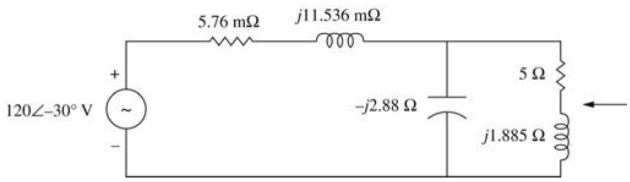
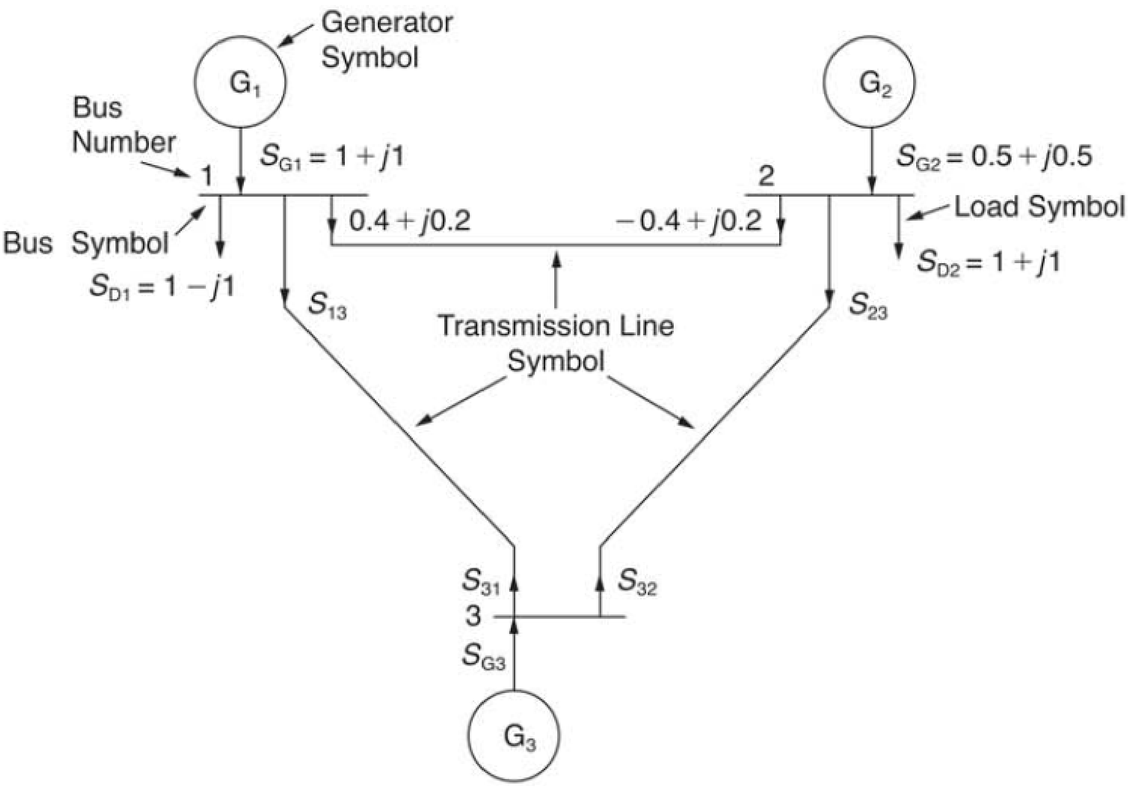
HW1 1

The circuit transformed to phasor domain is shown below:



HW1 2

Modeling the transmission lines as inductors, with $S_{ij} = S_{ji}^*$, Compute S_{13}, S_{31}, S_{23}, S_{32}, and S_{G3} in Figure 2.25. (*Hint:* complex power balance holds good at each bus, satisfying KCL.)



