

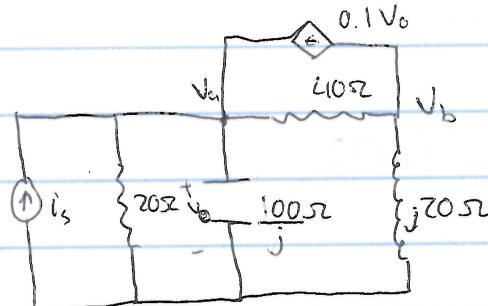
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11/30/2017

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EECS 215 HW10

8



$$i_s = 6 \cos(2\pi 6t + 15) A$$
$$= 6 \cos 15 + j6 \sin 15$$

Nodal @ V_a

$$i_s + 0.1V_a = \frac{V_a}{20} + \frac{V_a - V_b}{\cancel{-j100}} + \frac{V_a - V_b}{40}$$

$$V_0 = V_a$$

$$i_s + 0.1V_a = \frac{V_a}{20} + \cancel{\frac{V_a}{-j100}} + \frac{V_a - V_b}{40}$$

$$40i_s + 4V_a = \frac{40V_a}{20} - \frac{40V_a}{+j100} + V_a - V_b$$

$$40i_s = \frac{40V_a}{20} - \frac{40V_a}{+j100} + V_a - 4V_a - V_b$$

$$40i_s = V_a \left(\frac{40}{20} - \frac{40V_a}{j100} + 1 - 4 \right) - V_b (-1) \quad (1)$$

Nodal @ V_b

$$\frac{V_b - V_a}{40} + 0.1V_a + \frac{V_b}{j20} = 0$$

$$\frac{V_b - V_a}{40} + 4V_a + \frac{40V_b}{j20} = 0$$

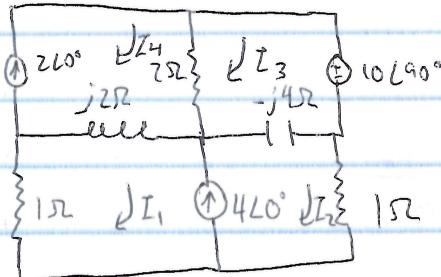
$$V_a (+3) + V_b \left(1 + \frac{40}{j20} \right) = 0 \quad (2)$$

$$\begin{bmatrix} 3 & 1 + \frac{40}{j20} \\ \frac{40}{20} - \frac{40}{j100} + 1 & -4 \end{bmatrix} \begin{bmatrix} V_a \\ V_b \end{bmatrix} = \begin{bmatrix} 0 \\ 40i_s \end{bmatrix}$$

$$\begin{bmatrix} V_a \\ V_b \end{bmatrix} = \begin{bmatrix} -1.3144 + j0.2690 \\ 1.1114 + j1.4159 \end{bmatrix} \cdot 10^2$$

$$I_o = \frac{V_a - V_b}{40} = \boxed{-6.0645 - j2.8673}$$

38.



$$I_1 + (I_1 - I_4)j2\cancel{0} + (I_2 - I_3)(-j4) + I_2 = 0 \quad (1)$$

$$I_1 = I_2 - 4L0 \quad (2)$$

$$(I_2 - 4L0) + (I_2 - 4L0 - I_4)j2 + (I_2 - I_3)(-j4) + I_2 = 0 \quad (3)$$

$$I_4 = 2L0$$

$$(I_2 - 4L0) + (I_2 - 4L0 - 2L0)j2 + (I_2 - I_3)(-j4) + I_2 = 0$$

$$2.828L-4S I_2 + j4 I_3 = 12.65L71.56 \quad (4)$$

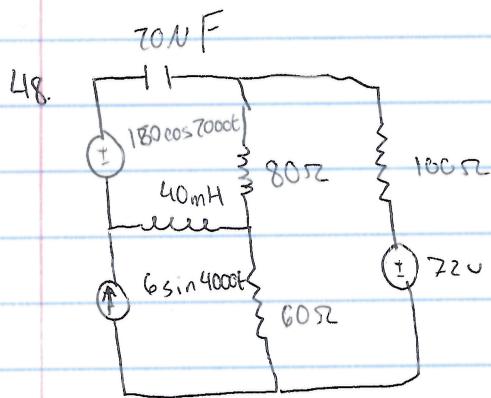
$$(I_3 - I_4)2 + 10L90 + (I_3 - I_2)(-j4) = 0$$

