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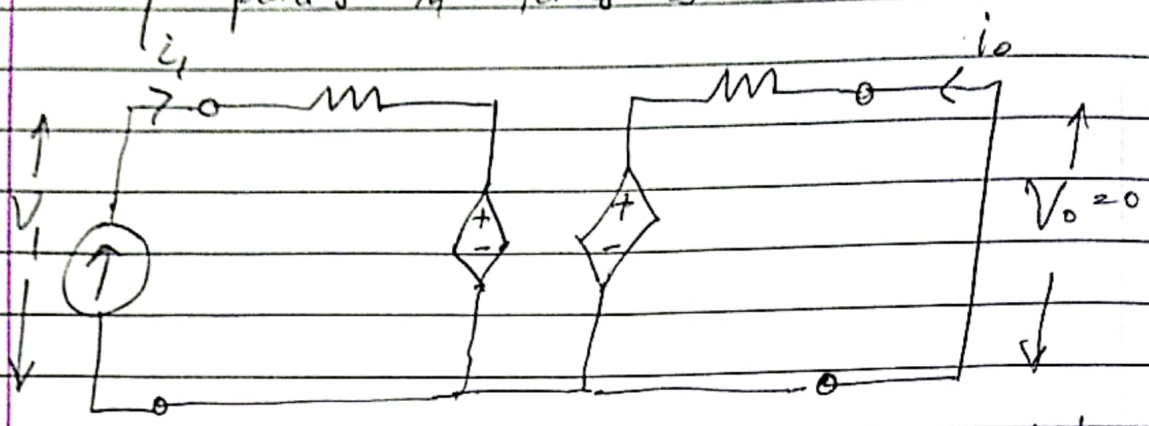
19MS151

PS-3 PH3104 Circuit analysis

PAGE NO.:
DATE / /

2. Y para's in terms of Z



$$Y_1 = \left.\frac{i_1}{V_1}\right|_{V_o=0}, \quad Y_r = \left.\frac{i_1}{V_o}\right|_{V_1=0}, \quad Y_f = \left.\frac{i_o}{V_1}\right|_{V_o=0}$$

$$Y_o = \left.\frac{i_o}{V_o}\right|_{V_1=0}$$

for $V_1 = 0 = z_o i_o + z_f i_1$

$$\Rightarrow i_o = -\frac{z_f}{z_o} i_1$$

$$V_1 = z_f i_1 + z_r i_o = z_1 i_1 + z_r\left(-\frac{z_f}{z_o}\right) i_1$$

$$= \left(\frac{z_1 z_o - z_r z_f}{z_o}\right) i_1$$

$$Y_f = \frac{i_o}{V_1} = \frac{z_f}{z_r z_f - z_1 z_o}, \quad Y_i = \frac{i_1}{V_1} = \frac{z_o}{z_1 z_o - z_r z_f}$$

