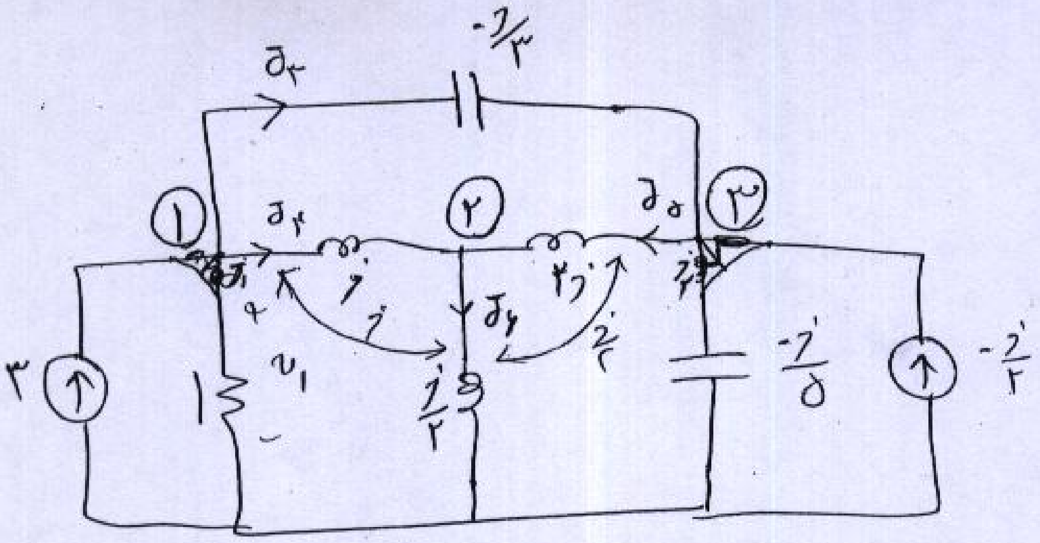


$$AJ=0 \Rightarrow \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & -1 & -1 & 1 \\ 0 & 1 & -1 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} J_1 \\ J_2 \\ J_3 \\ J_4 \\ J_5 \\ J_6 \end{bmatrix} = 0$$

$$v = A^T E = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & -1 \\ 1 & -1 & 0 \\ 0 & -1 & 1 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix} = \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_6 \end{bmatrix} = \begin{bmatrix} E_1 \\ E_3 \\ E_1 - E_3 \\ E_1 - E_2 \\ -E_2 + E_3 \\ E_2 \end{bmatrix}$$

$$J_1 = v_1 - 3$$

$$J_2 = \frac{v_1 - v_4}{\frac{-j}{3}} = 3j\,(v_1 - v_2)$$

$$J_3 = \frac{v_3}{\frac{-j}{5}} + \frac{j}{2} = 5j\,v_3 + \frac{j}{4}$$

$$\begin{bmatrix} v_4 \\ v_5 \\ v_6 \end{bmatrix} = j \begin{bmatrix} 1 & 0 & 1 \\ 0 & 2 & \frac{1}{2} \\ 1 & \frac{1}{2} & \frac{1}{2} \end{bmatrix} \begin{bmatrix} J_4 \\ J_5 \\ J_6 \end{bmatrix} \Rightarrow \begin{bmatrix} J_4 \\ J_5 \\ J_6 \end{bmatrix} = j \begin{bmatrix} 0.7 & 0.2 & -1.7 \\ 0.2 & -0.2 & -0.2 \\ -1.7 & -0.2 & 1.7 \end{bmatrix} \begin{bmatrix} v_4 \\ v_5 \\ v_6 \end{bmatrix}$$

بنابراین داریم:

