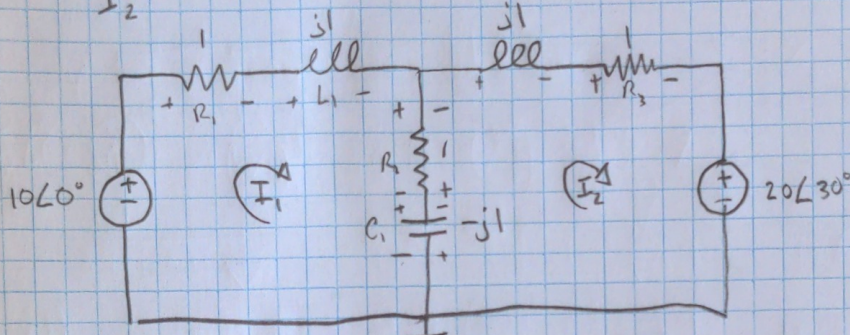
Chris Hunt HW6 ENGR 202

6.1) Use mesh-current analysis to find the mesh currents I_1 and I_2



Mesh I_1) $(1)(-10\angle 0° + 1I_1 + jI_1 + 1I_1 - I_2 - jI_1 + jI_2 = 0)\ \frac{1}{1\Omega}$

$2I_1 + (-1+j)I_2 = 10\angle 0°$

Mesh I_2) $20\angle 30° - jI_2 + jI_1 + I_2 - I_1 + jI_2 + I_2 = 0\ \frac{1}{1\Omega}$

$(1-j)I_1 - 2I_2 = 20\angle 30°$

$$\underset{A}{\begin{bmatrix} 2 & -1+j \\ 1-j & -2 \end{bmatrix}} \underset{X}{\begin{bmatrix} I_1 \\ I_2 \end{bmatrix}} = \underset{b}{\begin{bmatrix} 10 \\ 20\cos(30) + j20\sin(30) \end{bmatrix}}$$

$$A^{-1}b = X$$

$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} -0.73 + j2.2 \\ -7.9 - j3.5 \end{bmatrix} A$$

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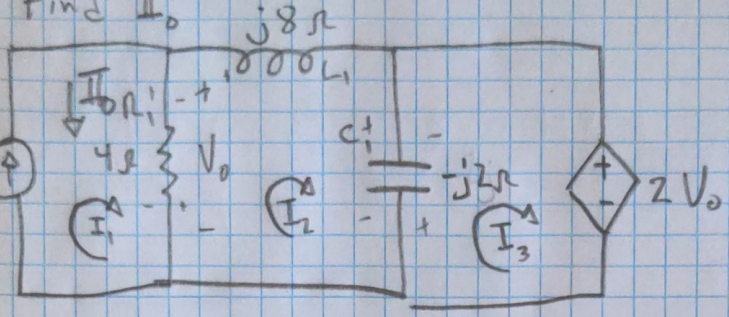
6.2) Find I_o



Mesh I_1: $I_1 = 2\angle -30^\circ$ A

Mesh I_2: $(4\Omega(I_2 - I_1) + j8 I_2 + -j2(I_2 - I_3) = 0)\ \frac{1}{1\Omega}$

$4I_2 - 8\angle -30^\circ + j8I_2 - j2I_2 + j2I_3 = 0$

$(4 + j6)I_2 + j2 I_3 = 8\angle -30^\circ$ A

Mesh I_3: $(-j2(I_3 - I_2) + 2(I_1 \cdot 4\Omega) = 0)\ \frac{1}{1\Omega}$

$-j2I_3 + j2I_2 + 16\angle -30^\circ_A = 0$

$-j2I_2 + j2I_3 = 16\angle -30^\circ$

$$\underbrace{\begin{bmatrix} 4+j6 & j2 \\ -j2 & j2 \end{bmatrix}}_{A} \underbrace{\begin{bmatrix} I_2 \\ I_3 \end{bmatrix}}_{x} = \underbrace{\begin{bmatrix} 8\angle -30^\circ \\ 16\angle -30^\circ \end{bmatrix}}_{b} \quad A^{-1}b = x \rightarrow \begin{bmatrix} I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 0.054 + j0.893 \\ -3.95 - j6.035 \end{bmatrix} A$$