Since complex powers satisfy KCL at each bus, it follows that

$$\bar{S}_{13} = (1+j1)-(1-j1)-(0.4+j0.2) = -0.4+j1.8 \quad \leftarrow$$

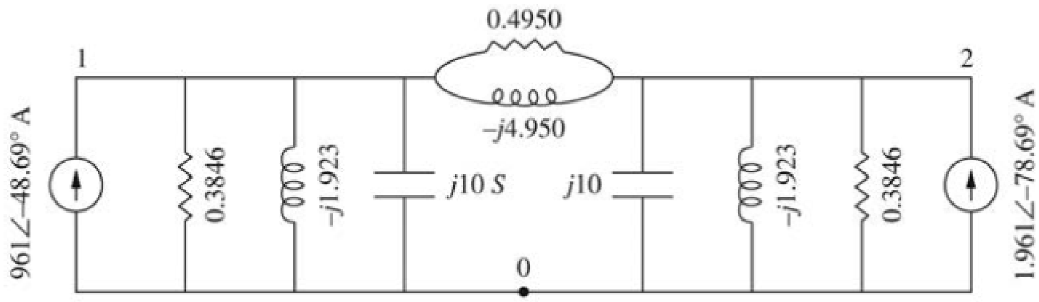
$$\bar{S}_{31} = -\bar{S}_{13}^* = 0.4+j1.8 \quad \leftarrow$$

Similarly, $\bar{S}_{23} = (0.5+j0.5)-(1+j1)-(-0.4+j0.2) = -0.1-j0.7 \quad \leftarrow$

$$\bar{S}_{32} = -\bar{S}_{23}^* = 0.1-j0.7 \quad \leftarrow$$

At Bus 3, $\bar{S}_{G3} = \bar{S}_{31}+\bar{S}_{32} = (0.4+j1.8)+(0.1-j0.7) = 0.5+j1.1 \quad \leftarrow$

HW1-3



(Admittance values are shown)

$$\begin{bmatrix} (.3846+.4950)+j(10-1.923-4.950) & -(.4950-j4.950) \\ -(.4950-j4.950) & (.3846+.4950)+j(10-1.923-4.95) \end{bmatrix} \begin{bmatrix} \overline{V}_{10} \\ \overline{V}_{20} \end{bmatrix} = \begin{bmatrix} 1.961\angle-48.69^\circ \\ 1.961\angle-78.69^\circ \end{bmatrix}$$

$$\begin{bmatrix} 0.8796+j3.127 & -0.4950+j4.950 \\ -0.4950+j4.950 & -0.8796+j3.127 \end{bmatrix} \begin{bmatrix} \overline{V}_{10} \\ \overline{V}_{20} \end{bmatrix} = \begin{bmatrix} 1.961\angle-48.69^\circ \\ 1.961\angle-78.69^\circ \end{bmatrix}$$

HW1-4

After converting impedance values in Figure 2.29 to admittance values, the bus admittance matrix is:

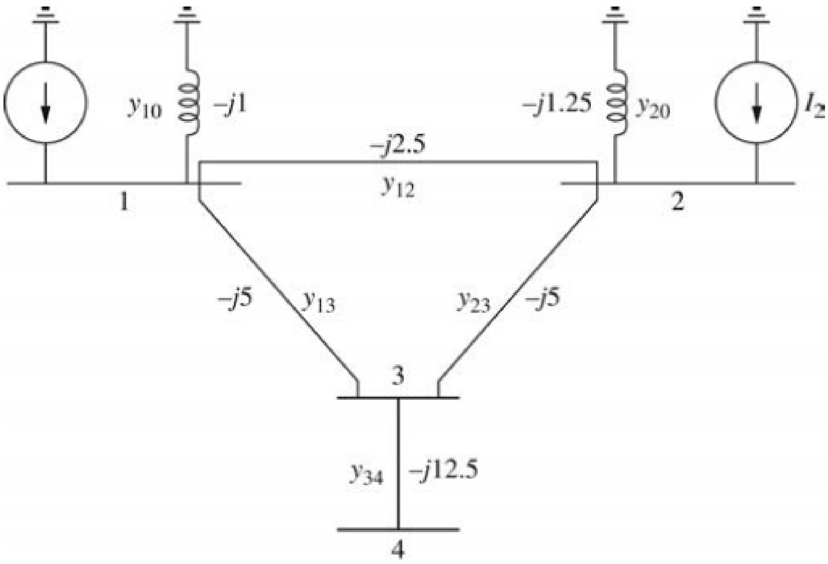
$$\overline{Y}_{bus} = \begin{bmatrix} 1 & -1 & 0 & 0 \\ -1 & \left(1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}-j1\right) & -\left(\frac{1}{3}-j1\right) & -\left(\frac{1}{4}\right) \\ 0 & -\left(\frac{1}{3}-j1\right) & \left(\frac{1}{3}-j1+j\frac{1}{4}+j\frac{1}{2}\right) & -\left(j\frac{1}{4}\right) \\ 0 & -\left(\frac{1}{4}\right) & -\left(j\frac{1}{4}\right) & \left(\frac{1}{4}+j\frac{1}{4}-j\frac{1}{3}\right) \end{bmatrix}$$

