Form node-transformation matrix for the given network using a.c nodal analysis figure 1.

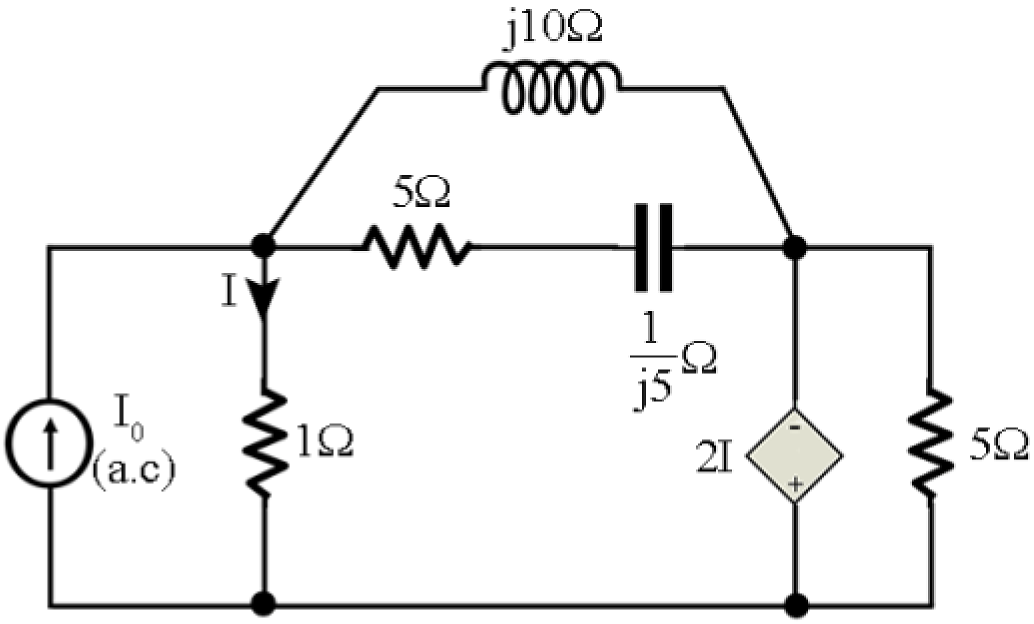

Figure: 1

Solution:

Let us first designate nodes as shown in figure 2 with assumed nodal voltages.

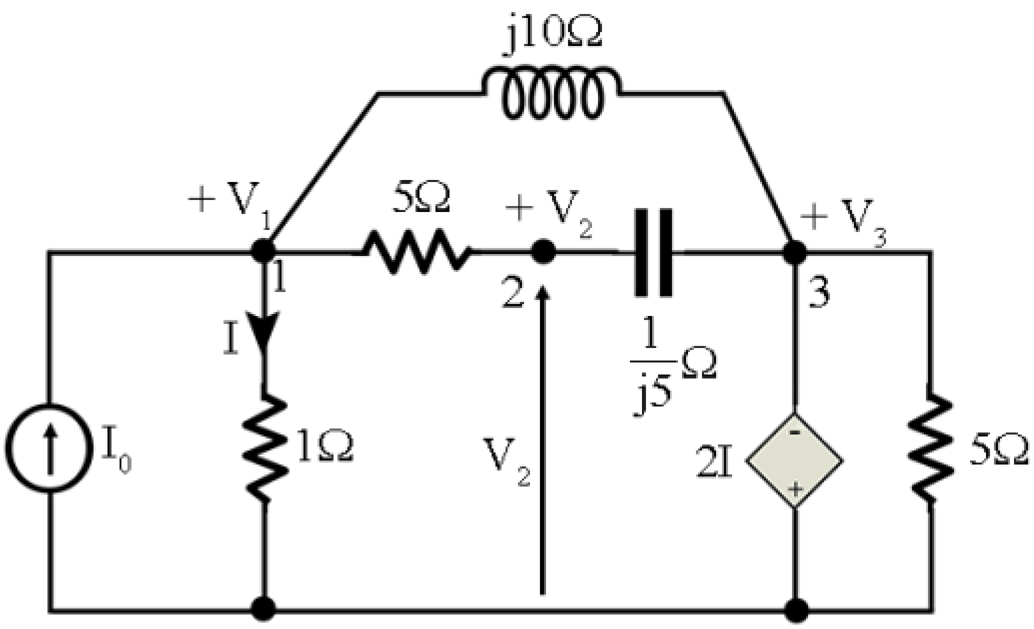

Figure: 2

At node-1, nodal equation can be written as

$$-I_0 + \frac{V_1}{1} + \frac{V_1 - V_2}{5} + + \frac{V_1 - V_3}{j10} = 0$$

or $\quad V_1(1 + 0.2 - j0.1) + V_2(-0.2) + V_3(+j0.1) = I_0$

or $\quad V_1(1.2 - j0.1) - 0.2V_2 + j0.1V_3 = I_0$ …(1)

At node-2, nodal equation can be written as

$$\frac{V_2 - V_1}{5} + \frac{V_2 - V_3}{\frac{1}{j5}} = 0$$

or $\quad -0.2V_1 + 0.2V_2 + j5V_2 - j5V_3 = 0$ …(2)

At node-3, the nodal equation is

$$V_3 = -2I = -2(\frac{V_1}{1}) = -2V_1$$

or $\quad 2V_1 + 0 \times V_2 + V_3 = 0$ …(3)

Thus, in matrix form, equation (1), (2) and (3) are

$$\begin{bmatrix} (1.2 - j0.1) & -0.2 & j0.1 \\ -0.2 & (0.2 + j5) & -j5 \\ 2 & 0 & 1 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} I_0 \\ 0 \\ 0 \end{bmatrix}$$

The left hand matrix is required node transformation matrix.