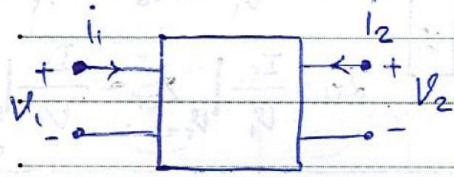
- شبکه های دو دریچه ای (دوقطبی):



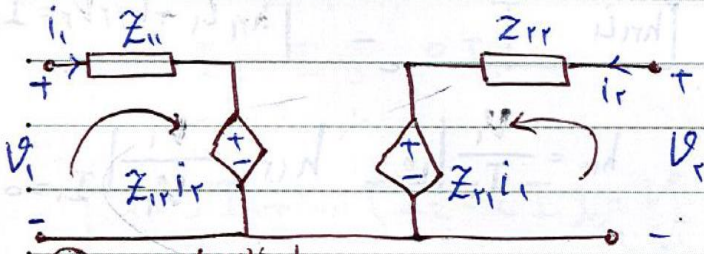
انواع شبکه های دو دریچه ای:

الف: شبکه ی امپدانس Z

ب: " ادمیتانس Y

ج: " هایبرید (مختلط) h

د: " انتقالی T



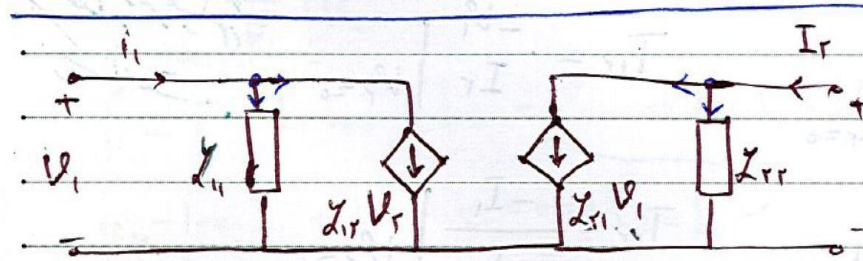
(Z) → واحدشان اهم

$$\begin{cases} Z_{11}i_1 + Z_{12}i_2 = v_1 \\ Z_{21}i_1 + Z_{22}i_2 = v_2 \end{cases}$$

$$\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

$$Z_{11} = \frac{v_1}{I_1}\Big|_{I_2=0} \quad Z_{12} = \frac{v_1}{I_2}\Big|_{i_1=0}$$

$$Z_{21} = \frac{v_2}{I_1}\Big|_{i_2=0} \quad Z_{22} = \frac{v_2}{I_2}\Big|_{I_1=0}$$

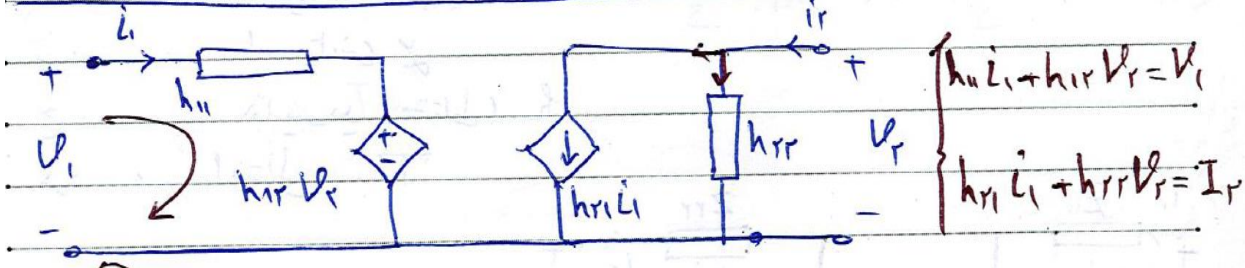


(Y) → واحدشان زیمنس

$$\begin{cases} z_{11} v_1 + z_{12} v_2 = I_1 \\ z_{21} v_1 + z_{22} v_2 = I_2 \end{cases} \qquad \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$$

$$z_{11} = \frac{I_1}{v_1}\Big|_{v_2=0} \quad z_{12} = \frac{I_1}{v_2}\Big|_{v_1=0}$$

$$z_{21} = \frac{I_2}{v_1}\Big|_{v_2=0} \quad z_{22} = \frac{I_2}{v_2}\Big|_{v_1=0}$$



$$\begin{cases} h_{11} i_1 + h_{12} v_2 = v_1 \\ h_{21} i_1 + h_{22} v_2 = I_2 \end{cases}$$

