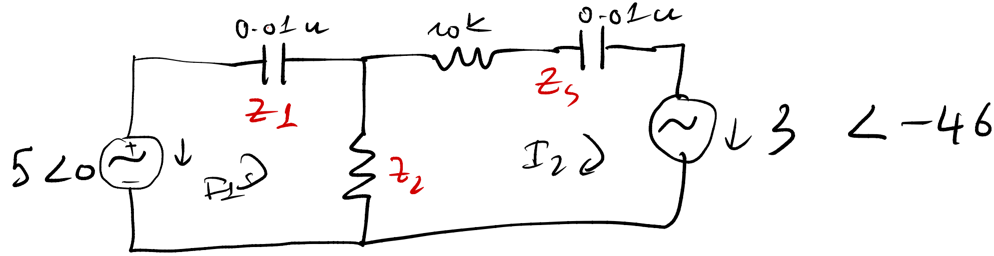


$w = 1000$

$Z_1 = j100\times10^3$

$Z_3 = 10^4 + j\,100\times10^3$

A B E

loop 1 : $I_1(j\,100\times10^3 + 22\times10^4) + I_2(-22\times10^4) = 5$

loop2: $3\angle-46 + I_2(10^4 + j\,100\times10^3 + 22\times10^4) + I_1(22\times10^4)$

$\Leftrightarrow -I_2(10^4 + j\,100\times10^3 + 22\times10^3) - I_1(22\times10^4)$

$\Leftrightarrow I_1(-22\times10^4) + I_2(-32\times10^3 - j\,100\times10^3) = 3\angle-46$

C D F

$\Delta = D \qquad \Delta x = E \qquad \Delta y = F$

$$x = \frac{\Delta x}{\Delta} = 4.104\times10^{-5}\angle-177^\circ$$

$$y = \frac{\Delta y}{\Delta} = 0.178\angle-75.61^\circ$$

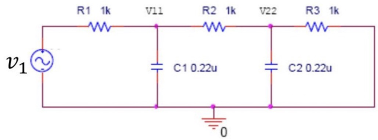


Figure 2. AC circuit used in the Node -voltage Analysis

1k : Nâu – Đen – Đỏ
1 0 $\times 10^2$

10k : Nâu – Đen – Cam
1 0 $\times 10^3$

22k : Đỏ – Đỏ – Cam
2 2 $\times 10^3$

Math $\rightarrow$ Operation

$\downarrow$

Substract

$V_1 - V_2$

$\downarrow$

Red line

V_{21}

$\downarrow$

Find $A \angle 0^\circ$

$$\phi_{z_2} - \phi_{v_2} \geq 0$$

loop 1:

$-5\angle 0 + I_1(-j15915.5) + 22\times 10^3(I_1 - I_2) = 0$

$\Leftrightarrow I_1(\underset{A}{22\times 10^3 - j15915.5}) + I_2(\underset{B}{-22\times 10^3}) = \underset{E}{5}$

loop 2

$22\times 10^3(I_2 - I_1) + I_2(10^4 - j15915.5) + 3\angle -46 = 0$

$\Leftrightarrow I_1(\underset{C}{-22\times 10^3}) + I_2(\underset{D}{32\times 10^3 - j15915.5}) = \underset{F}{j2.160 - 2.084}$

$\Delta = AD - BC = M$

$\Delta x = BF - ED \Rightarrow x = \frac{\Delta x}{\Delta} = 1.323\times 10^{-4}\angle -50.32$

$\Delta y = AF - EC \Rightarrow y = \frac{\Delta y}{\Delta} = 1.653\times 10^{-4}\angle 158.305$

