NATIONAL UNIVERSITY OF SCIENCES & TECHNOLOGY

Electric Network Analysis (EE-211)

Assignment # 3

Submitted to: Ahsan Azhar

Submitted by: Muhammad Umer

Class: BEE-12C

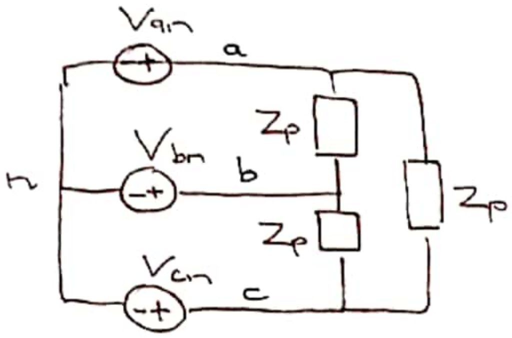
Semester: 2nd

Dated: 5/4/2021

CMS ID: 345834

Assignment # 3

12.11)



$V_{an} = 240\angle 0°\ V$

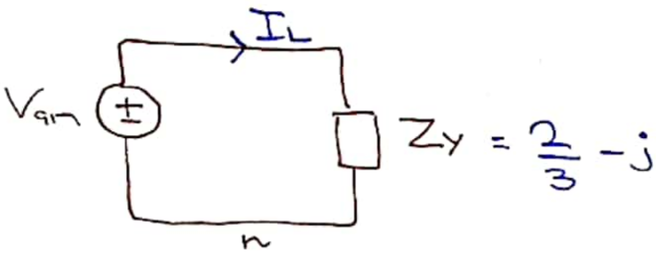
$Z_p = 2 - j3\ \Omega$

It is a Y - Δ connection;

Converting Zp to a Y load

$$Z_Y = \frac{Z_\Delta}{3} = \frac{2-j3}{3} = \frac{2}{3} - j$$

Single Phase Equivalent



$$I_L = \frac{V_{an}}{|Z_Y|} = \frac{240}{1.201} = \boxed{199.83\ A}$$

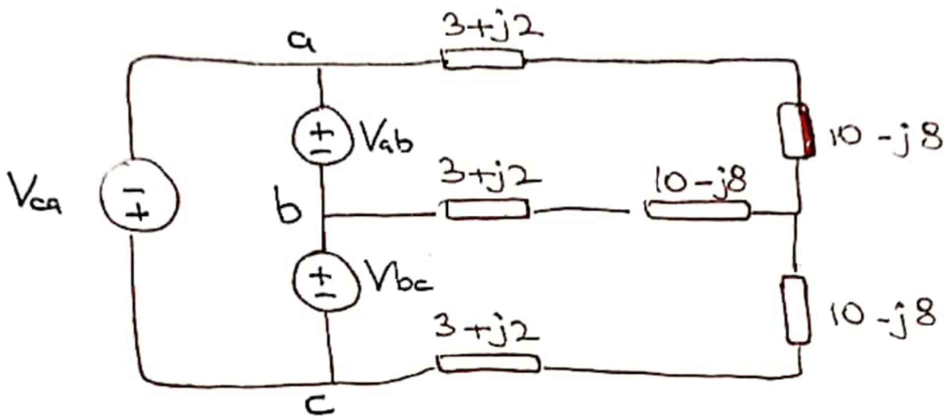
$$V_L = V_p(\sqrt{3}) = \boxed{415.69\ V}$$

12.25)

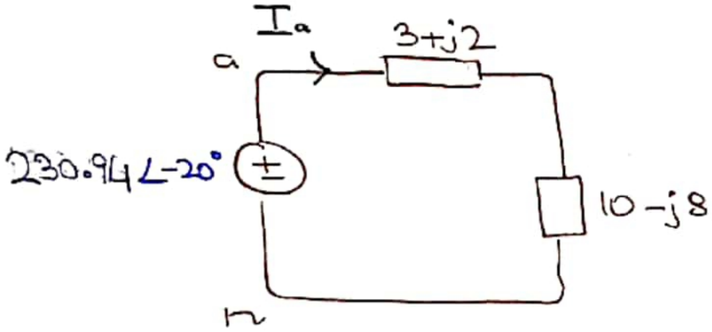
$V_{ab} = 440\angle 10°\ V$

$V_{bc} = 440\angle -110°\ V$

$V_{ca} = 440\angle 130°\ V$



Converting Δ source to Y equivalent;
And considering single phase equivalent



$$I_a = \frac{230.94 \angle -20}{13 - j6} = \boxed{17.742 \angle 4.77^\circ \text{ A}}$$

