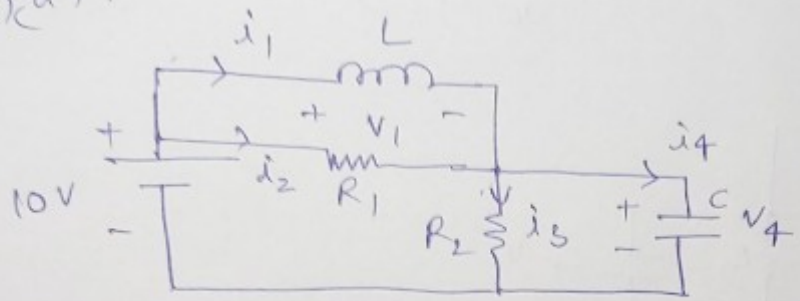
(10)

$-V_2\left[\frac{3}{3\Omega}\right.$

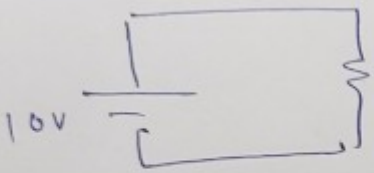
KCL @ 2:

(2)

Q1)(a).



$R_2 = 1\Omega$
$L = 1H$
$C = 0.5f$
$R_1 = 2\Omega$
$i_{R_1}(0^-) = 2A$
$V_4(0^-) = 4A.$



$i_3 = \frac{10}{R_2} = 10A$

$i_4 = 0$ ∴

$i_2 = 0$

$V_1 = 0$

$V_4 = 10V$

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190446 DII

$t = 0^+$: $i_1(0^+) = i_1(0^-) = 2A$

$V_4(0^+) = V_4(0^-) = 4V.$

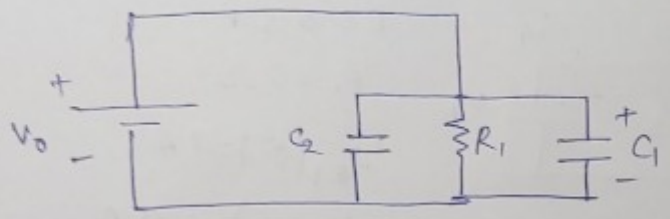
(10)

KCL @ 2 :-

(1)

Q1) $t<0$:-

b) $v(t) = ?$



$$v(t) = v(\infty) + (v(0) - v(\infty))\, e^{-t/\tau}$$

$v(0^-)$:-

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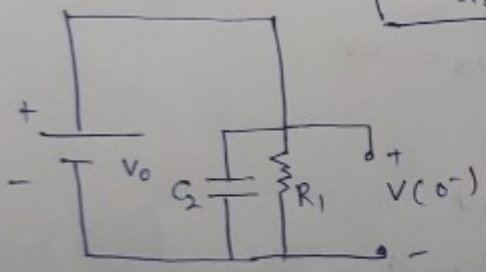
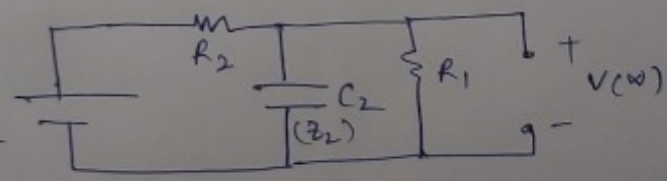


$C_{eq} = C_1 + C_2$

$R_{eq} = R_1$

$v(0^-) = V_0$

$t>0$:-



$$v(\infty) = V_0 \left(\frac{Z_2 \| R_1}{(Z_2 \| R_1) + R_2} \right)$$

$$= V_0 \left(\frac{\frac{R_1 \cdot \frac{1}{j\omega C_2}}{R_1 + \frac{1}{j\omega C_2}}}{\frac{\frac{R_1}{j\omega C_2}}{R_1 + \frac{1}{j\omega C_2}} + R_2} \right) = V_0 \left[\frac{\frac{R_1}{j\omega C_2}}{\frac{R_1}{j\omega C_2} + R_1 R_2 + \frac{R_2}{j\omega C_2}} \right]$$

Q2)