Writing nodal equations by inspection:

$$\begin{bmatrix} 1 & -1 & 0 & 0 \\ -1 & (2.083-j1) & (-0.3333+j1) & -0.25 \\ 0 & (-0.3333+j1) & (0.3333-j0.25) & -j0.25 \\ 0 & (-0.25) & -j0.25 & (0.25-j0.08333) \end{bmatrix} \begin{bmatrix} \overline{V}_{10} \\ \overline{V}_{20} \\ \overline{V}_{30} \\ \overline{V}_{40} \end{bmatrix} = \begin{bmatrix} 1\angle0^\circ \\ 0 \\ 0 \\ 2\angle30^\circ \end{bmatrix}$$

HW2　1

The admittance diagram for the system is shown below:



$$\overline{Y}_{BUS} = \begin{bmatrix} \overline{Y}_{11} & \overline{Y}_{12} & \overline{Y}_{13} & \overline{Y}_{14} \\ \overline{Y}_{21} & \overline{Y}_{22} & \overline{Y}_{23} & \overline{Y}_{24} \\ \overline{Y}_{31} & \overline{Y}_{32} & \overline{Y}_{33} & \overline{Y}_{34} \\ \overline{Y}_{41} & \overline{Y}_{42} & \overline{Y}_{43} & \overline{Y}_{44} \end{bmatrix} = j \begin{bmatrix} -8.5 & 2.5 & 5.0 & 0 \\ 2.5 & -8.75 & 5.0 & 0 \\ 5.0 & 5.0 & -22.5 & 12.5 \\ 0 & 0 & 12.5 & -12.5 \end{bmatrix} S$$

where　$\overline{Y}_{11} = \overline{y}_{10} + \overline{y}_{12} + \overline{y}_{13}$; $\overline{Y}_{22} = \overline{y}_{20} + \overline{y}_{12} + \overline{y}_{23}$; $\overline{Y}_{23} = \overline{y}_{13} + \overline{y}_{23} + \overline{y}_{34}$

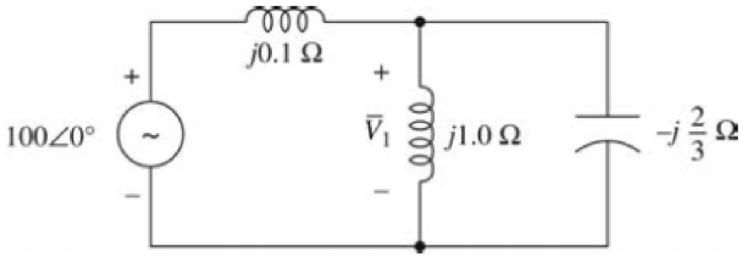
$\overline{Y}_{44} = y_{34}$; $\overline{Y}_{12} = \overline{Y}_{21} = -\overline{y}_{12}$; $\overline{Y}_{13} = \overline{Y}_{31} = -\overline{y}_{13}$; $\overline{Y}_{23} = \overline{Y}_{32} = -\overline{y}_{23}$

and　$\overline{Y}_{34} = \overline{Y}_{43} = -\overline{y}_{34}$

HW2 2

Replace delta by the equivalent WYE: $\bar{Z}_Y = -j\frac{2}{3}\,\Omega$

Per-phase equivalent circuit is shown below:



Noting that $\left(j1.0 \middle\| -j\frac{2}{3}\right) = -j2$, by voltage-divider law,

$$\bar{V}_1 = \frac{-j2}{-j2 + j0.1}(100\angle 0^\circ) = 105\angle 0^\circ$$

$$\therefore v_1(t) = 105\sqrt{2}\cos(\omega t + 0^\circ) = 148.5\cos\omega t\ \mathrm{V} \quad \leftarrow$$

In order to find $i_2(t)$ in the original circuit, let us calculate $\bar{V}_{A'B'}$

$$\bar{V}_{A'B'} = \bar{V}_{A'N'} - \bar{V}_{B'N'} = \sqrt{3}\,e^{j30^\circ}\bar{V}_{A'N'} = 173.2\angle 30^\circ$$

Then $\bar{I}_{A'B'} = \dfrac{173.2\angle 30^\circ}{-j2} = 86.6\angle 120^\circ$

$$\therefore i_2(t) = 86.6\sqrt{2}\cos(\omega t + 120^\circ)$$

$$= 122.5\cos(\omega t + 120^\circ)\,\mathrm{A} \quad \leftarrow$$