

Exercice 1

$$Y_{BUS} = \begin{array}{c|cccc} & (1) & (2) & (3) & (4) \\ \hline 1 & -j6.0 & j4.0 & 0 & j2.0 \\ \hline 2 & j4.0 & -j6.5 & j2.5 & 0 \\ \hline 3 & 0 & j2.5 & -j12.5 & j10 \\ \hline 4 & +j2 & 0 & j10 & -j12 \end{array}$$

Exercice 2

Eliminant le noeud 1

$$\begin{bmatrix} 0.6833 & -0.25 & -0.3333 \\ -0.25 & 0.75 & -0.5 \\ -0.3333 & -0.5 & 0.8333 \end{bmatrix} \begin{bmatrix} V_2 \\ V_3 \\ V_4 \end{bmatrix} = \begin{bmatrix} 2 \\ 0 \\ 4 \end{bmatrix}$$

Eliminant le noeud 3

$$\begin{bmatrix} 0.6 & -0.5 \\ -0.5 & 0.5 \end{bmatrix} \begin{bmatrix} V_2 \\ V_4 \end{bmatrix} = \begin{bmatrix} 2 \\ 4 \end{bmatrix} \quad V_2 = 60 \quad \text{and} \quad V_4 = 68$$

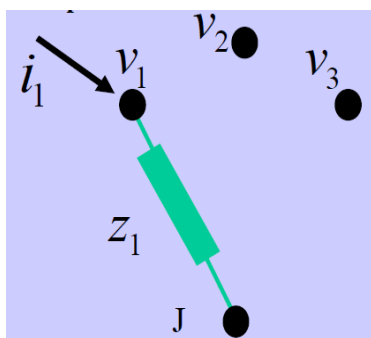
$$0.625 V_1 - 0.5 V_2 = 0 \quad V_1 = \frac{0.5 \times 60}{0.625} = 48$$

$$-0.25 V_2 + 0.75 V_3 - 0.5 V_4 = 0$$

$$V_3 = \frac{0.25 \times 60 + 0.5 \times 68}{0.75} = 65.3333$$

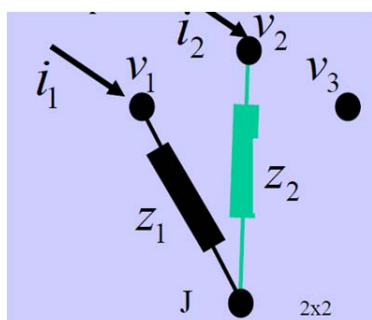
Exercice 3

Etape 1 : Ajout d'une nouvelle branche d'impedance Z_1 entre un nouveau bus (1) et le bus de référence (j)



$$Z_{bus} = [z_1] = [j0.15]$$

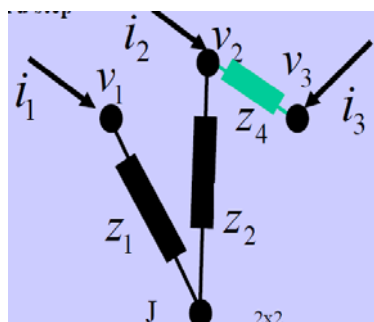
Etape 2 : Ajout d'une nouvelle branche d'impedance Z2 entre un nouveau bus (2) et le bus de référence (j)



$$\mathbf{Z}_{\text{bus}(\text{new})} = \begin{bmatrix} \mathbf{Z}_{\text{bus}(\text{old})} & 0 \\ 0 & z_2 \end{bmatrix} = \begin{bmatrix} j0.15 & 0 \\ 0 & j0.075 \end{bmatrix}$$

$$\mathbf{V}_{\text{bus}} = \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} z_1 & 0 \\ 0 & z_2 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$$

Etape 3 : Ajout d'une nouvelle branche d'impedance Z4 entre un nouveau bus (3) et un bus existant (2)

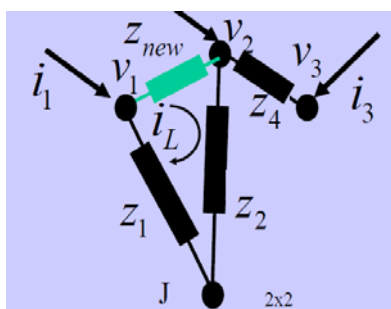


$$\mathbf{Z}_{\text{bus,new}} = \begin{bmatrix} \mathbf{Z}_{\text{bus,old}} & z_{12} \\ \text{---} & z_{22} \\ z_{12} & z_{22} & z_2 + z_4 \end{bmatrix}$$

$$= \begin{bmatrix} j0.15 & 0 & 0 \\ 0 & j0.075 & j0.075 \\ 0 & j0.075 & j0.175 \end{bmatrix}$$

$$\mathbf{V}_{\text{bus}} = \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix} = \begin{bmatrix} j0.15 & 0 & 0 \\ 0 & j0.075 & j0.075 \\ 0 & j0.075 & j0.175 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix}$$

Etape 4 : Ajout d'une nouvelle branche d'impedance (Znew=Z3) entre deux bus existants (1) et (2)

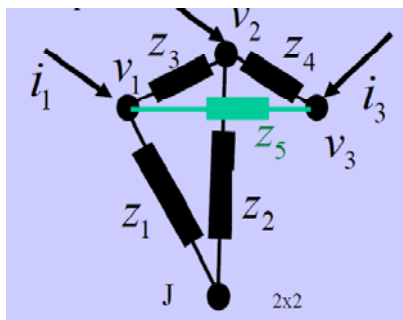


$$\mathbf{Z}_{\text{bus,new}} = \mathbf{Z}_{\text{bus,old}} + \frac{j \begin{bmatrix} 0.15 - 0 \\ 0 - 0.075 \\ 0 - 0.075 \end{bmatrix} j \begin{bmatrix} 0 - 0.15 & 0.075 - 0 & 0.075 - 0 \end{bmatrix}}{(z_{11} + z_{22} + z_3 - 2z_{12})}$$

Après calcul:

$$\mathbf{Z}_{\text{bus,new}} = j \begin{bmatrix} 0.0808 & 0.0346 & 0.0346 \\ 0.0346 & 0.0577 & 0.0577 \\ 0.0346 & 0.0577 & 0.1577 \end{bmatrix}$$

Etape 5 : Ajout d'une nouvelle branche d'impédance ($Z_{\text{new}}=Z_5$) entre deux bus existants (1) et (3)



$$\mathbf{Z}_{\text{bus,new}} = \mathbf{Z}_{\text{bus,old}} + \frac{j \begin{bmatrix} 0.0808 - 0.0346 \\ 0.0346 - 0.0577 \\ 0.0346 - 0.1577 \end{bmatrix} j \begin{bmatrix} 0.0346 - 0.0808 & 0.0577 - 0.0346 & 0.1577 - 0.0346 \end{bmatrix}}{(z_{11} + z_{33} + z_5 - 2z_{13})}$$

Après calcul:

$$\mathbf{Z}_{\text{bus,new}} = \mathbf{Z}_{\text{bus}} = j \begin{bmatrix} 0.0729 & 0.0386 & 0.0557 \\ 0.0386 & 0.0557 & 0.0471 \\ 0.0557 & 0.0471 & 0.1014 \end{bmatrix}$$