$R_L = 15\Omega \Rightarrow$

$$i_L = \sqrt{\frac{3.75}{15}} = 0.5\,A$$

$$i_L = \frac{V_t}{R_t + R_L} = 0.5$$

$$R_L = 45\Omega \Rightarrow i_L = \sqrt{\frac{1.8}{45}} = 0.2\,A$$

$$\Rightarrow i_L = \frac{V_t}{R_t + R_L}$$

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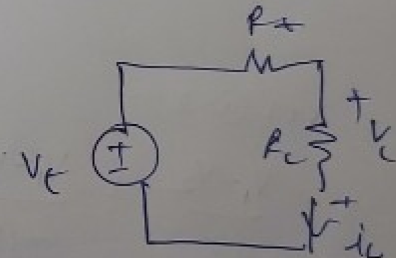
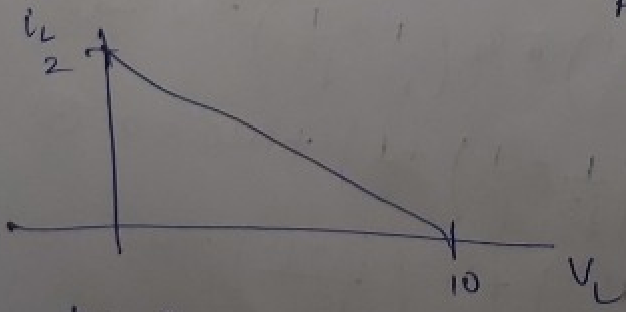
D11



$$\Rightarrow \frac{V_t}{R_t + 45} = 0.2$$

$$\Rightarrow V_t = 10\,V$$
$$R_t = 5\Omega$$

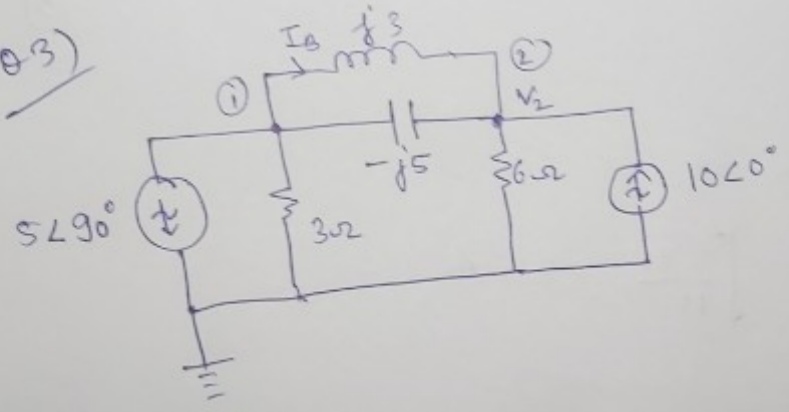
$$V_L = V_t - R_t i_L \Rightarrow i_L = \frac{V_t - V_L}{R_t}$$



max Power $\Rightarrow R_L = R_t = 5\Omega$

$$V_L = 5V$$
$$i_L = \frac{V_L}{2R_t} = 1A$$

Q3)



⇒ KCL@1:-

$$\Rightarrow -5\angle 90^\circ - \frac{V_1}{3} + \frac{V_2 - V_1}{-j5} - \frac{V_2 - V_1}{j3} = 0 \quad \text{—(1)}$$

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KCL@2:-

$$\Rightarrow \frac{V_1 - V_2}{j3} + \frac{V_1 - V_2}{-j5} - \frac{V_2}{6} + 10\angle 0^\circ = 0 \quad \text{—(2)}$$

$$\Rightarrow -5\angle 90^\circ - \frac{V_1}{3} + \frac{V_1}{j5} + \frac{V_1}{j3} - \frac{V_2}{j5} - \frac{V_2}{j3} = 0$$

$$\Rightarrow -5\angle 90^\circ + V_1\left(\frac{1}{j5} + \frac{1}{j3} - \frac{1}{3}\right) - V_2\left(\frac{1}{j5} + \frac{1}{j3}\right) = 0 \quad \text{—(1)}$$

$$\Rightarrow V_1\left(\frac{1}{j3} - \frac{1}{j5}\right) - V_2\left(\frac{1}{j3} - \frac{1}{j5} + \frac{1}{6}\right) + 10\angle 0^\circ = 0 \quad \text{—(2)}$$

$$\Rightarrow -5\angle 90^\circ - V_1\left(\frac{9j + 15j + 15}{45}\right) + V_2\left(\frac{j3 + j5}{15}\right) = 0$$

$$\Rightarrow -45 \times 5\angle 90^\circ - V_1(15 + j24) + V_2(24j) = 0$$

$$\Rightarrow V_1 = \frac{-45 \times 5\angle 90^\circ + V_2(24j)}{15 + j24}$$

(10)

