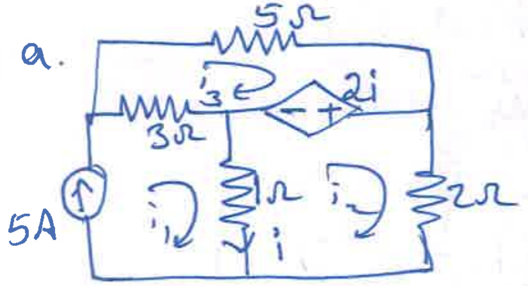
Q.P-Code:- 24948 Set-I

01

Q1 a.



$i = i_1 - i_2$, $i_1 = 5A$

$i = 5 - i_2$

KVL to 2nd mesh $-i_1 + 3i_2 = 2i$

$-5 + 3i_2 = 2(5 - i_2)$

$i_2 = 3A$

KVL to 3rd mesh

$-3i_1 + 8i_3 = -2(i)$

$-3\times5 + 8i_3 = -2(5 - i_2)$

$-15 + 8i_3 = -10 + 2i_2$

$i_2 = 3A$, $i_3 = 11/8 = 1.375A$

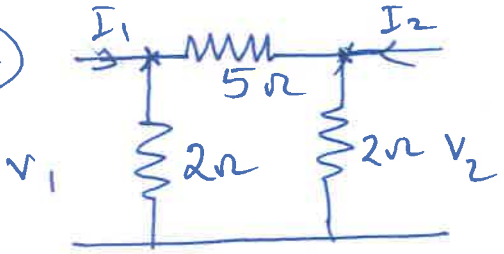
$V_{5\Omega} = 5\times1.375 = \underline{\underline{6.875}}$ volts

ⓑ

$$A_a = \begin{bmatrix} 1 & 0 & 0 & -1 & 0 \\ -1 & -1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & -1 & 1 & 1 \end{bmatrix}$$ No of trees $= AA^T$

$= 8$

ⓒ



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

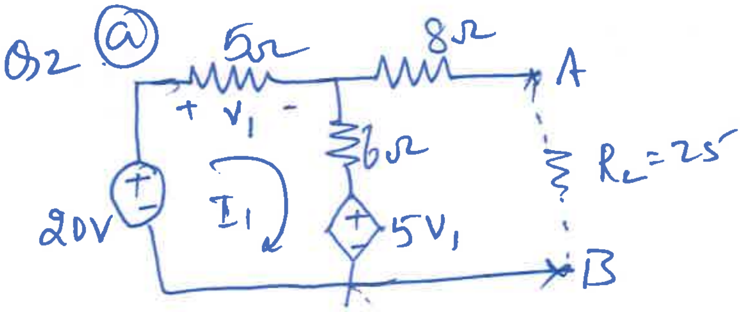
$I_2 = \frac{V_2}{2} + \frac{V_2 - V_1}{5}$

$$\begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} = \begin{bmatrix} 7/10 & -1/5 \\ -1/5 & 7/10 \end{bmatrix}$$

ⓓ i) $P(s) = s^4 + 7s^3 + 6s^2 + 21s + 8 \Rightarrow$ Hurwitz

ii) $P(s) = s^5 + 2s^3 + s \Rightarrow$ Hurwitz.

Q2 ⓐ



$V_1 = 5I_1$

To find V_{th}

$11I_1 + 5V_1 = 20$

$11I_1 + 5(5I_1) = 20$

$I_1 = \frac{20}{36} = \frac{5}{9}$

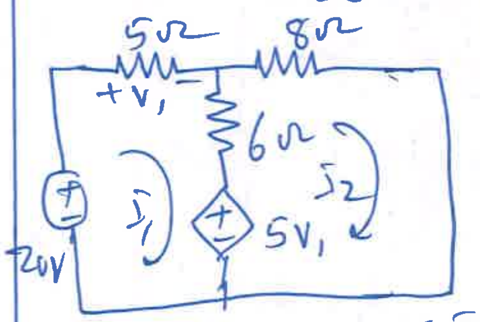
$V_{AB} = V_{th} = 20 - 5I_1$

$\underline{\underline{V_{th} = 17.22V}}$

$P_{25\Omega} = 6.48$ watts.

Q2

To find I_{sc}



$I_2 = I_{sc}$, $V_1 = 5I_1$

$11I_1 - 6I_2 + 5V_1 = 20$

$11I_1 - 6I_2 + 5 \times 5I_1 = 20$

$36I_1 - 6I_2 = 20$

$-6I_1 + 14I_2 - 5V_1 = 0$

$-6I_1 + 14I_2 - 5 \times 5I_1 = 0$

$-31I_1 + 14I_2 = 0$

$\underline{\underline{I_{sc} = I_2 = 1.95 \text{Amps}}}$

ⓒ $i(0^+) = 0$, $\frac{di}{dt}(0^+) = 2 \times 10^3 A/S$

$$\frac{d^2i}{dt^2} = -4 \times 10^6 A/S^2$$

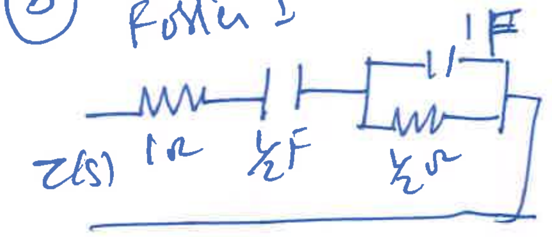
ⓑ $$\begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} = \begin{bmatrix} 5/3 & 2/3 \\ -2/3 & 5/6 \end{bmatrix}$$

