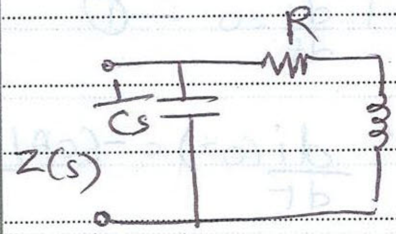
Q P code: 27433



The transformed network is shown.

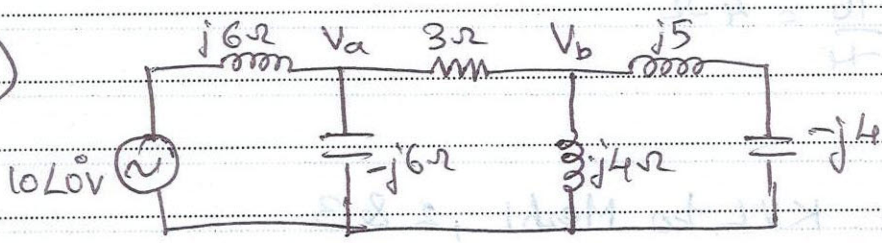
$$Z(s) = \frac{(R + Ls)\frac{1}{Cs}}{\frac{1}{Cs} + (R + Ls)}$$

$$Z(s) = \frac{1}{C}\,\frac{s + \frac{R}{L}}{s^2 + \frac{R}{L}s + \frac{1}{LC}}$$

c) By continued fraction expansion quotients are :- $\frac{s}{7}$, $\frac{7}{3}s$, $\frac{9}{7}s$, $\frac{7}{24}s$

Since all quotients are positive, P(s) is Hurwitz.

2a)



KCL at node a :-

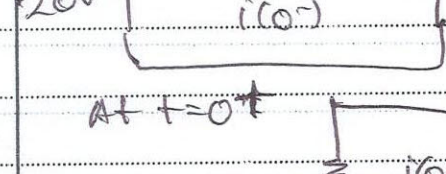
$$0.33V_a - 0.33V_b = 1.67\angle -90^\circ \quad -①$$

KCL at node b:-

$$-0.33V_a + (0.33 - j1.25)V_b = 0 \quad -②$$

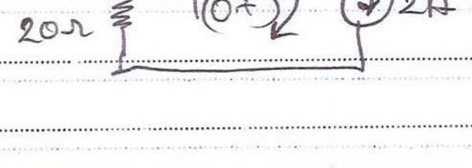
$$\therefore V_a = \underline{5.24\angle -75.17^\circ\ V}$$

2b) At $t = 0^-$



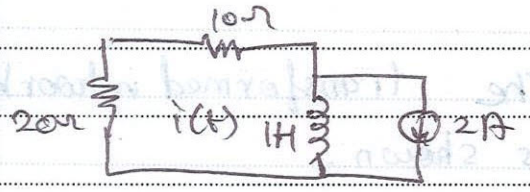
$i(0^-) = 2A$

At $t = 0^+$



$i(0^+) = 2A$

For $t > 0$ KVL



$$-30i - 1\frac{di}{dt} = 0 \quad \text{—} ①$$

At $t = 0^+$ $\frac{di}{dt}(0^+) = -60 A/s$

Differentiating eq^n ① :- & at $t = 0^+$

$$\frac{d^2 i}{dt}(0^+) = 1800 A/s^2$$

Q3a) $V_x = 4V$

$$V_{TH} = V_x - 5V_x = -4V_x = -16V$$

I_{sc} :- Applying KCL at node

$$V_x = -4V$$

$$I_{sc} = \frac{V_x - 5V_x}{4} = -4$$

$$R_{TH} = \frac{16}{-4} = 4\Omega$$

Q3b) Applying KVL to Mesh 1, 2 & 3

$$\begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} = \begin{bmatrix} 5 & 1 \\ -1 & 3 \end{bmatrix}$$

h parameters :-

$$\begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} = \begin{bmatrix} \frac{16}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \end{bmatrix}$$

