Q.P. code :- 50743

ENAS

01

Ans. key.

Q.1 a) $I_x = I_1 - I_2$ — (1)

For loop (1)

$50 I_1 - 40 I_2 - 10 I_3 = 100$ — (2)

For loop (2)

$60 I_2 - 40 I_1 - 20 I_3 = -50 I_x$ — (3)

$= \quad 10 I_1 + 10 I_2 - 20 I_3 = 0$ — (3)

For loop (3)

$60 I_3 - 10 I_1 - 20 I_2 = 0$ — (4)

Solving eq^{ns} we get

$I_1 = 0.74$, $I_2 = -1.48$ $I_3 = -0.37$

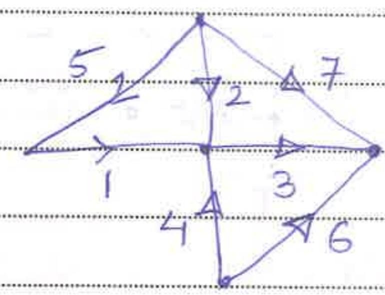
$I_{20} = I_3 - I_2 = \boxed{1.11 A}$

c) cutset 1 : {1, 5}

2 : {2, 5, 7}

3 : {3, 6, 7}

4 : {4, 6}



e) $I_1 = \frac{V_1 - V_3}{1} = V_1 - V_3$ — (1)

KCL at node (3) ⇒ $I_1 = \frac{V_3}{2} + \frac{V_3 - V_2}{2} = V_3 - \frac{V_2}{2}$ — (2)

KCL at nod (2) $I_2 = \frac{V_2}{4} + \frac{V_2 - V_3}{2} = \frac{3}{4} V_2 - \frac{V_3}{2}$ — (3)

∴ eq^n (1) & (2) ⇒

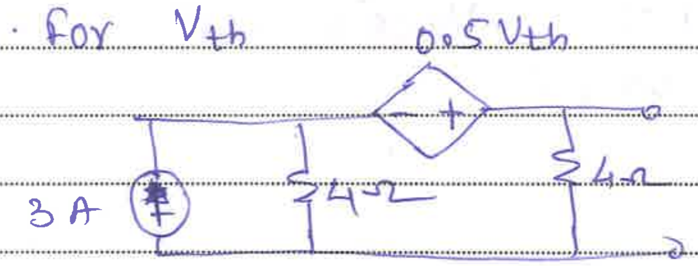
$V_3 = \frac{V_1}{2} + \frac{V_2}{4}$ — (4)

Using eq^n (4) in eq^n (2) $I_1 = \frac{V_1}{2} - \frac{V_2}{4}$ — (5)

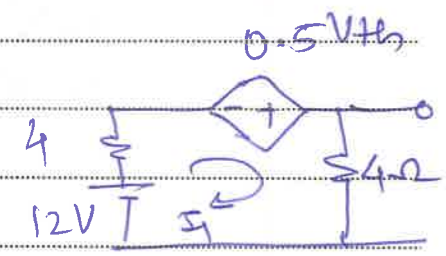
" eq^n (3) $I_2 = -\frac{V_1}{4} + \frac{5}{8} V_2$ — (6)

$$\begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix} = \begin{bmatrix} 1/2 & -1/4 \\ -1/4 & 5/8 \end{bmatrix}$$

