ASSIGNMENT 03 [Final-TERM]

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Problem-01

1\. Admittance, $\vec{Y} = \frac{1}{X_C} + \frac{1}{R} + \frac{1}{X_L}$

$$= \frac{1}{-j10} + \frac{1}{44} + \frac{1}{j20}$$

$$= 0.025 + j\,0.05S$$

$$= 0.05\angle 65.5^\circ$$

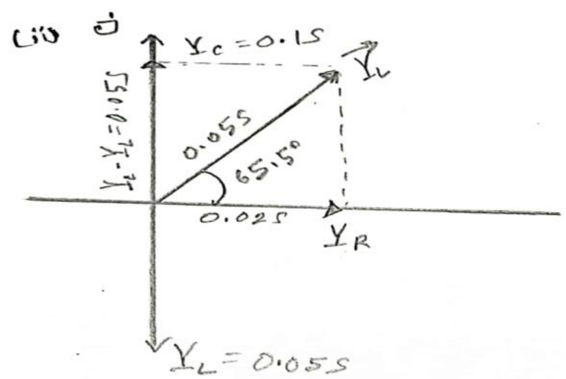
Impedance, $\vec{Z_T} = \frac{1}{\vec{Y_T}}$

$$= \frac{1}{0.02 + j0.05}$$

$$= 6.89 - j17.24$$

$$= 18.5\angle -68.1^\circ$$

(ii)

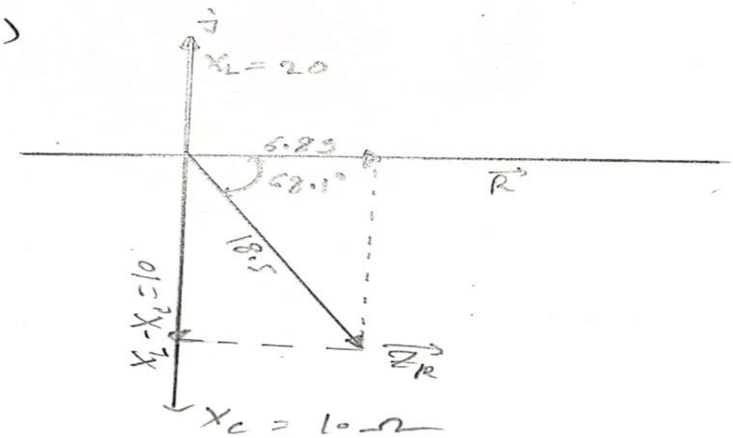


$$Y_C = \frac{1}{X_C} = \frac{-1}{j10} = j0.05S$$

$$Y_L = \frac{1}{X_L} = \frac{1}{j20} = j0.05S$$

$$Y_R = \frac{1}{R} = \frac{1}{44} = 0.02$$

(iii)



vi) $C = \frac{1}{\omega X_C} = \frac{1}{314 \times 10}$

$= 3.18 \times 10^{-4} \times 10^{-6}$

$= 3.18 \times 10^{-10} mF$

$L = \frac{X_L}{\omega}$

$= \frac{20}{314} = 0.063 H$

v)

