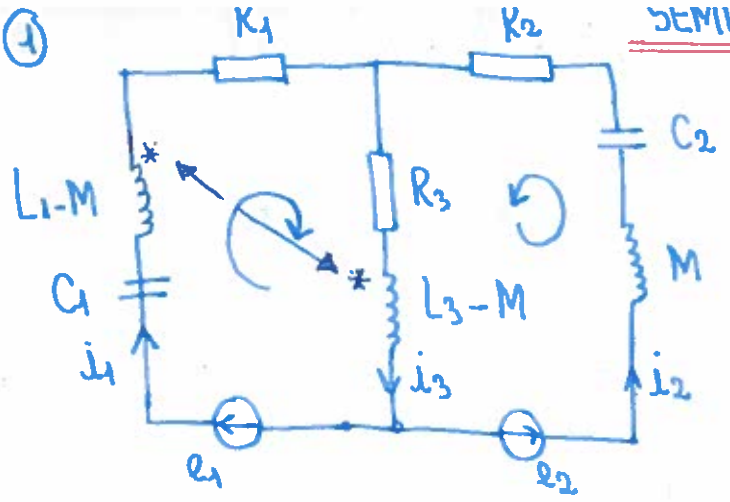
1)



$e_1(t) = 100\sqrt{2}\sin 100t$

$e_2(t) = 100\sqrt{2}\sin 100t + \pi/2$

$R_1 = 2.5\,\Omega \quad R_2 = 10\,\Omega \quad R_3 = 10\,\Omega$

$L_1 = 200\ mH \quad C_1 = 1\ mF$

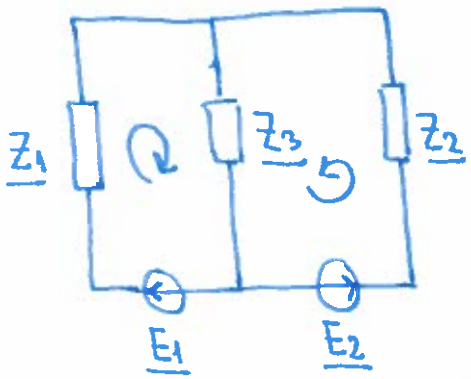
$C_2 = 1\ mF \quad M = 100\ mH$

$L_3 = 300\ mH$

$i_3 = i_1 + i_2$

$$e_1 = \frac{1}{C_1}\int i_1\,dt + L_1\frac{di_1}{dt} - M\frac{di_3}{dt} + R_1 i_1 + R_3 i_3 + L_3\frac{di_3}{dt} - M\frac{di_1}{dt}$$

$$e_2 = \frac{1}{C_2}\int i_2\,dt + R_2 i_2 + R_3 i_3 + L_3\frac{di_3}{dt} - M\frac{di_1}{dt}$$



$\underline{E_1} = 100\,e^{j0} = 100$

$\underline{E_2} = 100\,e^{j\frac{\pi}{2}} = 100j$

$$\underline{Z_1} = j\left(\omega(L_1 - M) - \frac{1}{\omega C_1}\right) + R_1$$

$$= 2.5 + j\left(100\cdot 10^{-1} - \frac{1}{100\cdot 10^{-3}}\right)$$

$= 2.5$

$\omega L = \frac{1}{\omega C}$ } serijska rezonanca

$X_L = X_C$

$$\underline{Z_2} = j\left(\omega M - \frac{1}{\omega C_2}\right) + R_2 = 10 + j\left(100 \cdot 10^{-1} - \frac{1}{100 \cdot 10^{-3}}\right) = 10$$

$$\underline{Z_3} = R_3 + j\omega\left(L_3 - M\right) = 10 + j\,100 \cdot 2 \cdot 10^{-1} = 10 + 20j = 10(1+2j)$$

$$\begin{cases} \underline{E_1} = \underline{i_1}\underline{Z_1} + \underline{i_3}\underline{Z_3} \\ \underline{E_2} = \underline{i_3}\underline{Z_3} + \underline{i_2}\underline{Z_2} \\ \underline{i_3} = \underline{i_1} + \underline{i_2} \end{cases} \Leftrightarrow \begin{cases} 100 = 2.5 \cdot \underline{i_1} + 10(1+2j)\underline{i_3} & |:2.5 \\ 100j = 10\,\underline{i_2} + 10(1+2j)\underline{i_3} & |:10 \\ \underline{i_3} = \underline{i_1} + \underline{i_2} \Rightarrow \underline{i_2} = \underline{i_3} - \underline{i_1} \end{cases}$$