$I_o = I_1 - I_2 \rightarrow (1.732 - j) - (0.054 + j0.893)$

$$\boxed{I_o = 1.678 - j1.893 = .876\angle -48.4^\circ \text{ A}}$$

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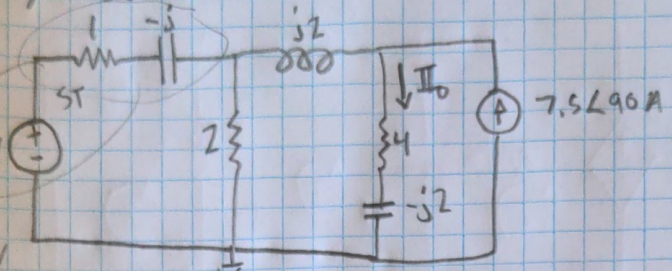
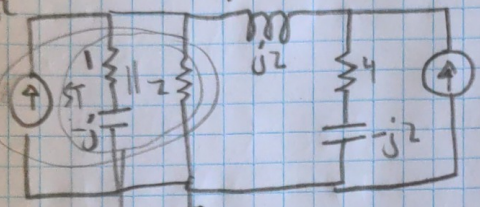
6.3) Use source transform to Fin I_0

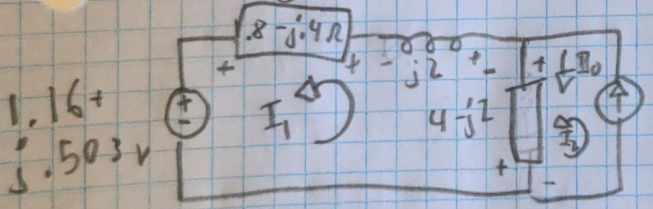


$\frac{2\angle 5V}{1-j\Omega} \downarrow$

$.909 + j1.08\ A$



$\frac{2-j2}{3-j} = .8 - j.4\ \Omega$



Mesh I_2: $7.5\angle 90 = I_2 = j7.5\ A$

Mesh I_1: $(4-j2)(I_1 - I_2) + (.8+j1.6)I_1 + (1.16 + j.503\ V) = 0$ 1Ω

$(4-j2)I_1 - (4-j2)I_2 + (.8+j1.6)I_1 = -1.16 - j.503\ A$

$(4.8 - j.4)I_1 = 13.84 + j29.497\ A$

$I_1 = 2.35 + j6.34\ A$

$I_0 = I_2 - I_1 = -2.35 + j1.16 = 2.62\angle 153.7°\ A$

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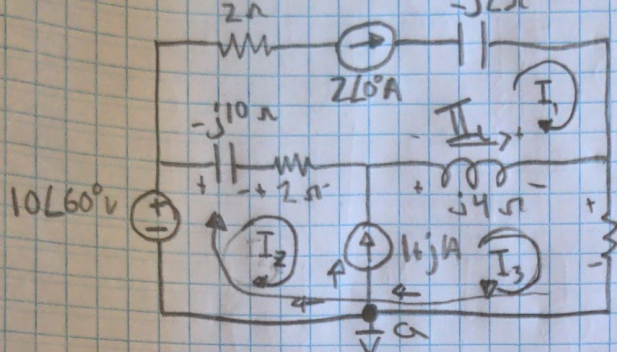
6.4) Use Mesh Analysis to Find $\mathbf{I}_L$



Mesh I_1) $I_1 = 2\angle 0° A = 2 A$

Supermesh) $\left(-10\angle 60° V + (2-j10\,\Omega)(I_2 - I_1) + j4(I_3 - I_1) + 4I_3 = 0\right)\frac{1}{1\Omega}$

$(2-j10)I_2 - (2-j10)(2) + j4I_3 - j8 + 4I_3 = 10\angle 60° A$

$+4 - j20 \qquad +j8$

$(2-j10)I_2 + (4+j4)I_3 = 9 - j3.34 A$

node a) $I_A + j = I_3 - I_2$

$$\begin{bmatrix} 2-j10 & 4+j4 \\ -1 & 1 \end{bmatrix}_A \begin{bmatrix} I_2 \\ I_3 \end{bmatrix}_X = \begin{bmatrix} 9-j3.34 \\ 1+j \end{bmatrix}_b \quad A^{-1}b = x \rightarrow \begin{bmatrix} I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 1.69 - j.19 \\ 2.695 + j.805 \end{bmatrix}$$

$I_L = I_3 - I_1 \rightarrow \boxed{I_L = .695 + j.805 = 1.06\angle 49.2° A}$