Q2 a) For V_{th}



⇒

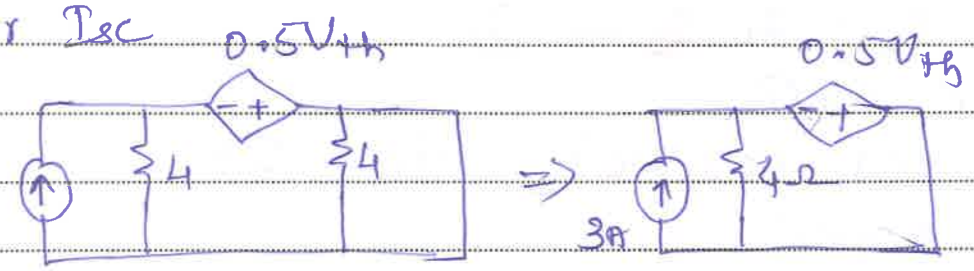


∴ $V_{th} = 4I$

$I = 2$

∴ $\boxed{V_{th} = 8 V}$

For I_{sc}

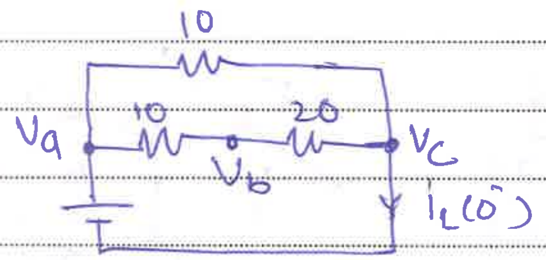


$\therefore V_{th} = 0 \quad \therefore I_{sc} = 3A$

$\therefore R_{th} = \frac{V_{th}}{I_{sc}} = \frac{8}{3} = 2.667\,\Omega$

$\therefore \boxed{R_L = R_{th} = 2.667\,\Omega}$

(b) at $t=0$ $\because$ ckt is already stable



$i_L(0^-) = 2/3\,A$

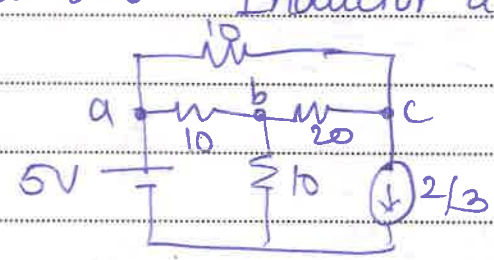
$V_L(0^-) = 0V$

$V_a = 5V, \quad V_b = 3.33V \quad V_c = 0$

$\therefore V_a(0^-) = 5V \quad V_b(0^-) = 3.33V.$

at $t=0^+$ Inductor acts as current source.

$\therefore$



KCL at node (b)

$$\frac{V_b - 5}{10} + \frac{V_b}{10} + \frac{V_b - V_c}{20} = 0$$

$\therefore$ at $t=0^+$ $\quad 2V_b(0^+) - 10 + 2V_b(0^+) + V_b(0^+) = 0$ — (1)

KCL at node (c)

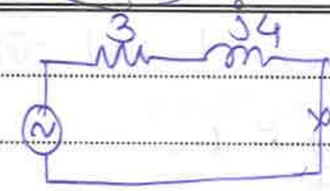
$$\frac{V_c(0^+) - V_b(0^+)}{20} + \frac{V_c(0^+) - 5}{10} + \frac{2}{3} = 0 \quad \text{— (2)}$$

$\therefore$ solving eq^n

$V_b(0^+) = 1.9\,V \qquad V_a(0^+) = 5V$

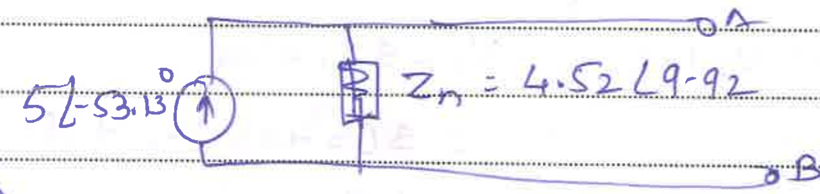
$V_c(0^+) = -0.476\,V$

Q.3 a) To find I_{sc}



$\therefore I_{sc} = 5\angle -53.13^\circ$

$Z_n = 4.46 + j0.78 = 4.52\angle 9.92^\circ\ \Omega$



(b)

$I_{(-j5)} = 13.41\angle 26.56\ A$ using CDR

$\therefore V_{th} = -j5 \times I$

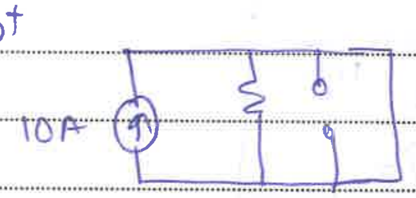
$= 67.08\angle -63.43^\circ\ V$

$\therefore Z_{th} = (5+j15) \parallel (-j5)$

$= 7.07\angle -81.86\ \Omega$

(c) at $t=0^-$ $\quad i_L(0^-)=0 \quad V_c(0^-)=0$

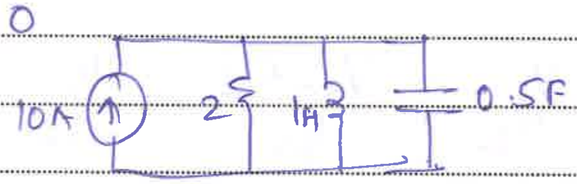
at $t=0^+$



$\therefore i_L(0^+) = 0$

$V_c(0^+) = 0$

at $t>0$



$\therefore$ Applying KCL $\quad 10 = \frac{v}{2} + \int_{-\infty}^{t} v\,dt + 0.5\mu F \frac{dv}{dt}$ — (1)

$\therefore$ at $t=0^+$

$10 = \frac{v(0^+)}{2} + \int_{-\infty}^{t} v(0^+)\,dt + 0.5\times10^{-6} \frac{dv(0^+)}{dt}$

$\therefore \boxed{\frac{dv(0^+)}{dt} = 20\times10^{6}\ V/s}$

diff. eq^n (1) $\Rightarrow$ $0 = \frac{1}{2}\frac{dv}{dt} + v + 0.5\mu F \frac{d^2v}{dt^2}$

$\therefore \boxed{\frac{d^2v}{dt^2} = -20\times10^{12}\ v/s^2}$

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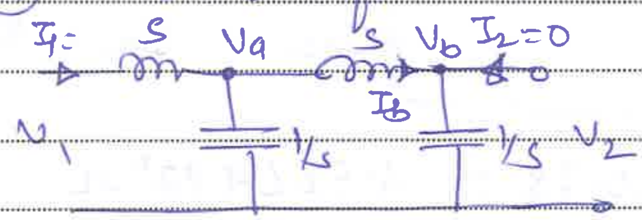
Q.4 (a) The transformed network is.