Ltspice $I_1 = 1.37871\times 10^{-4}\angle -103.488^\circ$

$I_2 = 1.4801\times 10^{-4}\angle -48.4726^\circ$

web: $I_1 = 1.37857\times 10^{-4}\angle 76.53^\circ$

$I_2 = 1.48070\times 10^{-4}\angle 131.53^\circ$

$V_{Z_1} = I_1 Z_{C_1} = 2.19\angle -13.47^\circ$

$V_{Z_2} =$

$$V_R = v_{in} \times \frac{R}{Z_L + R}$$

$$\Leftrightarrow Z_L + R = \frac{v_{in}}{v_R} \times R$$

$$\Leftrightarrow 2\pi F \times L = R \left(\frac{v_{in}}{v_R} - 1 \right)$$

$$\Rightarrow L = \frac{R \left(\frac{v_{in}}{v_R} - 1 \right)}{2\pi F}$$

$$z_c = \frac{1}{0.01\times10^{-6}\times 2\pi \times 1000 j} = -j15915.49431$$

loop 1:

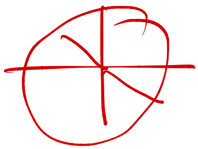
$$I_1(z_c + 22000) + I_2(-22000) = 5\angle 0$$

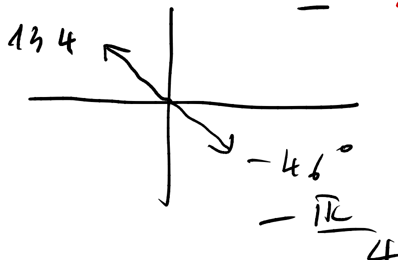
loop 2:

$$I_1(-22000) + I_2(22000 + 10000 + z_c) = -3\angle 46^\circ$$

$$3\angle -46 = 2.084 - j2.16$$

$$= -2.084 + j2.16$$





$z_1 = 2.19\angle 166.512^\circ$

$-a - jb$

$z_2 =$

Ltspice $I_1 = 1.37871\times10^{-4}\angle -103.488$

$a - jb$

$I_2 = 1.4801\times10^{-4}\angle -48.4726^\circ$

$a + jb$

Web: $I_1 = 1.37857\times10^{-4}\angle 76.53^\circ$

$I_2 = 1.48070\times10^{-4}\angle 131.53^\circ$

$V_{z_1} = 2.19\angle -13.47^\circ$ — $a + jb$

$Z_c = -j723.43$

$V_1 = 3.772 \angle 60.05°$

Node 1:

$V_2 = 1.55 \angle 25.40°$

$$\frac{V_1 - 5}{1000} + \frac{V_1 - V_2}{Z_c} + \frac{V_1 - V_2}{1000} = 0$$

$$\Rightarrow V_1\Big(\overset{A}{\frac{100}{72343}j}\Big) + V_2\Big(\overset{B}{-\frac{100}{72343}j - \frac{1}{1000}}\Big) = \overset{E_1}{\frac{1}{200}}$$

Node 2:

$$\frac{V_2 - V_1}{1000} + \frac{V_2}{Z_c} + \frac{V2}{1000} = 0$$

$$\Leftrightarrow V_1\Big(-\frac{1}{1000}\Big) + V_2\Big(\frac{1}{1000} + \frac{1}{1000} + \frac{100}{72343}j\Big)$$

$$\Rightarrow V_1\Big(\overset{C}{-\frac{1}{1000}}\Big) + V_2\Big(\overset{D}{\frac{1}{500} + \frac{100}{72343}j}\Big) = \overset{F}{0}$$

$D = 3.22 \times 10^{-6} \angle 154.597° = z$

$D_x = 1.22 \times 10^{-5} \angle 34.65° = x$

$D_y = 5 \times 10^{-6} \angle 180° = y$

$$\Rightarrow V_1 = \frac{Dx}{D} = 3.77 \angle -119.95°$$

$$V_2 = \frac{Dy}{D} = 1.55 \angle 25.40°$$

$$I_{c_1} = \frac{3.772 \angle 60.05^\circ}{\ } = 5.21 \times 10^{-3} \angle 150.05$$

$$5.21 \times 10^{-3} \angle -29.95\,^\circ C$$

$$I_{c_1} = 5.21 \times 10^{-3} \angle 150.05^\circ$$

$$V_{c_1} = I_{c_1} \cdot Z_{c_1} =$$