(h)

$$\begin{bmatrix} v_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ v_2 \end{bmatrix}$$

$$h_{11} = \frac{v_1}{I_1}\Big|_{v_2=0} \quad h_{12} = \frac{v_1}{v_2}\Big|_{I_1=0}$$

مقاومت امپدانس

$$h_{21} = \frac{I_2}{I_1}\Big|_{v_2=0} \quad h_{22} = \frac{I_2}{v_2}\Big|_{I_1=0}$$

مقاومت ادمیتانس

سوال امتحان آمپدانس ←

$$\begin{cases} T_{11} v_2 - T_{12} I_2 = v_1 \\ T_{21} v_2 - T_{22} I_2 = I_1 \end{cases} \qquad \begin{bmatrix} v_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} T_{11} & T_{12} \\ T_{21} & T_{22} \end{bmatrix} \begin{bmatrix} v_2 \\ -I_2 \end{bmatrix}$$

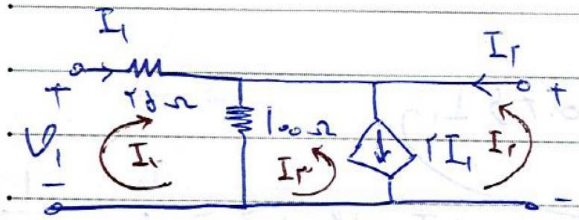
نکته

صفار دترمینان ماتریس است

$$T_{11} = \frac{v_1}{v_2}\Big|_{I_2=0} \quad T_{12} = \frac{-v_1}{I_2}\Big|_{v_2=0}$$

$$T_{21} = \frac{I_1}{v_2}\Big|_{I_2=0} \quad T_{22} = \frac{-I_1}{I_2}\Big|_{v_2=0}$$

ص 41 سوال 11: $\gamma = ?$



$$\begin{cases} 25I_1 + 100(I_1 + I_2) = V_1 \\ 100(I_2 + I_1) = V_2 \\ I_2 - I_3 = 2I_1 \end{cases} \Rightarrow \begin{cases} 125I_1 + 100I_3 = V_1 \\ 100I_1 + 100I_3 = V_2 \\ I_2 - 2I_1 = I_3 \end{cases}$$

$$\begin{cases} 125I_1 + 100(I_2 - 2I_1) = V_1 \\ 100I_1 + 100(I_2 - 2I_1) = V_2 \end{cases}$$

$$\begin{cases} -75I_1 + 100I_2 = V_1 \\ -100I_1 + 100I_2 = V_2 \end{cases}$$

$$\gamma_{11} = \frac{I_1}{V_1}\Big|_{V_2=0}$$

$$\begin{cases} -75I_1 + 100I_2 = V_1 \Rightarrow 25I_1 = V_1 \Rightarrow \gamma_{11} = \frac{I_1}{V_1} = \frac{1}{25} \\ -100I_1 + 100I_2 = 0 \Rightarrow I_2 = I_1 \end{cases}$$

$$= 40\,mS$$

$$y_{11} = \frac{I_1}{V_1}\Big|_{V_2=0}$$

$$\begin{cases} -75 I_1 + 100 I_1 = 0 \Rightarrow I_1 = 0.75 I_1 \\ -100 I_1 + 100 I_1 = V_1 \end{cases} \Rightarrow -25 I_1 = V_2 \Rightarrow y_{12} = \frac{I_1}{V_2} = -\frac{1}{25}$$

$$= -40\,mS$$

$$y_{21} = \frac{I_2}{V_1}\Big|_{V_2=0}$$

$$\begin{cases} -75 I_1 + 100 I_2 = V_1 \\ -100 I_1 + 100 I_2 = 0 \Rightarrow I_1 = I_2 \end{cases} \Rightarrow 25 I_2 = V_1 \Rightarrow y_{21} = \frac{1}{25}$$