ادامه

$$\begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & -1 & -1 & 1 \\ 0 & 1 & -1 & 0 & 1 & 0 \end{bmatrix} \left(\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5j & 0 & 0 & 0 & 0 \\ 3j & -3j & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & j0.6 & j0.4 & -j1.6 \\ 0 & 0 & 0 & j0.4 & -j0.4 & -j0.4 \\ 0 & 0 & 0 & -j1.6 & -j0.4 & j1.6 \end{bmatrix} \begin{bmatrix} E_1 \\ E_3 \\ E_1 - E_3 \\ E_1 - E_2 \\ -E_2 + E_4 \\ E_2 \end{bmatrix} + \begin{bmatrix} -3 \\ \frac{j}{2} \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \right) = 0$$

$$\begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & -1 & -1 & 1 \\ 0 & 1 & -1 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} E_1 - 3 \\ 5jE_3 + \frac{j}{2} \\ 3jE_1 - 3jE_3 \\ j0.6E_1 - j0.6E_2 - j0.4E_2 + j0.4E_4 - j1.6E_2 = j0.6E_1 - j2.6E_2 + j0.4E_4 \\ j0.4E_1 - j0.4E_2 + j0.4E_2 - j0.4E_4 - j0.4E_2 = j0.4E_1 - j0.4E_2 - j0.4E_4 \\ -j1.6E_1 + j1.6E_2 + j0.4E_2 - j0.4E_4 + j1.6E_2 = -j1.6E_1 + j3.6E_2 - j0.4E_4 \end{bmatrix}$$

$$E_1 - 3 + 3jE_3 + j0.6E_1 - j2.6E_2 + j0.4E_4 = 0$$

$$-j1.6E_1 + j3.6E_2 - j0.4E_4 - j0.4E_1 + j0.4E_2 + j0.4E_4 - j0.6E_1 + j2.6E_2 - j0.4E_4 = 0$$

$$5jE_1 - 5jE_4 + \frac{j}{2} - 3jE_4 + j0.4E_1 - j0.4E_2 - j0.4E_4 = 0$$

$$\Rightarrow \begin{bmatrix} 1 + j3.6 & -j2.6 & -6.6j \\ -2.6j & 6.2j & -j0.4 \\ -6.6j & -j0.4 & j7.6 \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \\ E_4 \end{bmatrix} = \begin{bmatrix} 3 \\ 0 \\ -\frac{j}{2} \end{bmatrix}$$

