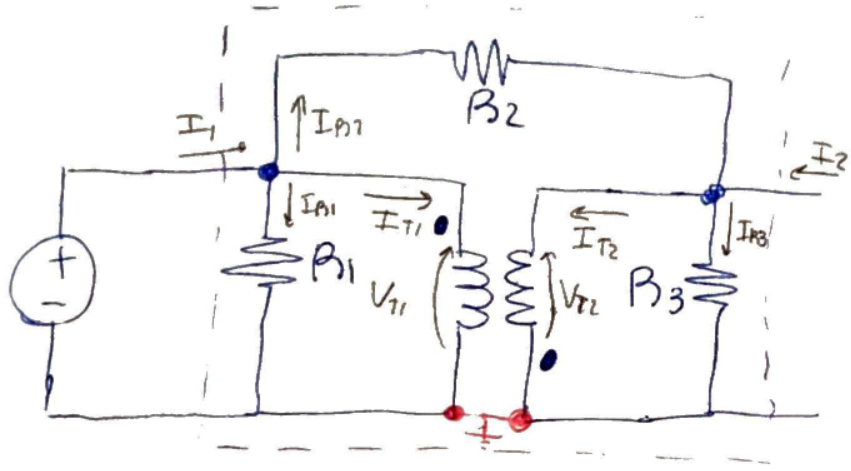
TS6

1)



$V_{T1} = -a V_{T2}$

$I_{T1} = \frac{1}{a} I_{T2}$

$V = Z I$

$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2=0} \quad Z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0}$

$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0} \quad Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0}$

$\underline{I_2 = 0}$

$V_{T1} = V_1$

$V_{T2} = -a V_1$

$I_{T2} = I_{R2} - I_{R3}$

$I_{T2} = \frac{V_1 + a V_1}{R_2} + \frac{a V_1}{R_3}$

$I_{T2} = V_1 \cdot \left(\frac{a+1}{R_2} + \frac{a}{R_3}\right)$

$I_{T1} = V_1 \cdot \left(\frac{1+a}{R_2} + \frac{1}{R_3}\right)$

$\underline{I_1 = 0}$

$V_{T1} = V_1$

$V_{T2} = -a V_1$

$I_{R2} = \frac{V_1 + a V_1}{R_2}$

$I_{T1} = -I_{R1} - I_{R2}$

$I_{T2} = a \cdot I_{T1}$

$I_{T2} = -a V_1 \left(\frac{1}{R_1} + \frac{1+a}{R_2}\right)$

$I_{R3} = \frac{V_2}{R_3} = -\frac{V_1}{R_3 a}$

$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2=0} = \frac{V_1}{V_1 \cdot \frac{1}{R_1} + I_{T1} + I_{R2}}$

$Z_{11} = \frac{V_1}{V_1 \cdot \frac{1}{R_1} + V_1 \cdot \left(\frac{1+\frac{1}{a}}{R_2} + \frac{1}{R_3}\right) + V_1 \cdot \left(\frac{1+a}{R_2}\right)}$

$Z_{11} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_3} + \frac{2+a+\frac{1}{a}}{R_2}}$

$\boxed{Z_{11} = \frac{3}{10}\,\Omega}$

$Z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0} = \frac{V_1}{I_{R3} + I_{T2} - I_{R2}} = \frac{V_1}{-\frac{V_1}{R_3 a} - a V_1\left(\frac{1}{R_1} + \frac{1+a}{R_2}\right) - \frac{V_1 + a V_1}{R_2}}$

$Z_{12} = \frac{1}{-\frac{1}{R_3 a} - \frac{a}{R_1} - \frac{a^2 + 1 + 2a}{R_2}}$

$\boxed{Z_{12} = -\frac{3}{10}\,\Omega}$

$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0} = \frac{V_2}{V_1}\left.\frac{V_1}{I_1}\right|_{I_2=0} = -a \left.\frac{V_1}{I_1}\right|_{I_2=0} = -a Z_{11}$

$\boxed{Z_{21} = -\frac{3}{10}\,\Omega}$

$Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0} = \frac{V_2}{V_1}\left.\frac{V_1}{I_2}\right|_{I_1=0} = -a Z_{12}$

$\boxed{Z_{22} = \frac{3}{10}\,\Omega}$

$$\boxed{Z = \begin{pmatrix} 0.3\,\Omega & -0.3\,\Omega \\ -0.3\,\Omega & 0.3\,\Omega \end{pmatrix}}$$