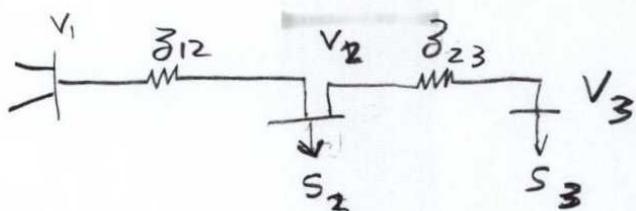


EE 341

①

A. Keyha

Distribution line voltage calculation.

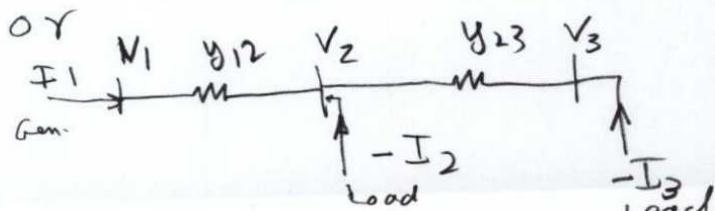
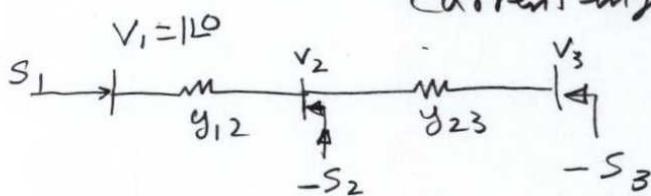


Given: \bar{Y}_{12} , \bar{Y}_{23} , S_2 , S_3 and V_1

Find: V_2 and V_3 .

Convention.

1. Assume all loads are negative complex power (or current injection)
2. Assume $V_1 = 1 \angle 0^\circ$ with deviation of plus or minus 10%
3. Assume complex power generation as positive injection (or positive current injection)



(2)

Assume at each bus sum of the current flowing to the bus (node) = 0

$$\sum I = 0$$

Set 1 {

$$\begin{aligned} (V_2 - V_1)Y_{12} + I_1 &= 0 \\ (V_1 - V_2)Y_{12} + (V_3 - V_2)Y_{23} - I_2 &= 0 \\ (V_2 - V_3)Y_{23} - I_3 &= 0 \end{aligned}$$

You may also assume at each bus sum of the current flowing away from the bus (node) = 0

$$\sum I = 0$$

In this case, you will have

Set 2 {

$$\begin{aligned} (V_1 - V_2)Y_{12} - I_1 &= 0 \\ (V_2 - V_1)Y_{12} + (V_2 - V_3)Y_{23} + I_2 &= 0 \\ (V_3 - V_2)Y_{23} + I_3 &= 0 \end{aligned}$$

Note that if you multiply each equation by minus, you will obtain the equations given above (set 1)

(3)

let us rewrite the set 2.

$$-y_{12}v_1 - v_2 y_{12} = I_1$$

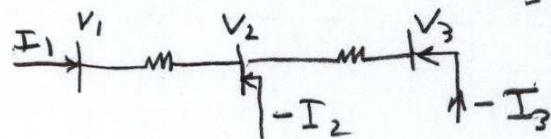
$$-y_{12}v_1 + v_2(y_{12} + y_{23}) - v_3 y_{23} = -I_2$$

$$(0) v_1 - y_{23}v_2 + v_3 y_{23} = -I_3$$

$$\text{let } Y_{11} = y_{12} \quad Y_{12} = -y_{12}$$

$$Y_{22} = y_{12} + y_{23} \quad Y_{23} = y_{23}$$

$$\begin{bmatrix} Y_{11} & Y_{12} & 0 \\ Y_{21} & Y_{22} & Y_{23} \\ 0 & Y_{23} & Y_{33} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix} = \begin{bmatrix} I_1 \\ -I_2 \\ -I_3 \end{bmatrix}$$



$$Y_{ij} \begin{cases} Y_{ii} = \sum y_{ij} \text{ when } i=j \\ Y_{ij} = 0 \text{ when } i \text{ is not connected to } j \\ Y_{ij} = -y_{ij} \text{ if } i \text{ connected to } j \end{cases}$$

(4)

solution.

$$K=0 \quad \text{assume } V_1 = 1 \text{ V}$$

$$V_2 = 1 \text{ V} \quad V_3 = 1 \text{ V}$$

$$Y_{11} V_1 + Y_{12} V_2 = I_1$$

$$Y_{21} V_1 + Y_{22} V_2 + Y_{23} V_3 = -I_2$$

$$Y_{23} V_2 + Y_{33} V_3 = -I_3$$

$k = k + 1$

compute I_2, I_3

$$I_2^K = \left(\frac{S_2}{V_2^K} \right)^*$$

$$I_3^K = \left(\frac{S_3}{V_3^K} \right)^*$$

$$V_2^{K+1} = \frac{Y_{21}V_1 + Y_{23}V_3^K - I_2^K}{Y_{22}}$$

$$V_3^{K+1} = \frac{Y_{23}V_2^{K+1} - I_3^K}{Y_{33}}$$

check

$$\text{If } S^K = V_K^K I_K^K \quad K=2, 3$$
$$S^K - S^{\text{Given}} \leq 10^{-6} \rightarrow \text{Done}$$