Now $i_1 = -\frac{z_r}{z_1} i_o$

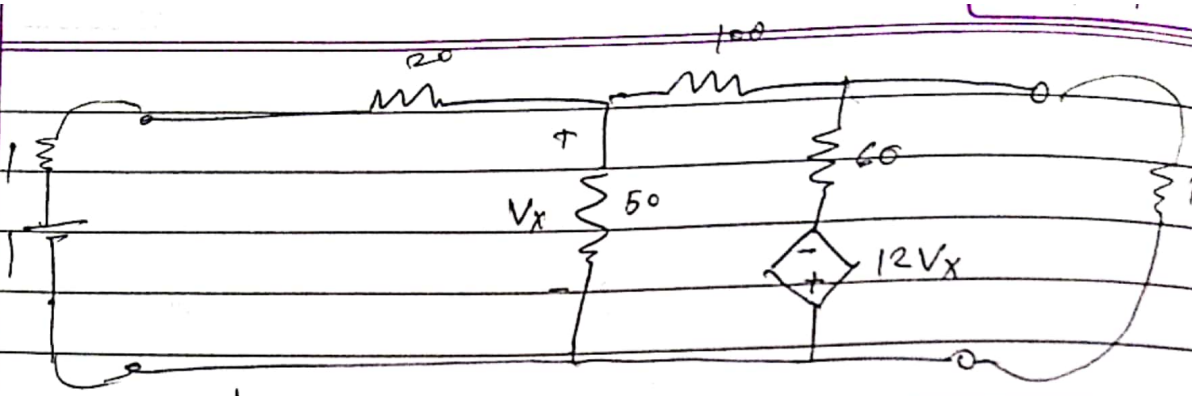
$$V_o = z_f i_1 + z_o i_o$$

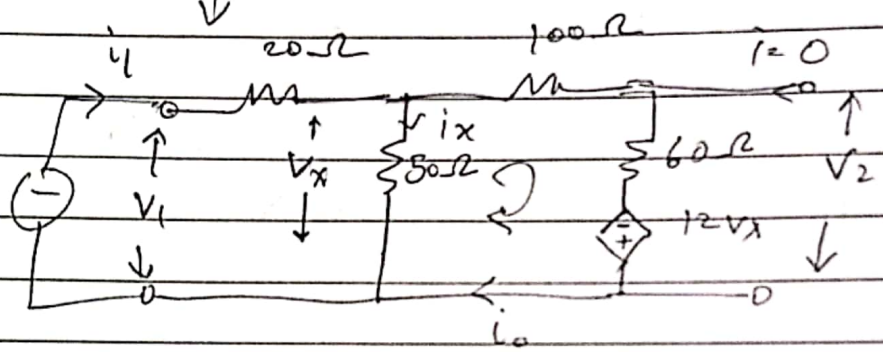
$$= \left(\frac{z_o z_1 - z_r z_f}{z_1}\right) i_o$$

$$Y_o = \frac{i_o}{V_o} = \frac{z_1}{z_o z_1 - z_r z_f}, \quad Y_r = \frac{z_r}{z_r z_f - z_o z_1}$$

So we get y factors from Z factors.

Q3





$i_o = i_1 - i_x$.

$100(i_1 - i_x) - 50i_x + 60(i_1 - i_x) - 600 i_x = 0$.

~~(~~$12V_x = 600\, i_x$).

$\Rightarrow 160 i_1 - 810 i_x = 0$

$\Rightarrow i_x = \frac{16}{81} i_1$.

$V_1 - V_x + 20 i_1 = 50 i_x + 20 i_1 = \left(20 + \frac{16}{81}\right) i_1$

$= 29.87\, i_1$

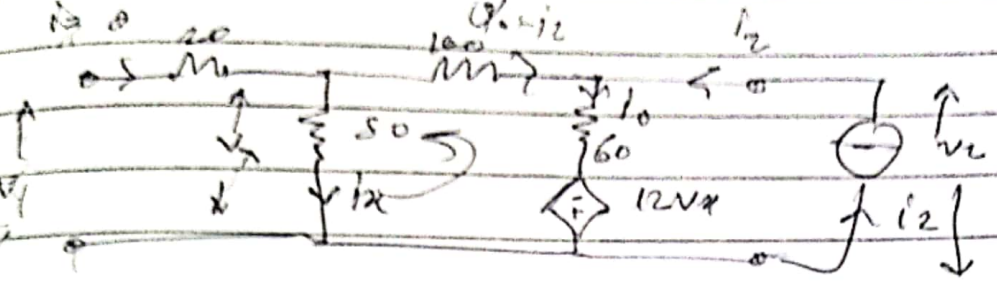
$V_2 = 60 i_1 - 660 i_x = \left(60 - 660 \cdot \frac{16}{81}\right) i_1$

$= -70.37\, i_1$

$\Rightarrow z_{11} = \left.\frac{\partial V_1}{\partial i_1}\right|_{i_2=0} = 29.87\ \Omega$

