4	0.3	—	PQ
4	0.3	0.1	—	PQ



$$Y_{bus} = \begin{bmatrix} Y_{11} & Y_{12} & Y_{13} & Y_{14} \\ Y_{21} & Y_{22} & Y_{23} & Y_{24} \\ Y_{31} & Y_{32} & Y_{33} & Y_{34} \\ Y_{41} & Y_{42} & Y_{43} & Y_{44} \end{bmatrix}.$$

$Y_{11} = Y_{12} + Y_{13} = 2 - j8 + 1 - j4 = 3 - j12$

$Y_{22} = Y_{21} + Y_{23} + Y_{24} = 2 - j8 + 1 - j4 + 0.666 - j2.664$

$= 3.666 - j14.664.$

$Y_{13} = Y_{31} = 1 - j4.$

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

$Y_{21} = -Y_{12} = -2 + j8.$

$Y_{23} = -Y_{32} = -0.666 + j2.664.$

$Y_{24} = -Y_{42} = -1 + j4.$

$Y_{34} = -Y_{43} = -2 - j8.$

$Y_{33} = 1 - j4 + 0.666 - j2.664 + 2 - j8$

$= 3.666 - j14.664.$

$Y_{44} = 1 - j4 + 2 - j8 = 3 - j12$

$$Y_{bus} = \begin{bmatrix} 3 - j12 & -2 + j8 & -1 + j4 & 0 \\ -2 + j8 & 3.666 + j14.664 & -0.666 + j2.664 & -1 + j4 \\ -1 + j4 & -0.666 + j2.664 & 3.666 - j14.664 & -2 + j8 \\ 0 & -1 + j4 & -2 + j8 & 3 - j12 \end{bmatrix}$$

The initial values of bus voltages are considered as 1 pu except slack bus.

$V_2^0 = 1+j0$

$V_3^0 = 1+j0$

$V_4^0 = 1+j0$

Bus 1 is slack bus, so its voltage remain at the specified value for all iterations.

$V_1^0 = 1.06+j0$ pu

∵ buses are PQ bus the specified real & reactive powers are considered as load powers.

∴ -ive sign is attached

(k+1)th iteration voltage of a PQ load bus p is given by

$$V_p^{k+1} = \frac{1}{Y_{pp}}\left[\frac{P_p - jQ_q}{(V_p^k)^*} - \sum_{q=1}^{p-1} Y_{pq}V_q^{k+1} - \sum_{q=p+1}^{n} Y_{pq}\right.$$

1^{st} iteration $k=0$,

p value from 1 to 4

$V_1^1 = V_1^0 = 1.06 + j0$ p.u (∵ slack bus)

$$V_2^1 = \frac{1}{Y_{22}}\left[\frac{P_2 - jQ_2}{(V_2^0)} - \sum_{q=1}^{1} Y_{pq} V_q^{k+1} - \sum_{3}^{4} Y_{pq} V_q^{k}\right]$$

$$= \frac{1}{Y_{22}}\left[\frac{P_2 - jQ_2}{(V_2^0)} - Y_{21}V_1^1 - Y_{23}V_3^0 - Y_{24}V_4^0\right]$$

$$= 1.0123 \angle -1.64^\circ = 1.0119 - j0.0290 \text{ pu}$$

$$V_{2\,acc}^1 = V_2^0 + \alpha (V_2^1 - V_2^0)$$

$$= 1.0190 - j0.0464$$

$$= 1.0201 \angle -2.61^\circ \text{ p.u}$$

$$V_3^1 = \frac{1}{Y_{33}}\left[\frac{P_3 - jQ_3}{(V_3^0)} - Y_{31}V_1^1 - Y_{32}V_2^1 - Y_{34}V_4^0\right]$$

$$= 0.9946 \angle -1.69^\circ$$

$$= 0.9942 - j0.0293 \text{ pu}$$

$$V_{3\,acc}^1 = V_3^0 + \alpha (V_3^1 - V_3^0)$$

$$= 0.9907 - j0.0469$$

$$= 0.9918 \angle -2.71 \text{ p.u}$$

$$V_4^1 = \frac{1}{Y_{44}}\left[\frac{P_4 - jQ_4}{(V_4^0)^*} - Y_{41}V_1^1 - Y_{42}V_2^1 - Y_{43}V_3^1\right]$$

$$= 0.9864 - j0.0683 \text{ p.u.}$$

$$= 0.9888 \angle -3.96$$

$$V_{4\,acc}^1 = V_4^0 + \alpha(V_4^1 - V_4^0)$$

$$= 0.9782 - j0.1083$$

$$= 0.9843 \angle -6.38^\circ \text{ p.u.}$$

(2) For the system in figg. Determine the voltages at the end of first iteration Gauss - seidal method. $\alpha = 1$.