$V_b = V_2$

$I_b = sV_2 \quad \because V_2 / 1/s$

$V_a = I_b + V_2$

$= s(s V_2) + V_2$

$= s^2 + s^2 V_2 + V_2$

$= (s^2+1) V_2$

$I_1 = \frac{V_a}{1/s} + I_b$

$= sV_a + I_b$

$= (s^3+2s) V_2$

$V_1 = s I_1 + V_a$

$= s(s^3+2s) V_2 + (s^2+1) V_2$

$= (s^4 + 3s^2 + 1) V_2$

$\therefore \frac{V_1}{I_1} \quad \frac{s^4+3s^2+1}{s^3+2s}$

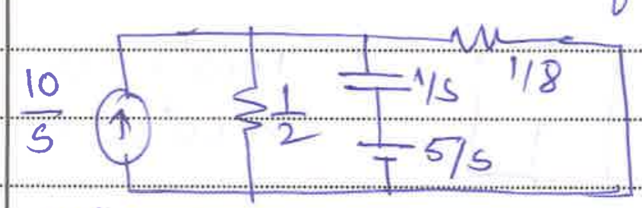
$\frac{V_2}{V_1} = \frac{1}{s^4+3s^2+1}$

$\frac{V_2}{I_1} = \frac{1}{s^3+2s}$

Q.4 (b) at $t=0^-$

$V_c(0^-) = 5V$

at $t>0$ the transformed ckt is



Using KCL

$\frac{10}{s} = \frac{V_s}{1/2} + \frac{V_s - 5/s}{1/s} + \frac{V_s}{1/8}$

$\therefore 10 = s(s+5) V_s$ ——— (1)

$\therefore V_s = \frac{10}{s(s+5)} = \frac{A}{s} + \frac{B}{s+5}$

$\therefore A\big|_{s=0} = \frac{10}{s+0} \frac{s}{s} = 2$

$B\big|_{s=5} = -2$

$\therefore V_s = \frac{2}{s} - 2/s+5$

$\therefore L^{-1}$ is

$V(t) = 2 - 2e^{-5t}$

Q. 5 (a) $A_a = \begin{bmatrix} 1 & 0 & 0 & -1 & 1 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & -1 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & -1 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & -1 & -1 & -1 & -1 \end{bmatrix}$

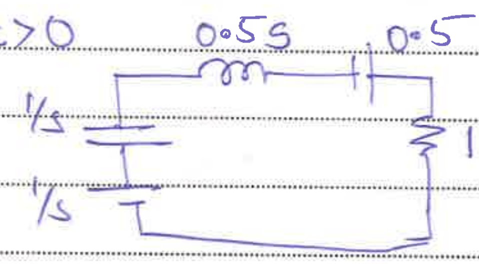
$Q = \begin{bmatrix} 1 & -1 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & -1 & 0 & 0 & 0 & -1 \\ 0 & 1 & 0 & -1 & 1 & 1 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 1 & 1 \end{bmatrix}$

$B = \begin{bmatrix} 1 & 1 & 0 & 0 & -1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & -1 & 0 \\ 1 & 0 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & -1 & 0 \end{bmatrix}$

(b) at $t = 0^-$ $V_c(0^-) = 1V$ $i(0^-) = 1A$

$\therefore$ $V_c(0^+) = 1V$ $i(0^+) = 1A$

for $t > 0$



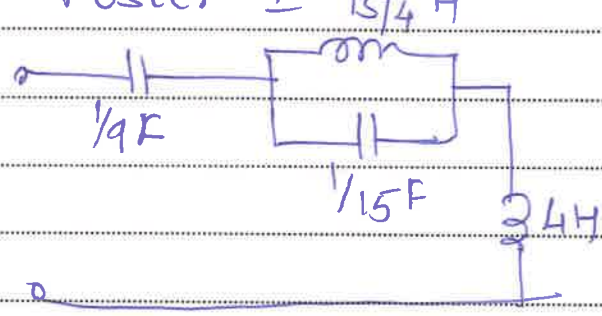
$\therefore$ Applying KVL we get $\frac{1}{s}\ \frac{1}{s} I(s) - 0.5s\,I(s) + 0.5 + I(s) = 0$

$$I(s) = \frac{s+2}{s^2+2s+2}$$

$$= \frac{(s+1)+1}{(s+1)^2+1} = \frac{s+1}{(s+1)^2+1} + \frac{1}{(s+1)^2+1}$$

$L^{-1} \Rightarrow$ $i(t) = e^{-t}\cos t + e^{-t}\sin t$ A

Q. 6 (a) Foster I



Foster - II