Then,

$I_b = 17.742 \angle -115.23^\circ$ A

$I_c = 17.742 \angle 124.77^\circ$ A

12.36)

a) Complex Power

$|S| = 10^6$ VA

$\phi = \cos^{-1}(0.75) = 41.4^\circ$

$$S = |S| \angle \phi$$

$$= \boxed{10^6 \angle 41.4^\circ}$$

or $\boxed{750111 + 661311.8j}$

b) Power Loss

$$S = 3 V_{rms} I_{rms}^*$$

$$I_{rms} = I_p \ , \ V_{rms} = V_p$$

$$I_p^* = \frac{S}{3V_p} = \frac{750111 + 661311.8j}{3 \times 4200}$$

$$I_p = 59.53 - j52.48 \text{ A}$$

$$P_{Loss} = |I_p|^2 R_L = (79.36)^2 (4) = \boxed{25.19 \text{ kW}}$$

c) Voltage at Sending End

$$V_s = V_p + I_p(4+j)$$

$$= 4200 + (59.53 - j52.48)(4+j)$$

$$= \underline{4493 \angle -1.91^\circ}$$

12.41)

$$P = 5kW$$

$$pf = 0.8 \text{ (lag)}$$

$$S = P/pf = 5k/0.8 = \boxed{6250 \text{ VA}}$$

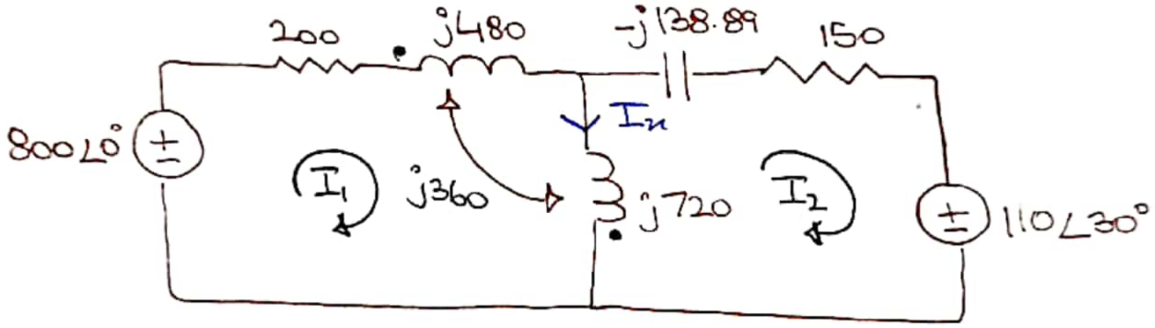
And, $S = \sqrt{3} V_L I_L$

$$\sqrt{3}\, V_L I_L = 6250$$

$$I_L = \frac{6250}{\sqrt{3}(400)}$$

$$= \boxed{9.021\ A}$$

13.11)



1 ▷

$$-800 + 200 I_1 + I_1(j480) + I_1(j720) - I_2(j720)$$
$$+ I_2(j360) = 0$$

- $(1200j + 200) I_1 - (360j) I_2 = 800$

2 ▷

$$110\angle 30 + (j720) I_2 - (j720) I_1 + I_2(-j138.9)$$
$$+ 150 I_2 + (j360) I_1 = 0$$

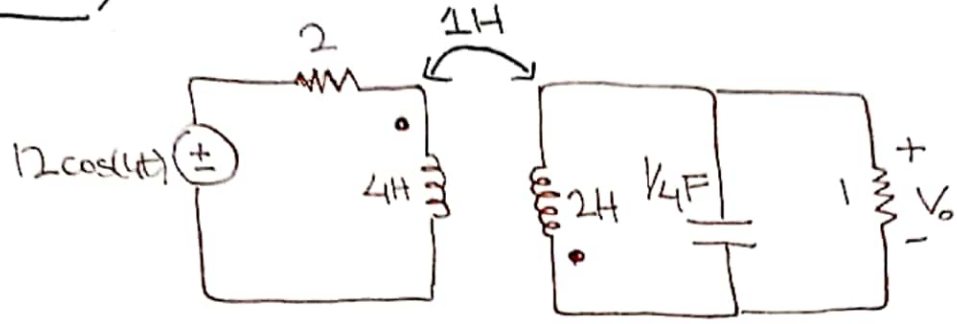
- $(-360j) I_1 + (150 + j581.1) I_2 = -95.26 - 55j$