$z_{21} = -70.37\ \Omega$

Now second config



$100 i_x + 50 i_x + 12(50 i_x) - 60(i_2 - i_x) = 0$

$\Rightarrow i_x = \frac{2}{27} i_2$

$V_2 = i_x 50 + 100 i_x$

$= 150 \cdot \frac{2}{27} i_2 = 11.11 i_2$

$V_1 = (20\Omega) 0 + 50 i_x$

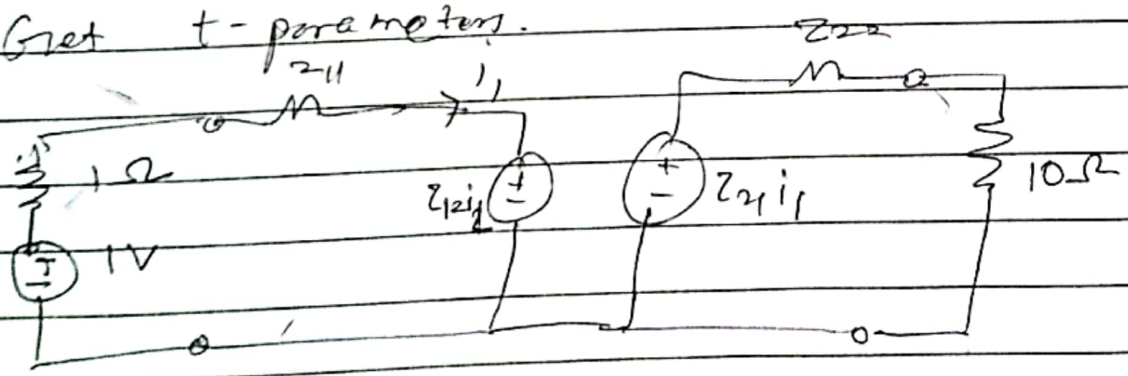
$= 50 \cdot \frac{2}{27} i_2 = 3.703 i_2$

$\Rightarrow z_{22} = 11.11 \ \Omega$

$z_{12} = 3.703 \ \Omega$

$$z = \begin{pmatrix} 29.87 & 3.703 \\ -70.37 & 11.11 \end{pmatrix}$$

Get t-parameters.



$\Rightarrow z_{11} i_1 + z_{12} i_2 - 1 + i_1 = 0$

and $z_{22} i_2 + z_{21} i_1 + 10 i_2 = 0$

$\Rightarrow 30.87 i_1 + 3.703 i_2 = 1$

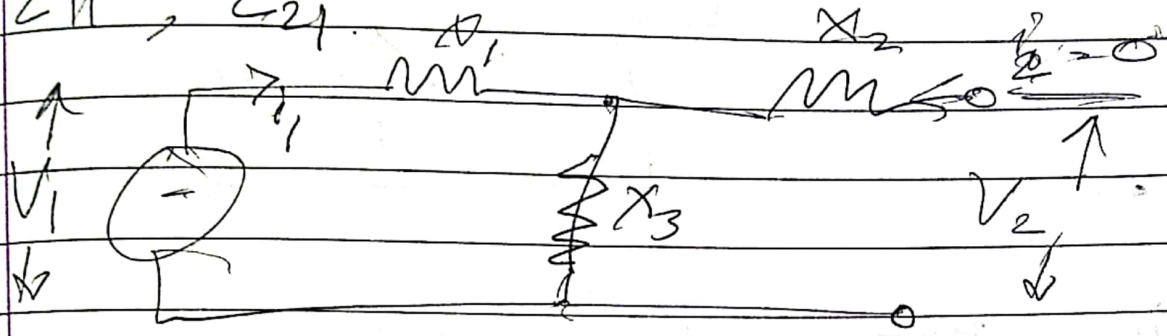
$z_{11} i_2 + -70.37 i_1 = 0$

$\Rightarrow i_1 = 0.023A, \ i_2 = 0.07 A.$

Current from 10Ω is 23 mA. and 10Ω is 7 mA.

4) Calculate Z-factors.

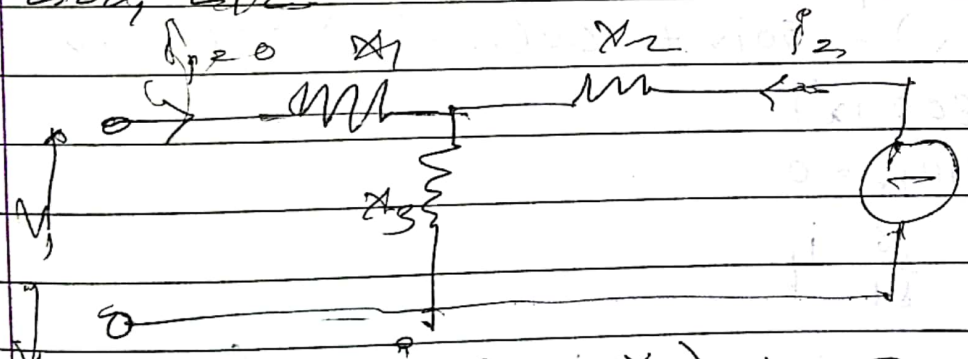
Z_{11}, Z_{21}



$V_1 = i_1(X_1 + X_3)$ $\quad V_2 = I_1 X_3$

$\Rightarrow Z_{11} = X_1 + X_3$ & $Z_{21} = X_3$.

Z_{22}, Z_{12}



$V_2 = i_2(X_2 + X_3) \Rightarrow Z_{22} = X_2 + X_3$

$V_1 = i_2(X_3) \quad Z_{12} = X_3$