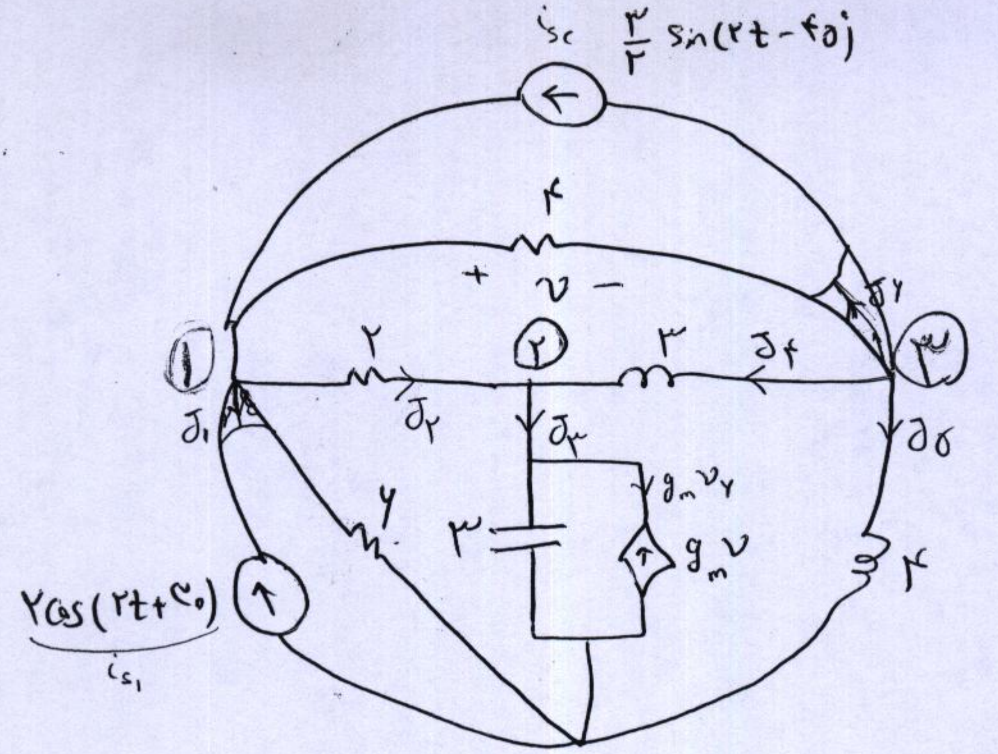
ادامه ۵ روش نظری

$$\begin{bmatrix} 1+3j & 0 & -2j \\ 0 & 0 & 0 \\ -2j & 0 & 8j \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix} = \begin{bmatrix} 3-J_2 \\ J_4 + J_5 - J_6 \\ -\frac{j}{2} - J_5 \end{bmatrix}$$

$$\begin{bmatrix} J_4 \\ J_5 \\ J_6 \end{bmatrix} = j \begin{bmatrix} 0.6 & 0.4 & -1.6 \\ 0.4 & -0.4 & -0.4 \\ -1.6 & -0.4 & 1.6 \end{bmatrix} \begin{bmatrix} E_1 - E_3 \\ -E_2 + E_3 \\ E_2 \end{bmatrix} = j \begin{bmatrix} 0.6E_1 - 1.6E_2 + 0.4E_3 \\ 0.4E_1 - 0.4E_3 - 0.4E_2 \\ -1.6E_1 + 0.4E_2 - 0.4E_3 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 1+2j & 0 & -2j \\ 0 & 0 & 0 \\ -2j & 0 & 8j \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix} = \begin{bmatrix} 3 - j0.6E_1 + j2.6E_2 - j0.4E_3 \\ j2.6E_1 - j4.6E_2 + j0.4E_3 \\ j1.6E_1 - j3.6E_2 + j0.4E_3 - \frac{j}{2} \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 1+3.6j & -j2.6 & -j2.6 \\ -j2.6 & j4.6 & -j0.4 \\ -2.6j & -j0.4 & 7.6j \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix} = \begin{bmatrix} 2 \\ 0 \\ -\frac{j}{2} \end{bmatrix}$$



$v = -v_6$

$$J_1 = \frac{1}{6}v_1 - i_{s1}$$

$$J_2 = \frac{v_1}{2} - \frac{v_3}{2}$$

$$J_3 = g\,v_6 + 3Dv_2$$

$$J_4 = (v_5 - v_2)/3D + i_{01}$$

$$J_5 = \frac{v_5}{4D} + i_{02}$$

$$J_6 = \frac{v_5 - v_1}{4} + i_{s2}$$

$$A = \begin{bmatrix} 1 & 1 & 0 & 0 & 0 & -1 \\ 0 & -1 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 \end{bmatrix}$$

$$AJ = 0$$

$$A^T E = V$$

همانند سؤال قبل :

$$A \cdot \begin{bmatrix} \frac{E_1}{6} - i_{s1} \\ -E_2 + \frac{E_1}{2} \\ 3DE_2 - g_m E_1 + g_m E_3 \\ i_{01} - \frac{E_2}{3D} + \frac{E_5}{3D} \\ i_{02} + \frac{E_5}{4D} \\ \frac{E_3}{4} - \frac{E_1}{4} + i_{s2} \end{bmatrix}$$

$$\begin{bmatrix} -\frac{11}{12} & -\frac{1}{2} & -\frac{1}{4} \\ -g-\frac{1}{2} & 1+\frac{1}{3D}+3D & -g-\frac{1}{3D} \\ -\frac{1}{4} & -\frac{1}{3D} & \frac{1}{4}+\frac{7}{12D} \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix} = \begin{bmatrix} 2\cos(2t+30^\circ)+\frac{3}{2}\sin(2t-45^\circ) \\ i_{o_1} \\ -i_{o_1}-i_{o_2}-\frac{3}{2}\sin(2t-45^\circ) \end{bmatrix}$$