34
a) 30 A source alone:-

$I_x' = -\frac{V_1}{5}$

KCL at node:-

$I_x' = 3A (\rightarrow)$

20 V source is alone:-

KVL to mesh:- $I_x'' = 2A (\rightarrow)$

By Superposition theorem:-

$I_x = I_x' + I_x''$

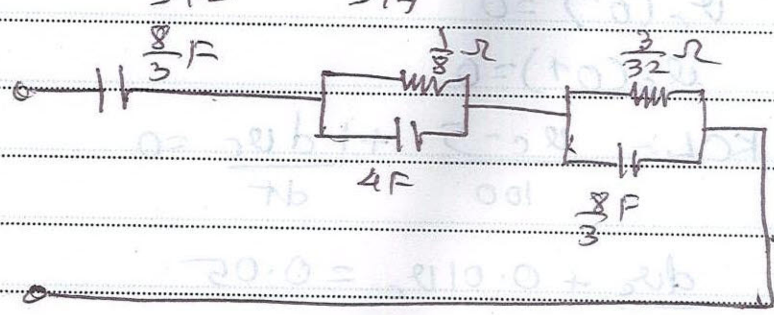
$I_x = 3 + 2 = 5A (\rightarrow)$

34b) $Z(s) = \frac{(s+1)(s+3)}{s(s+2)(s+4)}$

Foster I:- By partial fraction exp.

$Z(s) = \frac{(3/8)}{s} + \frac{(1/4)}{s+2} + \frac{(3/8)}{s+4}$

Network:-



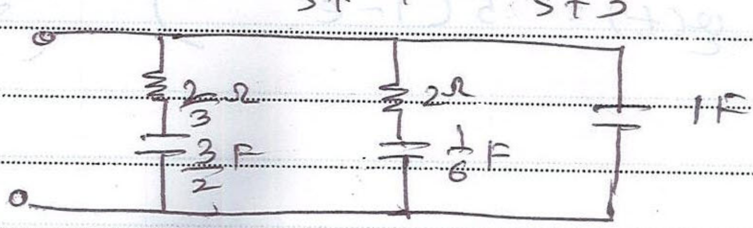
Foster II:- $\frac{Y(s)}{s} = \frac{s^2+6s+8}{s^2+4s+3}$

By division. $\frac{Y(s)}{s} = 1 + \frac{2s+5}{(s+1)(s+3)}$

By partial fraction exp.

$Y(s) = s + \frac{(3/2)s}{s+1} + \frac{(1/2)s}{s+3}$

Network



Q5b) i)

$I_1 = V_1 - V_3$ — ①

$I_2 = \frac{V_2}{3} - \frac{V_3}{3}$ — ②

KCL :- $I_1 + I_2 = \frac{V_3}{2}$ — ③.

Substituting eq^n ① & ② in ③.

$V_3 = \frac{6}{11}V_1 + \frac{2}{11}V_2$ — ④

eq^n ④ in ①.

$I_1 = \frac{5}{11}V_1 - \frac{2}{11}V_2$

Substituting ④ in ②

$I_2 = -\frac{2}{11}V_1 + \frac{3}{11}V_2$

$$\begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix} = \begin{bmatrix} \frac{5}{11} & -\frac{2}{11} \\ -\frac{2}{11} & \frac{3}{11} \end{bmatrix}$$

5b ii)

$v_c(0^-) = 0$

$v_c(0^+) = 0$

KCL :- $\frac{v_c - 5}{100} + 1\frac{dv_c}{dt} = 0$

$\frac{dv_c}{dt} + 0.01v_c = 0.05$

Solution of this differential equation is :-

$v_c(t) = \frac{Q}{P} + Ke^{-Pt}$

$= 5 + Ke^{-0.01t}$

At $t=0$, $v_c(0) = 0$ $\therefore K = -5$

$v_c(t) = 5(1 - e^{-0.01t})$ for $t > 0$

5b) $F(s) = \frac{s^2+1}{s^3+4s} = \frac{(s+j1)(s-j1)}{s(s+j2)(s-j2)}$

poles at $s=0, -j2, j2$

zeros at $s=-j1, j1$

Residue test:-

$$F(s) = \frac{K_1}{s} + \frac{K_2}{s+j2} + \frac{K_2^*}{s-j2}$$

$K_1 = \frac{1}{4}$, $K_2 = \frac{3}{8}$, $K_2^* = \frac{3}{8}$

Residues are real & positive

$A(\omega^2) = m_1 m_2 - n_1 n_2 |_{s=j\omega}$

$= 0$.

$A(\omega^2)$ is zero ~~for~~ for all $\omega \geq 0$

Since all 3 test conditions are satisfied, function is positive real.