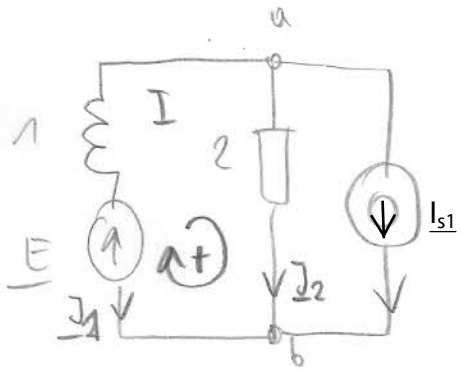
Calculate currents in branches using node-voltage method and mesh current method.



Known:
$Z_1=Z_2=1$[Ohm]
$\underline{E}_1=100$[V]
$\underline{I}_{s1}=-j10$[A]
n=2
m=2

Current source is not a branch
n - number of nodes
m - number of branches

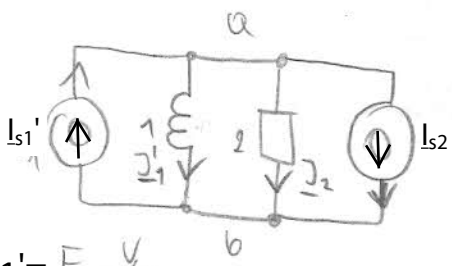
Node method uses Kirchhoff's current law (KCL). Node method does not see voltage sources. Physical voltage sources are transformed to virtual current source $\underline{E}\rightarrow\underline{I}_s'$. In this method we also have to assume that one of nodes has potential 0[V].
Number of equations for the Kirchhoff's current law is given by formula:
equations for KCL = n-1
n-1=2-1=1

$Z_1=j \quad \underline{Y}_1=\frac{1}{j}=-j \qquad Z_2=1 \quad \underline{Y}_2=1$

Assumption $V_b=0$[V]

Contraction

$$\left(\sum \underline{I}_s\right)_a=\underline{E}_1\cdot\underline{Y}_1-\underline{I}_{s2}=V_a(\underline{Y}_1+\underline{Y}_2)-\underbrace{V_b\cdot\underline{Y}_2}_{=0 \text{ bo } V_b=0}$$



$\underline{I}_{s1}'=\underline{E}_1\cdot\underline{Y}_1$

$$\underline{E}_1\cdot\underline{Y}_1-\underline{I}_{s2}=V_a\cdot(\underline{Y}_1+\underline{Y}_2)$$

$$V_a=\frac{\underline{E}_1\cdot\underline{Y}_1-\underline{I}_{s2}}{\underline{Y}_1+\underline{Y}_2}$$

$$\underline{J}_1+\underline{I}_{s1}'-\underline{J}_1'=0$$

$$\underline{J}_1=\underline{J}_1'-\underline{I}_{s1}'$$

$$\underline{J}_1=(V_a-V_b)\cdot\underline{Y}_1-\underline{E}_1\cdot\underline{Y}_1$$

$$\underline{J}_2=(V_a-V_b)\cdot\underline{Y}_2$$

$$V_a=\frac{100\cdot(-j)-(-j\cdot 10)}{1-j}$$

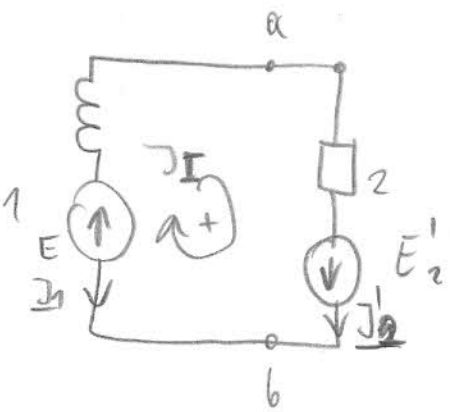
$$V_a=\frac{-100j+10j}{1-j}$$

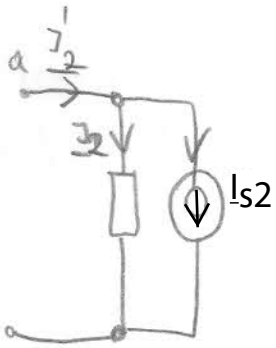
$$V_a=\frac{-90j\cdot(1+j)}{(1-j)(1+j)}=\frac{-90j+90}{1+j-j+1}$$

$$V_a=45-45j$$

Mesh analysis uses Kirchhoff's voltage law (KVL). Mesh analysis does not see current sources. Physical current sources are transformed to virtual voltage source $\underline{I}_s$->$\underline{E}$'. Currents between meshes are sum of meshes currents.
Number of equations for the Kirchhoff's voltage law is given by formula:
equations for KVL =m- (n-1)
m-(n-1)=2-(2-1)=1

$$\left(\sum \underline{E}\right)_I = \underline{E}_1 + \underline{I}_{s2} \cdot \underline{Z}_2 = \underline{J}_I (\underline{Z}_1 + \underline{Z}_2)$$





$$\underline{J}_1 = -\underline{J}_I$$

$$\underline{J}'_2 - \underline{J}_2 - \underline{I}_{s2} = 0$$

$$\underline{J}_2 = \underline{J}'_2 - \underline{I}_{s2}$$

$$\underline{J}_2 = \underline{J}_I - \underline{I}_{s2}$$

$$\underline{J}_I (\underline{Z}_1 + \underline{Z}_2) = \underline{E}_1 + \underline{I}_{s2} \cdot \underline{Z}_2$$

$$\underline{J}_I = \frac{\underline{E}_1 + \underline{I}_{s2} \cdot \underline{Z}_2}{\underline{Z}_1 + \underline{Z}_2}$$

$$\underline{J}_I = \frac{100 + (-j \cdot 10)}{1 + j}$$

$$\underline{J}_I = \frac{(100 - 10j) \cdot (1 - j)}{(1+j)(1-j)}$$

$$\underline{J}_I = \frac{100 - 100j - 10j - 10}{1 - j + j + 1}$$

$$\underline{J}_I = \frac{90 - 110j}{2}$$

$$\underline{J}_I = 45 - 55j$$