Q3 a) 03

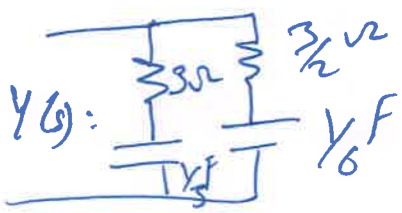
$$B = \begin{array}{c|ccccccccc} & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ \hline 6 & 1 & 1 & 1 & -1 & -1 & 1 & 0 & 0 & 0 \\ 7 & 0 & -1 & -1 & 1 & 0 & 0 & 1 & 0 & 0 \\ 8 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 9 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 1 \end{array}$$

$$Q = \begin{array}{ccccccccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ \hline 1 & 0 & 0 & 0 & 0 & -1 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 & 0 & -1 & 1 & -1 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & -1 & 0 & -1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & -1 \end{array}$$

Q3 ⓑ Foster I



Foster-II



Q4 ⓐ $i(t) = 6e^{-\frac{3}{4}t}$

Current becomes half at t = 0.924 sec.

ⓑ $z(s) = \dfrac{20s^2+27s+5}{2s^2+5s+1}$

ⓒ Proof.

Q5 ⓐ $\begin{bmatrix} A' & B' \\ C' & D' \end{bmatrix} = \begin{bmatrix} 41/9 & 20/3 \\ 8/9 & 5/3 \end{bmatrix}$

$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 26.68 & 41.48 \\ 5.53 & 8.7 \end{bmatrix}$

5 ⓑ $F(s) = \dfrac{s^2+6s+5}{s^2+9s+14}$

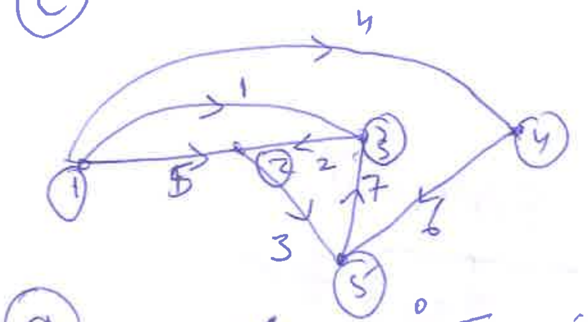
I test Nr - HWZ, Dn - HWZ.

II Not required

III $m_1 m_2 - n_1 n_2 = w^4 + 35w^2 + 70$ always +ve

$\therefore$ F(s) PR.

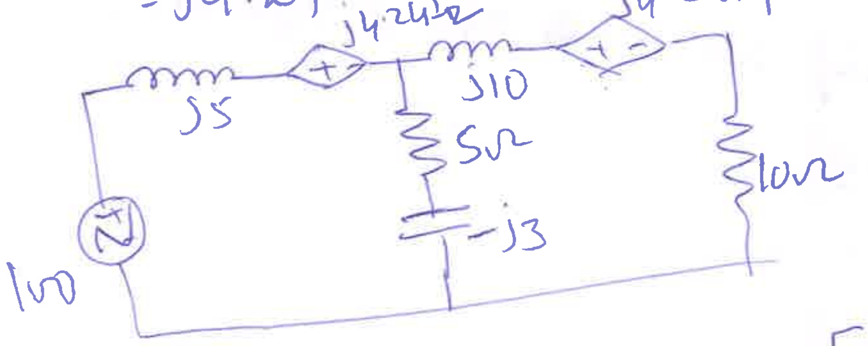
Q5 ⓒ



Q6 ⓐ K = 0.6 j5, j10

$M = K\sqrt{5 \times 10}$

$= j4.24$

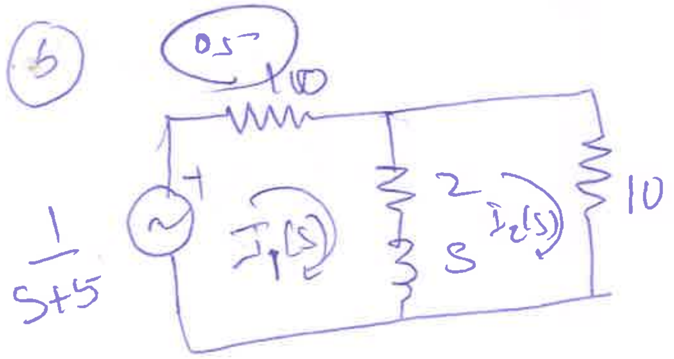


$$\begin{bmatrix} (5+j2) & (-5+j7.24) \\ (-5+j7.24) & (15+j7) \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 100 \\ 0 \end{bmatrix}$$

$I_1 = 8.57 - 5.4j$

$I_2 = -2.07 - 4.97j$

6 ⓑ



$$\begin{bmatrix}(s+12) & -(s+2)\\ -(s+2) & (s+12)\end{bmatrix}\begin{bmatrix}I_1(s)\\ I_2(s)\end{bmatrix}=\begin{bmatrix}\frac{1}{s+5}\\ 0\end{bmatrix}$$

$$I_2(s)=\frac{s+2}{20(s+5)(s+7)}=\frac{-3/40}{s+5}+\frac{5/40}{s+7}$$

$$i_2(t)=-\frac{3}{40}e^{-5t}+\frac{5}{40}e^{-7t}$$