ب)

$$\begin{bmatrix} v_4 \\ v_5 \end{bmatrix} = j\begin{bmatrix} 3 & 3 \\ 3 & 4 \end{bmatrix}\begin{bmatrix} J_4 \\ J_5 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} J_4 \\ J_5 \end{bmatrix} = \frac{-j}{6}\begin{bmatrix} 4 & -3 \\ -3 & 3 \end{bmatrix}\begin{bmatrix} v_4 \\ v_5 \end{bmatrix} = \begin{bmatrix} -\frac{2}{3}j & \frac{1}{2}j \\ \frac{1}{2}j & -\frac{1}{2}j \end{bmatrix}\begin{bmatrix} v_4 \\ v_5 \end{bmatrix}$$

$$J_2 = g\,v_2 + 6j\,v_2$$

$$A.\ \begin{bmatrix} \frac{E_1}{6}-i_{s_1} \\ E_2-\frac{E_1}{2} \\ 6jE_2-g_m(E_1-E_3) \\ +\frac{2}{3}jE_2+\frac{1}{6}jE_2 \\ -j\frac{E_2}{2} \\ i_{s_2}+\frac{E_3}{4}-\frac{E_1}{4} \end{bmatrix} \Rightarrow$$

$$\begin{bmatrix} \frac{11}{12} & -\frac{1}{2} & -\frac{1}{4} \\ -g-\frac{1}{2} & 1+\frac{17}{3}j & -g+\frac{j}{6} \\ -\frac{1}{4} & \frac{j}{6} & -\frac{j}{6} \end{bmatrix}\begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix} = \begin{bmatrix} i_{s_1}+i_{s_2} \\ 0 \\ -i_{s_2} \end{bmatrix}$$

(2

$$J_4 = -\frac{2}{3} j v_4 + \frac{j}{2} v_5 = -\frac{2}{3} j\,(E_3 - E_2) + \frac{j}{2}(E_3) = \frac{2}{3} j E_2 - \frac{1}{6} j E_3$$

$$J_5 = \frac{j}{2} v_4 - \frac{j}{2} v_5 = \frac{j}{2}\,(E_3 - E_2) - \frac{j}{2} E_3 = -\frac{j}{2} E_2$$

$$\begin{bmatrix} \frac{1}{4}+\frac{1}{2}+\frac{1}{6} & -\frac{1}{2} & -\frac{1}{4} \\ -\frac{1}{2} & \frac{1}{2}+2j & 0 \\ -\frac{1}{4} & 0 & \frac{1}{4} \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix} = \begin{bmatrix} i_{s_1} + i_{s_2} \\ g_m(E_1 - E_3) + J_4 \\ J_5 - J_4 - i_{s_2} \end{bmatrix}$$

$$= \begin{bmatrix} i_{s_1} + i_{s_2} \\ E_1(g_m) + E_2\left(\frac{2}{3} j\right) + E_3\left(-g - \frac{2}{3} j + \frac{1}{2} j\right) \\ E_1(0) + E_2\left(-\frac{j}{2} - \frac{2}{3} j\right) + E_3\left(\frac{j}{6}\right) - i_{s_2} \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} \frac{11}{12} & -\frac{1}{2} & -\frac{1}{4} \\ -\frac{1}{2} - g_m & \frac{1}{2} + 2j - \frac{2}{3} j & g_m + \frac{j}{6} \\ -\frac{1}{4} & \frac{j}{6} & -\frac{j}{6} \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix} = \begin{bmatrix} i_{s_1} + i_{s_2} \\ 0 \\ -i_{s_2} \end{bmatrix}$$