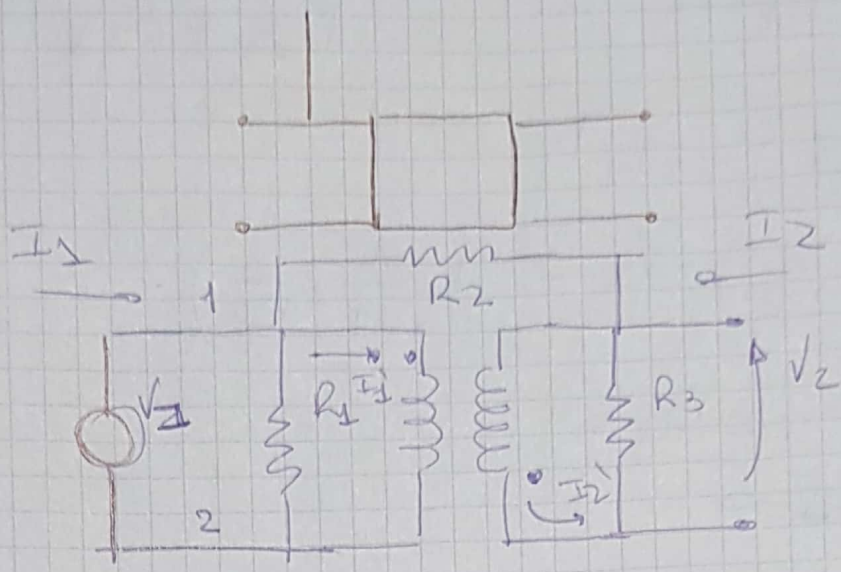


$$I_1 = \frac{V_1}{R_1} + \frac{V_1 - V_2}{R_2} + I_1'$$

$$I_2 = \frac{V_2}{R_3} + \frac{V_2 - V_1}{R_2} + I_2'$$

$$I_1 = V_1\left(\frac{1}{R_1} + \frac{2}{R_2}\right) + I_1'$$

$$I_2 = \left(\frac{1}{R_3} + \frac{2}{R_2}\right)V_2 + I_2'$$

$$z_{11} = \frac{V_1}{I_1}\Big|_{I_2=0}$$

$$-\frac{V_2}{V_1}\left(\frac{1}{R_3} + \frac{2}{R_2}\right) = \frac{I_2'}{I_1'}$$

$$I_1 = V_1\left(\frac{1}{R_1} + \frac{2}{R_2}\right) + V_1\left(\frac{1}{R_3} + \frac{2}{R_2}\right)$$

$$I_1 = V_1\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$$

$$z_{11} = 0{,}3$$

~~$I_2' = (-I_2')(a)$~~

~~$V_1 = -V_2 \cdot \frac{1}{a}$~~

~~$2 = 1$~~

$$I_1' = \frac{1}{a}\left(-I_2'\right)$$

$$V_1 = -aV_2$$

$2 = 0$

$$I_1' = I_2'$$

$$V_1 = -V_2$$

$$z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0} = -0,3$$ → COMO SON COMPONENTES PASIVOS $z_{12} = z_{21}$

$$-V_1\left(\frac{1}{R_1}+\frac{2}{R_2}\right) = I_1'$$

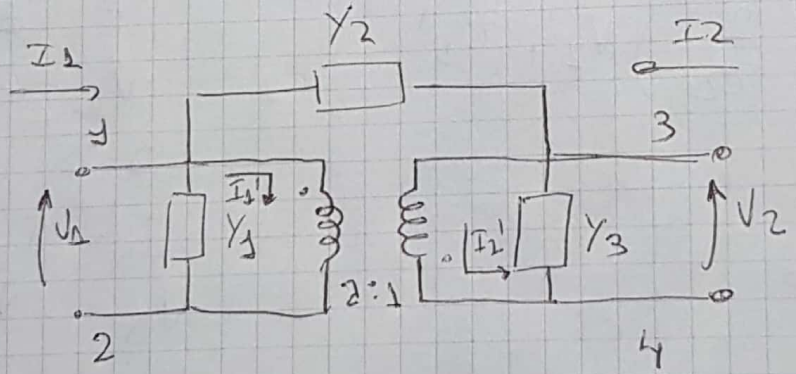
$$I_2 = \left(\frac{1}{R_3}+\frac{2}{R_2}\right)-V_1 - V_1\left(\frac{1}{R_1}+\frac{2}{R_2}\right)$$

$$z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0} = 0,3$$

$$I_2 = \left(\frac{1}{R_3}+\frac{2}{R_2}\right)\cdot V_2 + V_2\left(\frac{1}{R_1}+\frac{2}{R_2}\right)$$

$$\frac{V_2}{I_2} = \frac{1}{\frac{1}{R_3}+\frac{4}{R_2}+\frac{1}{R_1}} = 0,3$$

No solo es RECIPROCO, SINO QUE TAMBIEN ES SIMETRICO.