$$I_2 = 2.69 L-158.198 - 1.12 L-153.43 I_3 \quad (5)$$

$$2.828L-4S (2.69 L-158.198 - 1.12 L-153.43) + j4 I_3 = 12.65L71.56$$

$$I_3 = 3.35 L-5.596$$

$$I_o = -I_3 = 3.35 L124.4$$



current due to current source:

$$6\sin 4000t = 6L^{-90^\circ}$$

$$jwL = j(4000)(0.04) = j160$$

$$\frac{1}{jwL} = \frac{1}{j(4000)(20 \times 10^{-6})} = \frac{-j100}{8} = -j12.5$$

$$I_1 = -2j$$



$$I_1(-j12.5) + (I_2 - I_3)(80) + (I_2 - I_1)(j160) = 0$$

$$I_1(-j172.5) + I_2(80 + j160) + I_3(80) = 0$$

$$I_2 = \frac{345 + I_3(80)}{80 + j160}$$

$$(I_3 - I_1)60 + (I_3 - I_2)80 + I_3(100) = 0$$

$$I_3(200) - I_1(60) + I_2(80) = 0$$

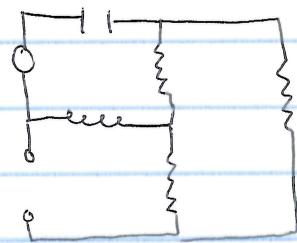
$$I_3(240) + 120j - I_2(80) = 0$$

$$I_3(240) + 120j - \left(\frac{345 + I_3(80)}{80 + j160} \right)(80) = 0$$

$$I_3 = 1.178 L - 83.15$$

$$I_0 = -1.178 \sin(4000t + 6.85)$$

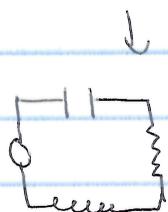
current due to ac source:



$$150 \cos 2000t = 150 \text{ A}$$

$$j\omega L = j80$$

$$\frac{1}{j\omega C} = -j25$$

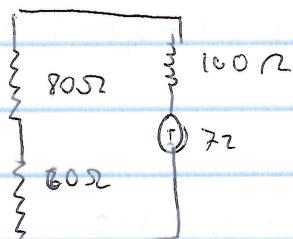


$$R_{eq} = 160 // 80 = 53.33 \Omega$$

$$I_0 = \frac{150 \text{ A}}{53.33 - j25 + j80}$$
$$= 0.4543 - 0.4685j$$

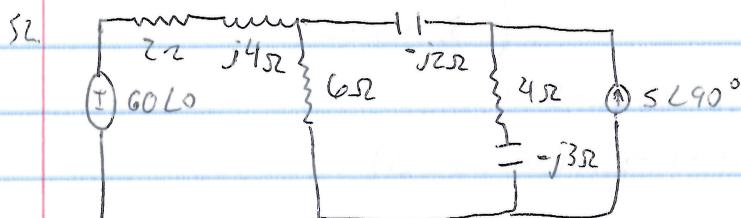
$$I_0 = (-0.4543 - 0.4685j) \left(\frac{80}{80+160} \right)$$
$$= 0.217 \cos(2000t + 134.06)$$

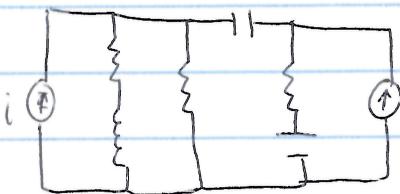
current due to dc source:



$$Z_0 = \frac{72}{240} = 0.3$$

$$I_0 = 0.3 \cos(2000t + 134.06) - 1.1478 \sin(4000t)$$
$$+ 0.217 \cos(2000t + 134.06)$$