$$\begin{cases} 40 = \underline{i_1} + 4(1+2j)\underline{i_3} \\ 10j = \underline{i_3} - \underline{i_1} + (1+2j)\underline{i_3} \end{cases}$$

$$40 + 10j = (6+10j)\underline{i_3} \Rightarrow \underline{i_3} = \frac{(3+5j)(20-5j)}{425} = \frac{425}{425}$$

$$\underline{i_3} = \frac{10(4+j)}{3+5j} = \frac{10(4+j)(3-5j)}{34} = \frac{5(4+j)(3-5j)}{34} = \frac{5}{2}(1-j)$$

$$= \frac{5\sqrt{2}}{2}\left(\frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2}j\right) = \frac{5\sqrt{2}}{2}\,e^{j\left(-\frac{\pi}{4}\right)}$$

$$i_3(t) = 5\sin\left(100 + \frac{-\pi}{4}\right)$$

$$40 = \underline{i_1} + 4(1+2j) \cdot \frac{5}{2}(1-j)$$

$$40 = \underline{i_1} + 10(3+j) \Rightarrow \underline{i_1} = 10 - 10j = 10(1-j) = 10\sqrt{2}\,e^{j\left(-\frac{\pi}{4}\right)}$$

$$i_1(t) = 20\sin\left(100 + \left(-\frac{\pi}{4}\right)\right)$$

$$\underline{i_2} = \underline{i_3} - \underline{i_1} \Rightarrow \underline{i_2} = \frac{5}{2}(1-j) - 10(1-j) = -\frac{15}{2} + \frac{15}{2}j = -\frac{15}{2}(-1+j)$$

$$\underline{i_2} = \frac{15\sqrt{2}}{2}\,e^{j\frac{3\pi}{4}} \qquad i_2(t) = 15\sin\left(100t + \frac{3\pi}{4}\right)$$

$$\underline{U}_{C_1} = \underline{Z}_{C_1}\underline{I}_1 = \frac{-j}{\omega C_1}\cdot 10(1-j) = \frac{-j}{100\cdot 10^{-3}}10(1-j) = -10j(10-10j)$$

$$= -100-100j = 100(-1-j) = 100\sqrt{2}\,e^{j\frac{5\pi}{4}}$$

$$\underline{U}_{C_2} = \underline{Z}_{C_2}\underline{I}_2 = \frac{-j}{\omega C_2}\cdot \underline{i}_2 = \frac{-j}{10^{-1}}\left(-\frac{15}{2}+\frac{15}{2}j\right) = -10j\left(-\frac{15}{2}+\frac{15}{2}j\right)$$

$$= 75j+75 = 75(1+j) = 75\sqrt{2}\left(\frac{\sqrt{2}}{2}+\frac{\sqrt{2}}{2}j\right) = 75\sqrt{2}\,e^{j\pi/4}$$

$$\underline{S}_{gen} = \underline{S}_{rez}$$

$$\underline{S}_{rez} = \underline{Z}_1 I_1^2 + \underline{Z}_2 I_2^2 + \underline{Z}_3 I_3^2 = 2{,}5\cdot 200 + 10\cdot\frac{225}{2} + 10(1+2j)\cdot\frac{25}{3}$$

$$= 500 + 1125 + 125 + 250j = 250(7+j)$$

$$\underline{S}_{gen} = \underline{E}_1\cdot \underline{i}_1^{\,*} + \underline{E}_2\cdot \underline{i}_2^{\,*} = 100\cdot 10(1+j) + 100j\cdot\frac{15}{2}(-1-j)$$