Q6) contd : $-\frac{225j + 24V_2 j}{15+j24}\left(\frac{2j}{-15}\right) = 0$ ⑤

$\Rightarrow -V_2\left[\frac{30j^2 - 18j - 15}{3j \times 5j \times 6}\right] + 10\angle 0^\circ = 0$

Q7)

$\Rightarrow \frac{+225j - 24V_2 j}{15+j24}\left(\frac{2j}{15}\right) + V_2\left(\frac{12j-15}{15\times 6}\right) + 10\angle 0^\circ = 0$

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$\Rightarrow 2\left(\frac{2}{15}\right)\left(\frac{24V_2 - 225}{15+j24}\right) + V_2\left(\frac{4j-5}{30}\right) + 10\angle 0^\circ = 0$

$\Rightarrow V_2\left[\frac{48}{225+j360} + \frac{4j-5}{30}\right] - \frac{30}{15+j24} + 10\angle 0^\circ = 0$

10 cos θ ...

$\frac{48}{15}\left(\frac{1}{15+j24}\right)\left(\frac{15-j24}{15-j24}\right)$

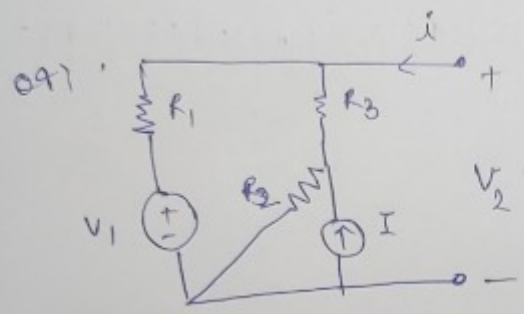
$= \frac{48(15-j24)}{15(225+(-24\times 24))} = \frac{\overset{16}{\cancel{48}}(15-j24)}{-15\times\cancel{351}_{117}}$

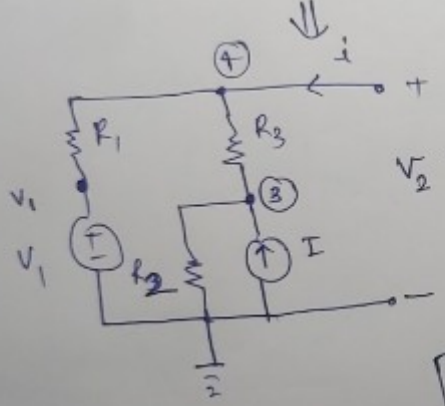
$\Rightarrow V_2\left[\frac{16(j24-15)}{15\times 117} + \frac{4j-5}{30}\right] + \frac{\overset{10}{\cancel{30}}(15-j24)}{\cancel{351}_{117}} = 0$

$\Rightarrow \frac{V_2}{117}\left[\frac{16(j24-15)}{15\times} + \frac{\overset{39}{\cancel{117}}}{\cancel{30}_{10}}(4j-5)\right] + 10\frac{(15-j24)}{117} = 0$

$\Rightarrow$

Q9)





$V_{OC} = V_2 = ?$

$V_4 = V_2$ — (1)

KCL @ 3 :-

$\Rightarrow I + \frac{V_2 - V_3}{R_3} - \frac{V_3}{R_2} = 0$ — (2)

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KCL @ 4 :-

$\Rightarrow \frac{V_1 - V_2}{R_1} + i + \frac{V_3 - V_2}{R_3} = 0$ — (3)

$I + \frac{V_2}{R_3} - V_3\left(\frac{1}{R_2} + \frac{1}{R_3}\right) = 0 \quad \times \frac{1}{R_3}$