$$V_1 = -a V_2$$

$$I_1' = \left(-\frac{1}{a}\right)\left(-I_2'\right)$$

$$V_1 Y_1 + (V_1 - V_2)Y_2 + I_1' = I_1$$

$$V_2 Y_3 + (V_2 - V_1)Y_2 + I_2' = I_2$$

NOTA

$$V_1 Y_1 + \left(\frac{1}{a} + \frac{1}{a}\right) V_1 Y_2 + I_1' = I_1$$

$$V_2 Y_3 + (1+a) Y_2 V_2 + I_2' = I_2$$

si $I_2 = 0$

$$-V_2 Y_3 - (1+a) Y_2 V_2 = I_2'$$

$$\frac{V_1}{a}\left(Y_3 + aY_2 + Y_2 a\right) = a I_1'$$

$$V_1 Y_1 + \left(1 + \frac{1}{a}\right) V_1 Y_2 + \frac{V_1}{a^2} Y_3 + \frac{V_1}{a^2} Y_2 + \frac{V_1}{a} Y_2 = I_1$$

$$V_1 Y_1 + \left(\frac{a+1}{a}\right) V_1 Y_2 + \frac{V_1 Y_3}{a^2} + V_1 Y_2 + \frac{V_1 Y_2}{a} = I_1$$

$$V_1\left(Y_1 a^2 + a^2 Y_2 + Y_2 a^2 + Y_3 + Y_2 a^2 + Y_2 a\right) = I_1 a^2$$

$$\frac{V_1}{I_1} = \frac{a^2}{Y_1 a^2 + a^2 Y_2 + a^2 Y_2 + Y_3 + Y_2 a^2 + Y_2 a} = Z_{11}$$

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

$$I_1' = -V_1\left(Y_1 + \left(1 + \frac{1}{a}\right) Y_2\right)$$

$$\frac{1}{a} I_2' = a V_2\left(Y_1 + \left(1 + \frac{1}{a}\right) Y_2\right)$$

$$V_2 Y_3 + (1+a) Y_2 V_2 + a^2 V_2 Y_1 + a^2 Y_2 V_2 + a V_2 Y_2 = I_2$$

$$V_2\left(Y_3 + (1+a) Y_2 + a^2 Y_1 + a^2 Y_2 + a Y_2\right) = I_2$$

$$\frac{V_2}{I_2} = \frac{1}{Y_3 + (1+a) Y_2 + a^2 Y_1 + a^2 Y_2 + a Y_2} = Z_{22}$$

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

$$I_1' = -V_1\left(Y_1 + \left(1+\frac{1}{a}\right)Y_2\right)$$

$$I_2 = V_2 Y_3 + (1+a)Y_2 V_2 + I_2' = 0$$

$$\frac{1}{a} I_2' = -V_1\left(Y_1 + \left(1+\frac{1}{a}\right)Y_2\right)$$

$$I_2 = \frac{-V_1}{a} Y_3 + (1+a)Y_2\left(\frac{-V_1}{a}\right) - aV_1\left(Y_1 + \left(1+\frac{1}{a}\right)Y_2\right)$$

$$I_2 = -V_1\left(Y_3 + (1+a)Y_2 + aY_1 + a\left(1+\frac{1}{a}\right)Y_2\right)$$

$$\frac{V_1}{I_2} = \frac{-1}{Y_3 + (1+a)Y_2 + aY_1 + a\left(1+\frac{1}{a}\right)Y_2} = z_{12}$$

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

$$I_1 = V_1 Y_1 + \left(1+\frac{1}{a}\right)V_1 Y_2 + I_1'$$

$$-V_2\left(Y_3 + (1+a)Y_2\right) = I_2'$$

$$-V_2\left(Y_3 + (1+a)Y_2\right) = aI_1'$$

$$I_1 = -aV_2 Y_1 + \left(1+\frac{1}{a}\right)(-aV_2)Y_2 - \frac{V_2\left(Y_3 + (1+a)Y_2\right)}{a}$$

$$I_1 = -V_2\left(aY_1 + \left(1+\frac{1}{a}\right)aY_2 + \frac{Y_3}{a} + \frac{(1+a)}{a}Y_2\right)$$

$$\frac{}{a^2 Y_1 + \{1 + (1+\frac{1}{a})a^2 Y_2 + Y_3 + (1+a)Y_2\}} = z_{21}$$