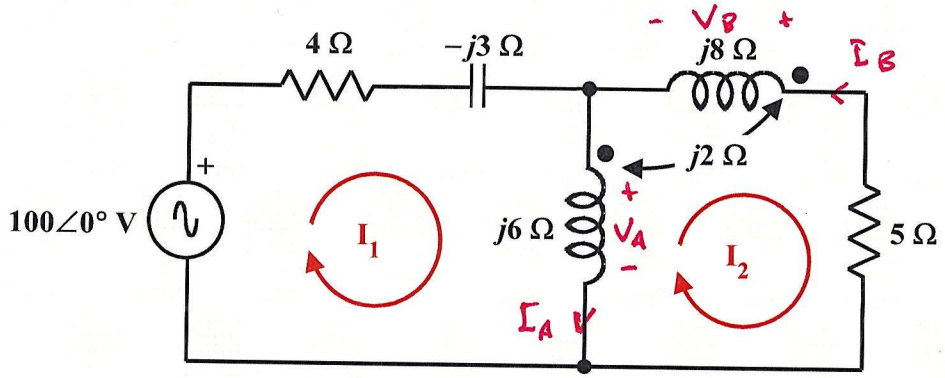
EE 3340

Homework Problem #036

Determine the phasor values of the mesh currents $\mathbf{I}_1$ and $\mathbf{I}_2$ (in polar form) in the circuit shown below. Show your work.



$V_A = j6\,I_A + j2\,I_B$

$V_B = j8\,I_B + j2\,I_A$

But $I_A = I_1 - I_2$ and $I_B = -I_2$

$\therefore V_A = j6\,(I_1 - I_2) + j2\,(-I_2)$

$= j6\,I_1 - j8\,I_2$

$V_B = j8\,(-I_2) + j2\,(I_1 - I_2)$

$= j2\,I_1 - j10\,I_2$

KCL for mesh 1:

$(4 - j3)\,I_1 + V_A = 100$

$\Rightarrow (4 - j3)\,I_1 + j6\,I_1 - j8\,I_2 = 100$

or $(4 + j3)\,I_1 - j8\,I_2 = 100$

KCL for mesh 2:

$-V_A - V_B + 5I_2 = 0$

$\Rightarrow -j6\,I_1 + j8\,I_2 - j2\,I_1 + j10\,I_2 + 5I_2 = 0$

or $-j8\,I_1 + (5 + j18)\,I_2 = 0$

In matrix form:

$$\underbrace{\begin{bmatrix} 4+j3 & -j8 \\ -j8 & 5+j18 \end{bmatrix}}_{A} \underbrace{\begin{bmatrix} I_1 \\ I_2 \end{bmatrix}}_{b} = \underbrace{\begin{bmatrix} 100 \\ 0 \end{bmatrix}}_{c}$$

Solving with MATLAB:

(See attached page.)

$$I_1 \approx 20.30 \angle 3.50^\circ \text{ A}$$

$$I_2 \approx 8.69 \angle 19.03^\circ \text{ A}$$

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>> A=[4+j*3 -j*8; -j*8 5+j*18]

A =

   4.0000 + 3.0000i   0.0000 - 8.0000i
   0.0000 - 8.0000i   5.0000 +18.0000i

>> c=[100; 0]

c =

   100
     0

>> b=A\c

b =

  20.2621 + 1.2398i
   8.2182 + 2.8339i

>> I1_magnitude=abs(b(1))

I1_magnitude =

   20.3000   <-- |I1|

>> I1_phase_rad=angle(b(1))

I1_phase_rad =

    0.0611   <-- ∠I1 in radians

>> I1_phase_deg=angle(b(1))*180/pi

I1_phase_deg =

    3.5015   <-- ∠I1 in degrees

>> I2_magnitude=abs(b(2))

I2_magnitude =

    8.6931   <-- |I2|

>> I2_phase_rad=angle(b(2))

I2_phase_rad =

    0.3321   <-- ∠I2 in radians

>> I2_phase_deg=angle(b(2))*180/pi

I2_phase_deg =

   19.0256   <-- ∠I2 in degrees
```