$\Rightarrow$

$\Rightarrow i + \frac{V_1}{R_1} - V_2\left(\frac{1}{R_1} + \frac{1}{R_3}\right) + \frac{V_3}{R_3} = 0 \quad \times \frac{1}{R_2} + \frac{1}{R_3}$

— (a)

$\Rightarrow \frac{I}{R_3} + \frac{V_2}{R_3^2} - \frac{V_3}{R_3}\left(\frac{1}{R_2} + \frac{1}{R_3}\right) = 0$

$\Rightarrow i\left(\frac{1}{R_2} + \frac{1}{R_3}\right) + \frac{V_1}{R_1}\left(\frac{1}{R_2} + \frac{1}{R_3}\right) - V_2\left(\frac{1}{R_1} + \frac{1}{R_3}\right)\left(\frac{1}{R_2} + \frac{1}{R_3}\right) +$

$\frac{V_3}{R_3}\left(\frac{1}{R_2} + \frac{1}{R_3}\right) = 0$ — (b)

$$\frac{I}{R_3} + i\left(\frac{1}{R_2} + \frac{1}{R_3}\right) + \frac{V_2}{R_3^2} + \frac{V_1}{R_1}\left(\frac{1}{R_2} + \frac{1}{R_3}\right) - V_2\left[\frac{1}{R_1R_2} + \frac{1}{R_1R_3} + \frac{1}{R_3^2} + \frac{1}{R_3R_2}\right] = 0$$

(10)

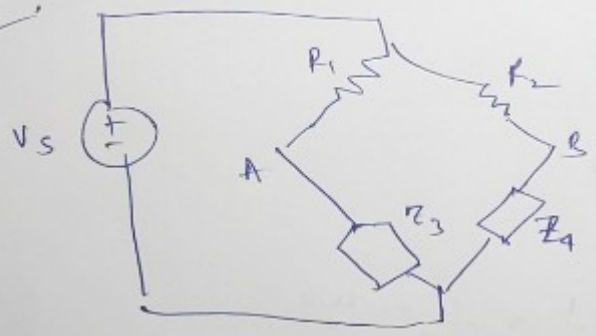
(6)

$$\Rightarrow \frac{V_2}{150}\left[\; 160(j24-15) + 39\times 15(4j-5)\right] + 10(15-j24) = 0$$

82)

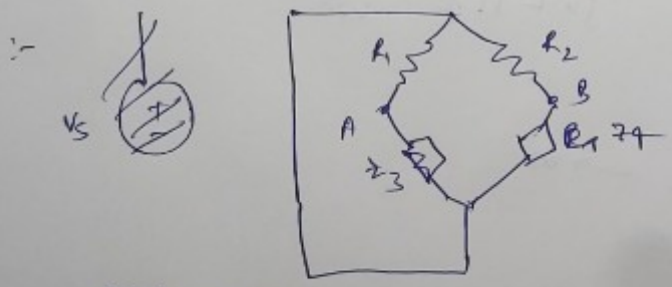
$Z_4 \| R_2$

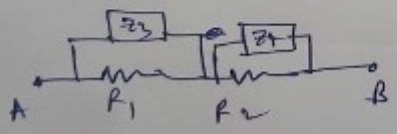
Q7)



$$\Rightarrow \quad V_A - V_B = V_{OC} = V_S \left(\frac{Z_3}{R_1 + Z_3} - \frac{Z_4}{R_2 + Z_4} \right)$$

R_{Th} :-





$$\Rightarrow R_{AB} = R_{Th} = Z_3 \| R_1 + Z_4 \| R_2$$

$V_{OC} = I_o R_{Th} \Rightarrow Z_o$

(13)

(11)

Q6)

for max V:

$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{j\omega C} - \frac{\omega C}{1}$$

$$= \frac{1}{R} + \frac{1 - j\omega^2 LC}{j\omega L}$$

Max V $\Rightarrow$ $j\omega L \,||\, \frac{-j}{\omega C} \to \infty$

$$\frac{\frac{\omega L}{\omega C}}{j\omega L - \frac{j}{\omega C}} \to \infty$$

$$\Rightarrow 2500 = \frac{1}{\sqrt{LC}} = \omega$$

$$\Rightarrow Z_{eq} = R \,||\, j\omega L \,||\, -j/\omega C$$

$\Rightarrow$ i.e $Z_{eq} = 40$ @ $\omega = 2400$

$$\Rightarrow (0.4\cos\omega t)R = 80$$

$$\Rightarrow \left(\frac{0.4}{\sqrt{2}}\right)R = 80$$

$$\Rightarrow \boxed{R = 200\sqrt{2}}$$

(11)

