http://www.mbstudent.com/electrical-engineering.html

Application of branch current method to AC circuit.

Branch currents will be calculated for AC electrical circuit.

$\underline{V_s} = 10 + j \cdot 5[V] = \sqrt{10^2 + 5^2} \cdot e^{j \cdot \arctan\frac{5}{10}}[V] = \sqrt{2} \cdot e^{-j \cdot \frac{\pi}{4}}[A]$

$\underline{I} = 1[A]$

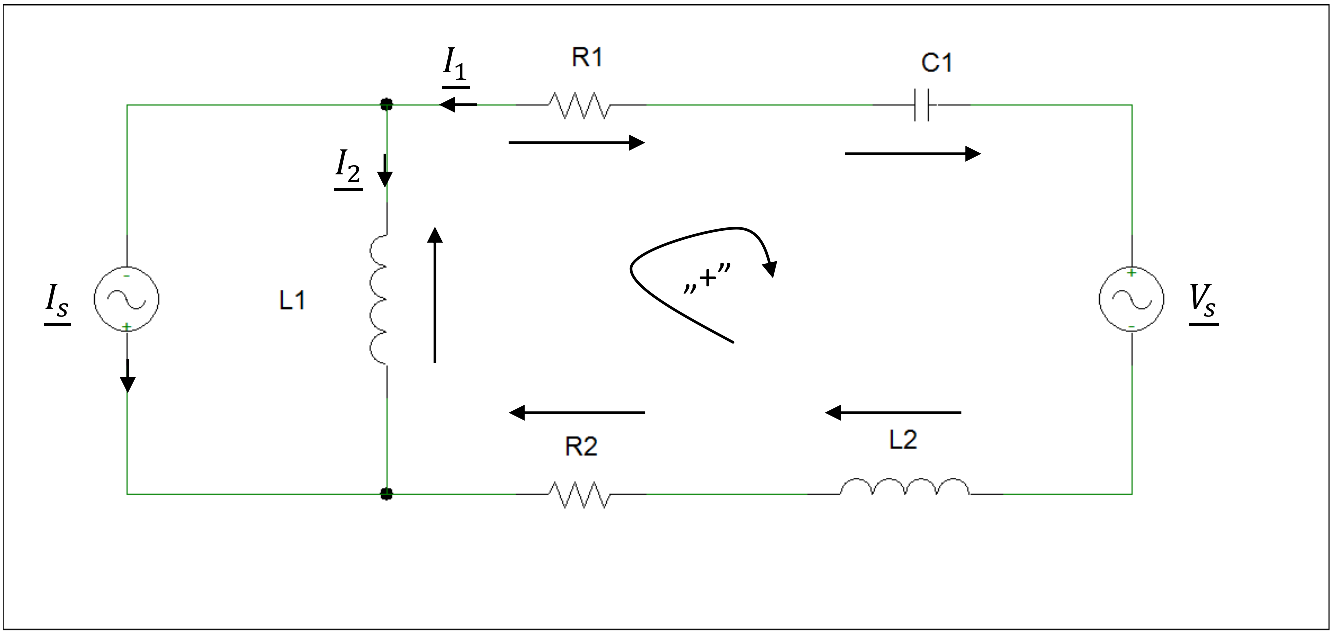
$\left|\underline{Z_{L1}}\right| = 5[\Omega] \rightarrow \underline{Z_{L1}} = j \cdot 5[\Omega]$

$\left|\underline{Z_{L2}}\right| = 2[\Omega] \rightarrow \underline{Z_{L2}} = j \cdot 2[\Omega]$

$\left|\underline{Z_{C1}}\right| = 1[\Omega] \rightarrow \underline{Z_{C1}} = -j[\Omega]$

$\left|\underline{Z_{R1}}\right| = 1[\Omega] \rightarrow \underline{Z_{R1}} = 1[\Omega]$

$\left|\underline{Z_{R2}}\right| = 1[\Omega] \rightarrow \underline{Z_{R2}} = 1[\Omega]$



Drawing 1. Electrical AC circuit.

Kirchhoff's current law equation (KCL)

$$\underline{I_1} - \underline{I_2} - \underline{I_s} = 0$$

Kirchhoff's voltage law equation (KVL)

$$\underline{I_2} \cdot \underline{Z_{L1}} + \underline{I_1} \cdot \underline{Z_{R1}} + \underline{I_1} \cdot \underline{Z_{C1}} - \underline{V_s} + \underline{I_1} \cdot \underline{Z_{R2}} + \underline{I_1} \cdot \underline{Z_{L2}} = 0$$

$$\underline{I_2} = \underline{I_1} - \underline{I_s}$$

$$\underline{I_2} \cdot \underline{Z_{L1}} + \underline{I_1} \cdot \left(\underline{Z_{R1}} + \underline{Z_{C1}} + \underline{Z_{R2}} + \underline{Z_{L2}}\right) - \underline{V_s} = 0$$

$$\left(\underline{I_1} - \underline{I_s}\right) \cdot \underline{Z_{L1}} + \underline{I_1} \cdot \left(\underline{Z_{R1}} + \underline{Z_{C1}} + \underline{Z_{R2}} + \underline{Z_{L2}}\right) - \underline{V_s} = 0$$

$$-\underline{I_s} \cdot \underline{Z_{L1}} + \underline{I_1} \cdot \left(\underline{Z_{R1}} + \underline{Z_{C1}} + \underline{Z_{R2}} + \underline{Z_{L2}} + \underline{Z_{L1}}\right) - \underline{V_s} = 0$$

$$\underline{I_1} = \frac{\underline{V_s} + \underline{I_s} \cdot \underline{Z_{L1}}}{\underline{Z_{R1}} + \underline{Z_{C1}} + \underline{Z_{R2}} + \underline{Z_{L2}} + \underline{Z_{L1}}}$$

$$\underline{I_1} = \frac{\underline{V_s} + \underline{I_s} \cdot \underline{Z_{L1}}}{\underline{Z_{R1}} + \underline{Z_{C1}} + \underline{Z_{R2}} + \underline{Z_{L2}} + \underline{Z_{L1}}}$$

$$\underline{I_1} = \frac{10 + j \cdot 5 + 1}{1 - j + 1 + j \cdot 2 + j \cdot 5} = \frac{11 + j \cdot 5}{2 + j \cdot 6}$$

$$\underline{I_1} = \frac{11 + j \cdot 5}{2 + j \cdot 6} \cdot \frac{2 - j \cdot 6}{2 - j \cdot 6} = \frac{22 - j \cdot 66 + j \cdot 10 - (-1) \cdot 30}{4 - j \cdot 12 + j \cdot 12 + 36}$$

$$\underline{I_1} = \frac{52 - j \cdot 56}{40} [A]$$

$$I_1 = \sqrt{\left(\frac{52}{40}\right)^2 + \left(\frac{56}{40}\right)^2} = 1{,}91[A]$$

$$\underline{I_2} = \underline{I_1} - \underline{I_s}$$

$$\underline{I_2} = \frac{52 - j \cdot 56}{40} - 1 = \frac{12 - j \cdot 56}{40} [A]$$

$$I_1 = \sqrt{\left(\frac{12}{40}\right)^2 + \left(\frac{56}{40}\right)^2} = 1{,}43[A]$$