$$= 1000 + 100j - 750j + 750 = 250(7+j)$$

Node Potential Method

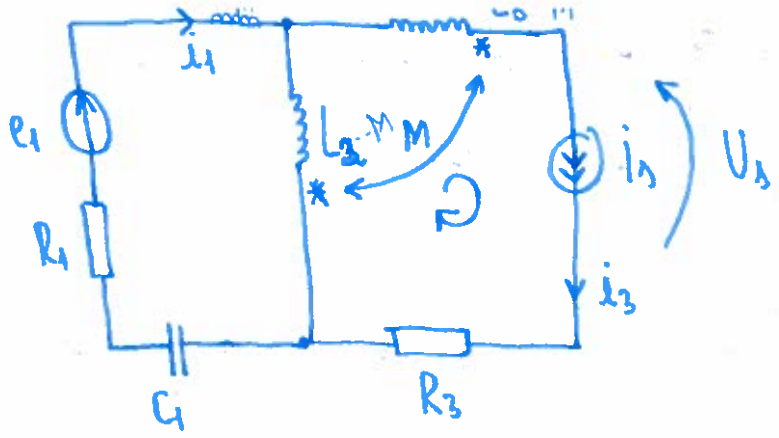
$$V_2 = 0$$

$$Y_{11}V_1 = J_{sc1}$$

$$Y_{11} = \frac{1}{\underline{Z}_1} + \frac{1}{\underline{Z}_2} + \frac{1}{\underline{Z}_3}$$

$$J_{sc1} = \frac{\underline{E}_1}{\underline{Z}_1} + \frac{\underline{E}_2}{\underline{Z}_2}$$

②



$R_1 = 2\Omega \qquad C_1 = \frac{10}{\pi}\ mF$

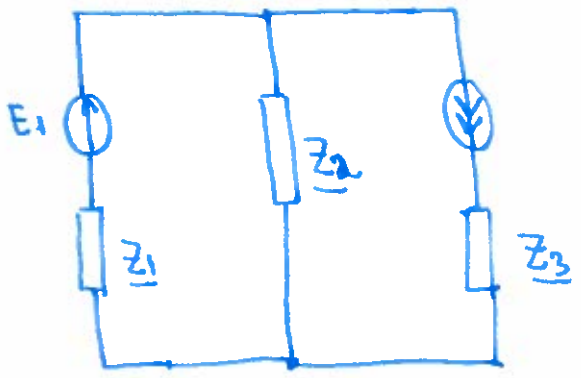
$\nu = 50\ Hz$

$L_2 = \frac{30}{\pi}\ mH \qquad L_3 = M = \frac{10}{\pi}\ mH$

$e_1(t) = 16 \sin\left(\omega + \frac{\pi}{4}\right)$

$i_5(t) = 4\sqrt{2}\cos \omega t$

$$\begin{cases} i_1 = i_2 + i_5 \\ e_1 = R_1 i_1 + \frac{1}{C_1}\int i_1\,dt + L_2\frac{di_2}{dt} + M\frac{di_3}{dt} \\ 0 = R_3 i_3 + L_3\frac{di_3}{dt} + M\frac{di_2}{dt} - U_5 - L_2\frac{di_2}{dt} - M\frac{di_3}{dt} \end{cases}$$



$\underline{E_1} = 8\sqrt{2}\, e^{j\frac{\pi}{4}} = 8\sqrt{2}\left(\frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2}j\right)$

$= 8(1+j)$

$\underline{I_5} = 4\, e^{j\frac{\pi}{2}} = 4j$

$\underline{Z_1} = R_1 + j\left(-\frac{1}{\omega C_1} + \omega M\right)$

$= 2 + j\left(\frac{-1}{2\cdot 50\pi\cdot\frac{10}{\pi}\cdot 10^{-3}} + 2\cdot 50\cdot\pi\cdot\frac{10}{\pi}\cdot 10^{-3}\right)$

$\underline{Z_1} = 2$

$$\underline{Z_2} = j\omega(L_2 - M) = j \cdot 2 \cdot 50 \cdot \pi \cdot \frac{20}{\pi} \cdot 10^{-3} = 2j$$

$$\underline{Z_3} = j\omega(L_3 - M) = 1$$

$$\begin{cases} \underline{Z_{11}}\,\underline{I_1'} + \underline{Z_{12}}\,\underline{I_2'} = \underline{E_1'} \\ \underline{I_2'} = \underline{I_3} = 4j \end{cases}$$

$$2(1+j)\,\underline{I_2'} - 2j \cdot 4j = 8(1+j)$$

$$2(1+j)\,I_1' = 8j \Rightarrow I_1' = \frac{8j}{2(1+j)} \Rightarrow I_1' = 2(1+j)$$

$$I_1 = I_1'$$

$$I_2 = I_1' - I_2'$$

$$U_3 + \underline{Z_2}\,\underline{I_2} - \underline{Z_3}\,\underline{I_3} = 0$$

$$\underline{S}_{gen} = \underline{E_1}\,\underline{I_1}^* + \underline{U_3}\,\underline{I_3}^*$$