(Q6)

for max V:

$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{j\omega C} - \frac{\omega C}{1}$$

$$= \frac{1}{R} + \frac{1 - j\omega^2 LC}{j\omega L}$$

Max V $\Rightarrow$ $j\omega L \,||\, \frac{-j}{\omega C} \to \infty$.

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$$\frac{\frac{\omega L}{\omega C}}{j\omega L - \frac{j}{\omega C}} \to \infty$$

$$\Rightarrow 2500 = \frac{1}{\sqrt{LC}} = \omega$$

$$\Rightarrow Z_{eq} = R \,||\, j\omega L \,||\, \frac{-j}{\omega C}$$

$\Rightarrow$ i/p $Z_{eq} = 40$ @ $\omega = 2400$

$\Rightarrow (0.4 \cos \omega t) R = 80$

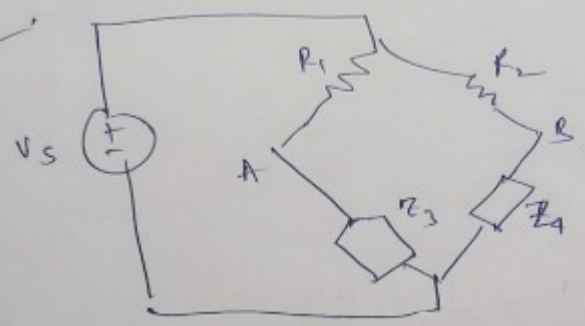
$\Rightarrow \left(\frac{0.4}{\sqrt{2}}\right) R = 80$

$\Rightarrow \boxed{R = 200\sqrt{2}}$

(13)

(10)

87)



$$\Rightarrow \quad V_A - V_B = V_{OC} = V_S \left(\frac{Z_3}{R_1 + Z_3} - \frac{Z_4}{R_2 + Z_4} \right)$$

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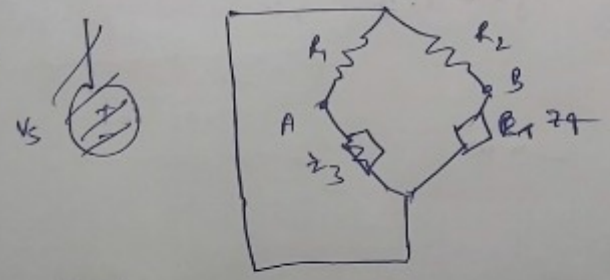
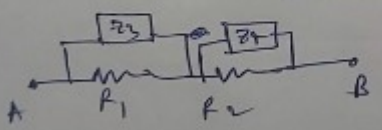
R_{Th} :-





$$\Rightarrow R_{AB} = R_{Th} = Z_3 \| R_1 + Z_4 \| R_2$$

$V_{OC} = I_0 R_{Th} \Rightarrow Z_0$

9) contd.

$$\Rightarrow \frac{\frac{I}{R_3} + i\left(\frac{1}{R_2} + \frac{1}{R_3}\right) + \frac{V}{R_1}\left(\frac{1}{R_2} + \frac{1}{R_3}\right)}{\left(\frac{1}{R_1R_2} + \frac{1}{R_1R_3} + \frac{1}{R_3R_2}\right)} = V_2.$$

$$R_{Th} = R_1 \,||\, (R_2 + R_3)$$

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08)

$$H(\omega) = \frac{2\left(10^4 + j\omega\right)}{(j\omega)^2\left(1 + \frac{j\omega}{1000}\right)}$$

$$= \frac{2\times10^4\left(1 + j\left(\frac{\omega}{10^4}\right)\right)}{\left(\frac{j\omega}{1}\right)^2\left(1 + j\left(\frac{\omega}{10^3}\right)\right)}$$

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