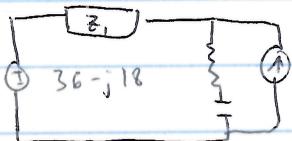
$$i = \frac{60\angle 0^\circ}{2+j4} = \frac{30 + j0}{2 + j4} = \cancel{13\angle 63.44^\circ} = \cancel{2\angle 71^\circ}$$

$$= 13 \angle 63.44^\circ = 6 + j12$$

$$Z_{eq} = 6 \parallel (2+j4) = 2.4 + j1.8$$

$$V_1 = (6 - j12) \times (2.4 + j1.8) = 36 - j18$$

$$Z_1 = Z - j2 = 2.4 - j0.2$$



$$I_1 = \frac{36 - j18}{Z_1} = 16.71 \angle -21.80^\circ$$

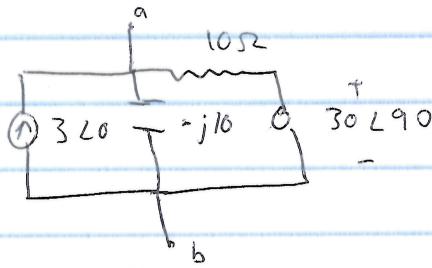
$$Z_x = (52.90 + I_1) \times \left(\frac{Z_1}{Z_1 + 4 - j3} \right)$$

$$= (52.90 + 16.71 \angle -21.80^\circ) \times \frac{2.4 - j0.2}{2.4 + j1.8 + 4 - j3}$$

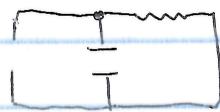
$$= 15.56 \angle -4.43^\circ \times \frac{2.4 - j0.2}{6.4 + j1.2} = 16.56 \angle -4.43^\circ \times 0.369 \angle 5.86^\circ$$

$$= 5.7549 \angle 1.476^\circ$$

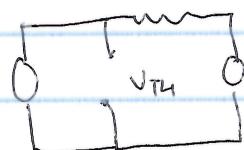
58.



$$Z_{TH} = -j10 + \text{resistance}$$

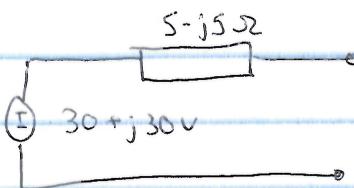


$$Z_{TH} = -j10 \parallel 10 \Omega = \frac{-j10 \cdot 10}{-j10 + 10} = 5 - j5 \Omega$$

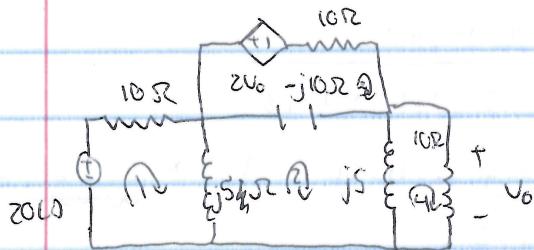
V_{TH}

$$30(90 - V_{TH} + 10(3L0)) = 0$$

$$V_{TH} = 30 + j30$$



62. source transform



$$\textcircled{1} \quad 10i_1 - 20 + j5(i_1 - i_2) = 0$$

$$i_1(10 + j5) + i_2(-j5) = 0$$

$$\textcircled{2} \quad j5(i_2 - i_1) - j10(i_2 - i_3) + j5(i_2 - i_4) = 0$$

$$i_1(-j5) + i_3(j10) + i_4(-j5) = 0$$

$$\textcircled{3} \quad -j10(i_3 - i_2) + 20i_4 + 10i_3 = 0$$

$$(j10)i_2 + i_3(10 - j10) + i_4(20) = 0$$

$$A) 10i_4 + j5(i_4 - i_2) = 0$$

$$i_2 (-j5) + i_4 (j15) = 0$$

$$V_b = i_4 \cdot 10 = \boxed{1.031 + j2.68 \text{ V}}$$