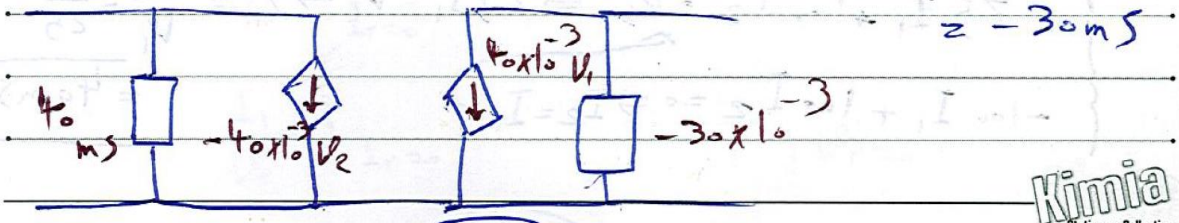
$$= 40\,mS$$

$$y_{22} = \frac{I_2}{V_2}\Big|_{V_1=0}$$

$$\begin{cases} -75 I_1 + 100 I_2 = 0 \Rightarrow I_1 = \frac{4}{3} I_2 \\ -100 I_1 + 100 I_2 = V_2 \end{cases} \Rightarrow \frac{-100}{3} I_2 = V_2 \Rightarrow y_{22} = \frac{I_2}{V_2}$$

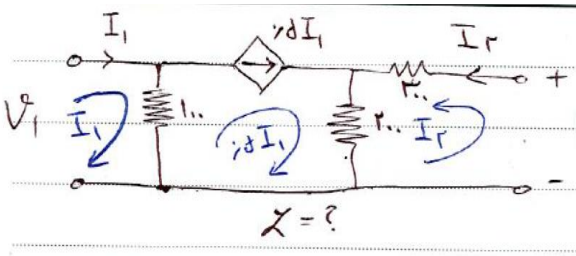
$$= -0.03\,S$$

$$= -30\,mS$$



9a

حل کامل سوال ۱۲:



$$\Rightarrow \begin{cases} V_1 = 100(I_1 - 0.5I_1) \\ V_2 = 200 I_2 + 200(I_2 + 0.5I_1) \end{cases}$$

$$\begin{cases} 5 \cdot I_1 = V_1 \\ 100 I_1 + 50 I_2 = V_2 \end{cases}$$

$$\chi_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0} \quad \begin{cases} 5 \cdot I_1 = V_1 \Rightarrow \chi_{11} = \frac{I_1}{V_1} = \frac{1}{50} = 20\,mS \\ 100 I_1 + 50 I_2 = 0 \end{cases}$$

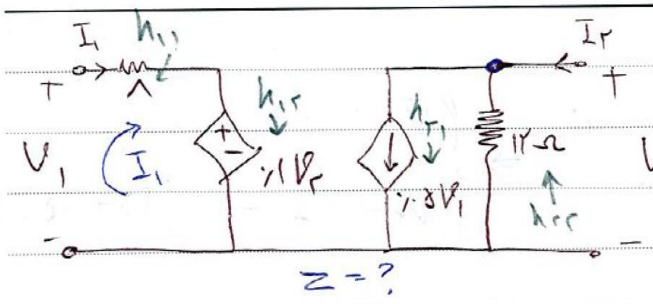
$$\chi_{12} = \left.\frac{I_1}{V_2}\right|_{V_1=0} \quad \begin{cases} 5 \cdot I_1 = 0 \Rightarrow I_1 = 0 \Rightarrow \chi_{12} = \frac{I_1}{V_2} = \frac{0}{V_2} = 0 \\ 100 I_1 + 50 I_2 = V_2 \end{cases}$$

$$\chi_{21} = \left.\frac{I_2}{V_1}\right|_{V_2=0} \quad \begin{cases} 5 \cdot I_1 = V_1 \Rightarrow -25 \cdot I_2 = V_1 \Rightarrow \chi_{21} = \frac{I_2}{V_1} = -\frac{1}{25} = -4\,mS \\ 100 I_1 + 50 I_2 = 0 \Rightarrow I_1 = -5 I_2 \end{cases}$$

$$\chi_{22} = \left.\frac{I_2}{V_2}\right|_{V_1=0} \quad \begin{cases} 5 \cdot I_1 = 0 \Rightarrow I_1 = 0 \\ 100 I_1 + 50 I_2 = V_2 \Rightarrow 50 \cdot I_2 = V_2 \Rightarrow \end{cases}$$

$$\chi_{22} = \frac{I_2}{V_2} = \frac{1}{50} = 2\,mS$$

ص ۴۲ سوال ۲۴:



$$\begin{cases} 8I_1 + 0.1V_2 = V_1 \\ 0.5V_1 + \frac{V_2}{12} = I_2 \end{cases} \leftarrow \times 12$$