Solving gets us;

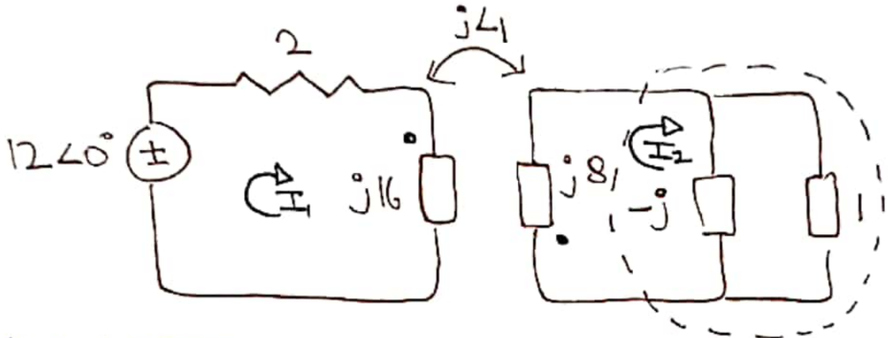
$I_1 = 0.73\angle -76.68$ $\qquad$ $I_2 = 0.29\angle -54.51$

$$I_x = I_1 - I_2 = \boxed{0.474 \cos(600t - 90.02)\ A}$$

13.24)



In complex system,



= 0.5 − 0.5j

a) $k = M/\sqrt{L_1 L_2} = 1/\sqrt{4\times 2} = \boxed{0.3535}$

$\xrightarrow{1}$ $-12 + 2I_1 + j16(I_1) + j4(I_2) = 0$

- $(2+j16)I_1 + (j4)I_2 = 12$

$\xrightarrow{2}$ $(0.5-0.5j)I_2 + j8(I_2) + j4(I_1) = 0$

- $(j4)I_1 + (0.5+7.5j)I_2 = 0$

$I_1 = 0.85\angle -81.23°$

$I_2 = 0.45\angle 102.59°$

b)

$V_o = I_2(0.5-0.5j)$

$= \underline{321.7\cos(4t + 57.59°)}\ V$

c) $i_1 = 0.855\cos(4t - 81.21^\circ)$

$i_2 = 0.45\cos(4t + 102.59)$

At $t = 2s$

$i_1 = 0.812\ A$

$i_2 = -0.420\ A$

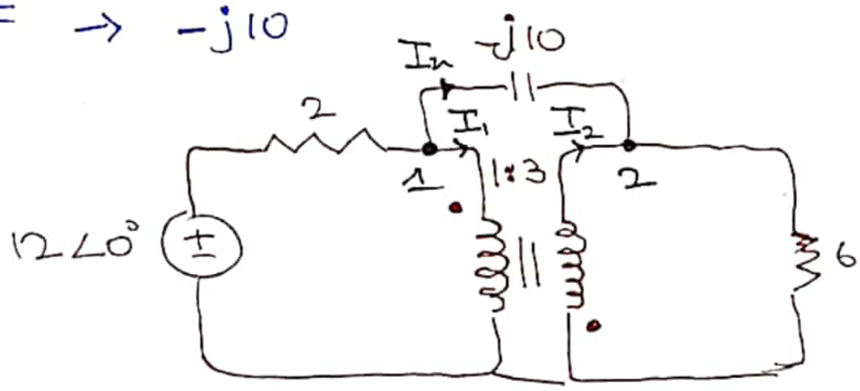
- $W = \frac{1}{2}L_1 i_1^2 + \frac{1}{2}L_2 i_2^2 + M i_1 i_2$