$e(t) = 70.8 \sin(3.14\cancel{t} + 60^\circ) v$

$\vec{E} = 50.1 \angle 60^\circ$

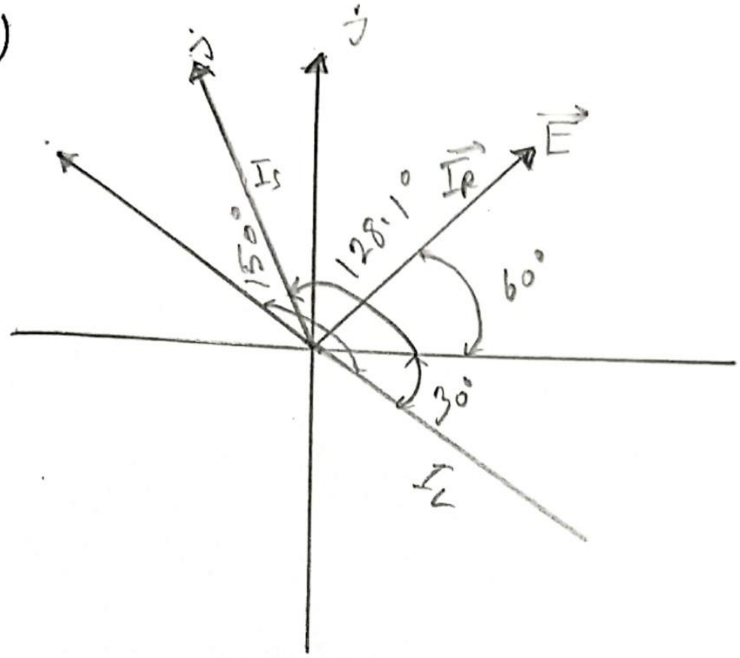
$I_S \Rightarrow \frac{\vec{E}}{\vec{Z_T}} = \frac{50.1 \angle 60^\circ}{18.5 \angle -68.1^\circ} = 2.7 \angle 128.1^\circ$

$I_R \Rightarrow \frac{\vec{E}}{\vec{R}} = \frac{50.1 \angle 60^\circ}{44 \angle 0^\circ} = 1.13 \angle 60^\circ$

$I_L \Rightarrow \frac{\vec{E}}{\vec{X_L}} = \frac{50.1 \angle 60^\circ}{20 \angle 90^\circ} = 2.5 \angle -30^\circ$

$I_C \Rightarrow \frac{\vec{E}}{\vec{X_C}} = \frac{50.1 \angle 60^\circ}{10 \angle -90} = 5.01 \angle 150^\circ$

vi)



vii) KCL,

$$\therefore I_s = I_R + I_L + I_C$$

$$= (1.13\angle 60°) + (2.5\angle -30°) + (5.01\angle 150°)$$

$$= 2.7\angle 125.7°$$

viii) $S = E I_s^*$

$$= (50.1\angle 60°) \times (2.7\angle 125.7°)^*$$

$$= (50.1\angle 60°) \times (2.7\angle -125.7°)$$

$$= 135.27\angle -65.7°$$

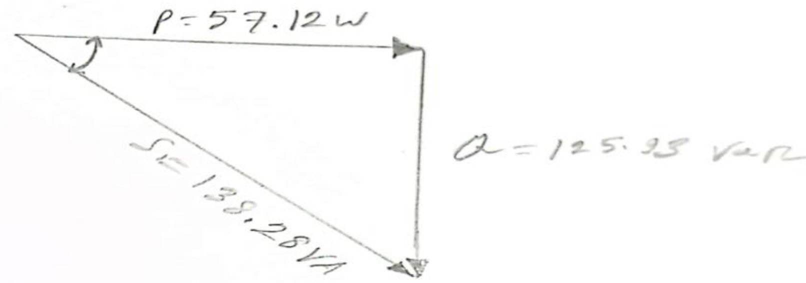
$$= 55.67 - j123.28$$

$\therefore$ Apparent power, $S = 135.27$.

Avg Power, $P = 55.67$ W

Reactive, $Q = -123.28$ Var

ix)



x) Power factor, $pf = \cos\theta_S$

$= \cos(-65.3)$

$= 0.418$ (leading)

xi) $I_S \Rightarrow \frac{2.76}{0.707} = 18.05 \sin(314t + 125.6^\circ)$

$I_R \Rightarrow \frac{1.14}{0.707} = 1.612 \sin(314t + 60)$

$I_L \Rightarrow \frac{2.51}{0.707} = 3.55 \sin(314t - 30^\circ)$

$I_C \Rightarrow \frac{5.01}{0.707} = 7.09 \sin(314t + 150^\circ)$

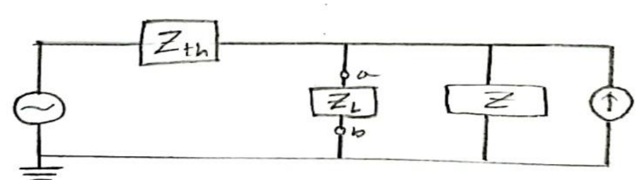
Problem-2:

a) i) $\vec{Z}_{th} = 6 + j8$

$= 10\angle 53.1^\circ$

$\vec{E}_{th} = 20\angle 0$

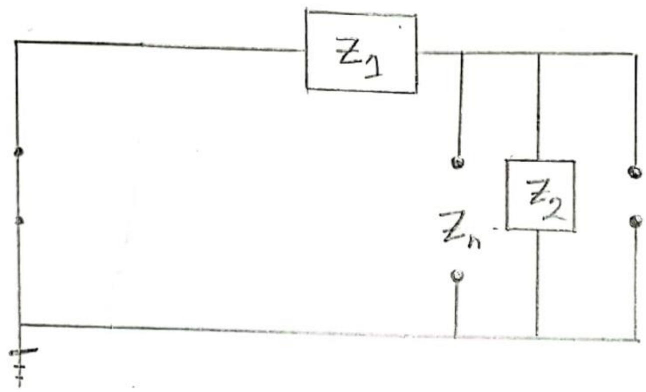
(ii)



Thevenin equivalent circuit

b)

(i) $\vec{E} = 20V\angle 0^\circ$

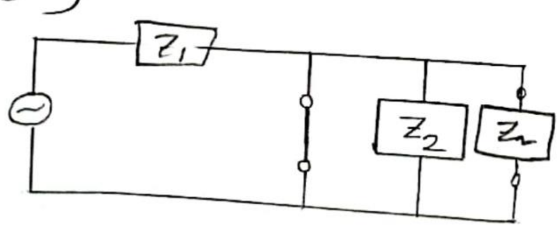


$$\vec{Z_1} = 6 + j8$$
$$= 10\angle 53.1^\circ$$

$$\vec{Z_2} = 9 - j12$$
$$= 15\angle -53.1^\circ$$

$$\vec{Z_n} = Z_1 \| Z_2 = 9.65\angle 12.92^\circ$$

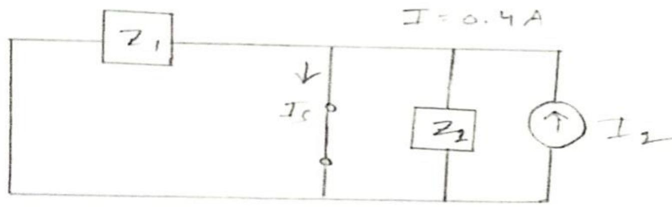
For-(E)



$$\therefore \vec{I_S} = \frac{\vec{E}}{\vec{Z_1}} = \frac{20\angle 0^\circ}{10\angle 53.1^\circ}$$

$$= 2A\angle -53.1^\circ$$

For (I_2)



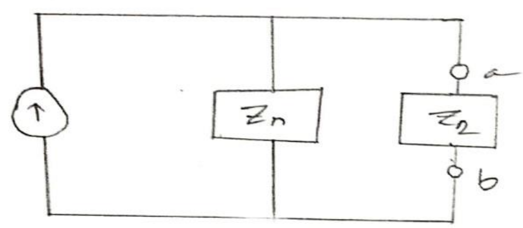
$$\therefore \vec{I_2} = 0.4A\angle 20^\circ$$

$$\therefore \vec{I_N} = \vec{I_S} + \vec{I_2}$$

$$= (2\angle -53.1) + (0.4\angle 20)$$

$$= 2.15\angle -42.89^\circ$$

(ii)



Norton's equivalant circuit

(c) $Z_L = (Z_{th})^*$

$$= 6 - j8$$

$$\text{Maximum power, } P = \frac{E_{th}^2}{4Z_L}$$

$$= \frac{20^2}{4 \times 6}$$

$$= 16.7W$$