$= (0.5)(4)(0.812)^2 + (0.5)(2)(-0.420)^2 + (1)(0.812)(-0.420)$

$\boxed{W = 1.154\ J}$

13.49) $\omega = 2$

$\frac{1}{20}F \rightarrow -j10$



1 $\rightarrow$ $\dfrac{V_1 - 12}{2} + \dfrac{V_1 - V_2}{-j10} + I_1 = 0$

2 $\rightarrow$ $\dfrac{V_2 - V_1}{-j10} + \dfrac{V_2}{6} = I_2$

From terminals of transformer,

$V_2 = -3V_1$

$I_2 = -\frac{1}{3} I_1$

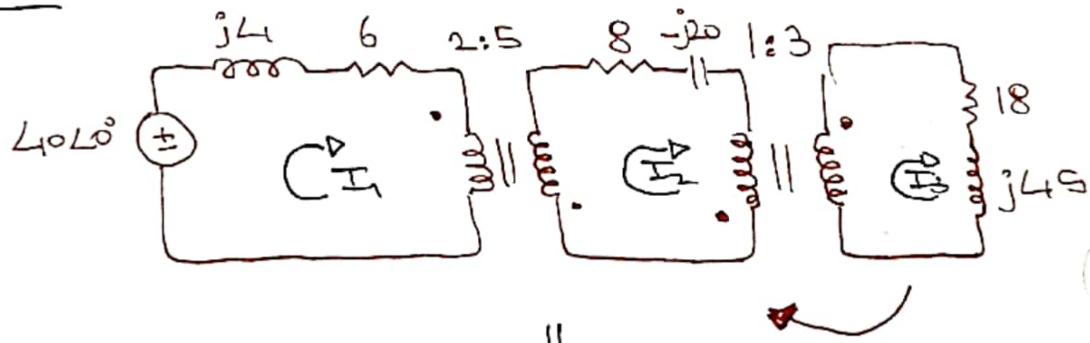
By substituting into 1 and 2;

$V_1 = 1.829 - j1.463 \text{ V}$

$I_n = \frac{V_1 - V_2}{-j10} = \frac{4V_1}{-j10} = \boxed{0.937 \angle 51.34^\circ}$

$I_n \Rightarrow i_n(t) = \boxed{937 \cos(2t + 51.34^\circ) \text{ mA}}$

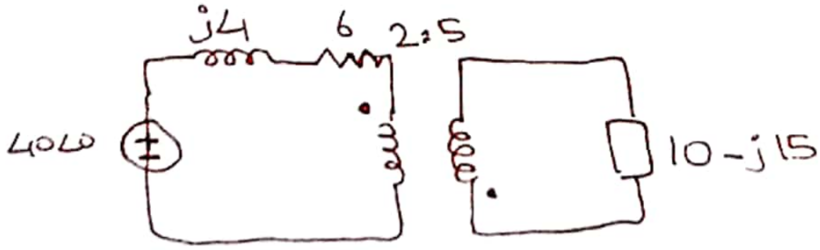
<u>13.62)</u>



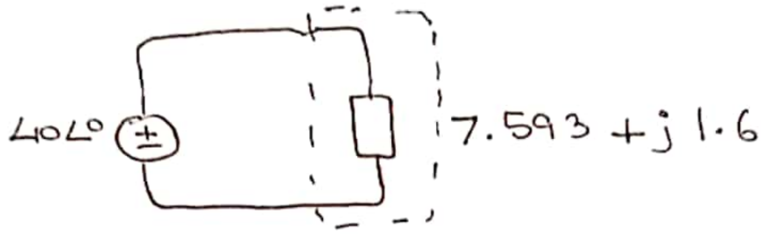
$\Downarrow$

$Z_L' = 8 - j20 + \frac{18 + j45}{3^2}$

$Z_L' = 10 - j15$



$Z_{in} = 6 + j4 + \frac{10 - j15}{(5/2)^2} = 7.76 \angle 11.88^\circ$



$$S = V_s I_1^* = (40)\left(\frac{40}{7.593 + j1.6}\right)^*$$

$$\boxed{S = 206.19 \angle 11.9^\circ \text{ VA}}$$

b) Average Power of $18\,\Omega$

$\Rightarrow I_2 = \dfrac{-I_1}{n}$

$\Rightarrow I_3 = \dfrac{-I_2}{n'} = \dfrac{I_1}{n'n}$

$$= \frac{5.154 \angle -11.9^\circ}{\left(\frac{5}{2}\right)(3)}$$

$$I_3 = 0.6867 \angle -11.89^\circ \text{ A}$$

$$P_{18\Omega} = |I_3|^2 (R)$$

$$= (0.6867)^2 (18)$$

$$= \boxed{8.4188 \text{ W}}$$