$$\boxed{\begin{aligned} 8I_1 + 0.1V_2 &= V_1 \\ 0.4V_1 + V_2 &= 12I_2 \end{aligned}}$$

$$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2=0} \quad \begin{cases} 8I_1 + 0.1V_2 = V_1 \\ 0.4V_1 + V_2 = 0 \Rightarrow V_2 = -0.4V_1 \end{cases} \Rightarrow 8I_1 - 0.04V_1 = V_1$$

$$\Rightarrow 8I_1 = 1.04V_1 \Rightarrow Z_1 = \frac{V_1}{I_1} = \frac{8}{1.04} = \boxed{7.69\ \Omega}$$

$$Z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0} \quad \begin{cases} 0.1V_2 = V_1 \Rightarrow V_2 = 10V_1 \\ 0.4V_1 + V_2 = 12I_2 \end{cases} \Rightarrow 0.4V_1 + 10V_1 = 12I_2$$

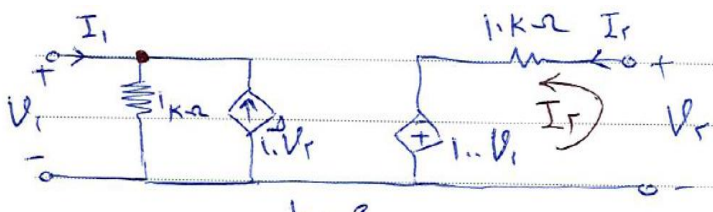
$$\Rightarrow 10.4V_1 = 12I_1 \Rightarrow Z_{12} = \frac{V_1}{I_2} = \frac{12}{10.4} = \boxed{1.15\ \Omega}$$

$$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0} \quad \begin{cases} 8I_1 + 0.1V_2 = V_1 \\ 0.4V_1 + V_2 = 0 \Rightarrow V_1 = -2.5V_2 \end{cases} \Rightarrow 8I_1 + 0.1V_2 = -2.5V_2$$

$$\Rightarrow 8I_1 = -2.6V_2 \Rightarrow Z_{21} = \frac{V_2}{I_1} = -\frac{8}{2.6} = \boxed{-3.08\ \Omega}$$

$$Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0} \quad \begin{cases} 0.1V_2 = V_1 \\ 0.4V_1 + V_2 = 12I_2 \end{cases} \Rightarrow 0.4V_2 + V_2 = 12I_2 \Rightarrow$$

$$1.4V_2 = 12I_2 \Rightarrow Z_{22} = \frac{V_2}{I_2} = \frac{12}{1.4} = \boxed{8.57\ \Omega}$$



$$\begin{cases} I_1 = \frac{V_1}{10^3} - 10^{-5} V_2 \\ V_2 = 10^3 I_2 - 10 V_1 \end{cases}$$

$h = ?$

$$\begin{cases} V_1 - 0.1 V_2 = 10^3 I_1 \\ V_2 = 10^3 I_2 - 10 V_1 \end{cases}$$

$$h_{11} = \frac{V_1}{I_1}\Big|_{V_2=0} \quad \begin{cases} V_1 = 10^3 I_1 \Rightarrow h_{11} = \frac{V_1}{I_1} = 10^3\,\Omega \\ 10^3 I_2 - 10 V_1 = 0 \end{cases}$$

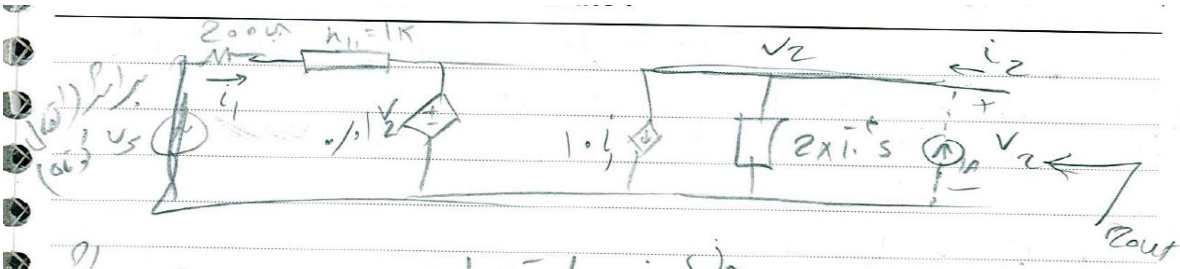
$$h_{12} = \frac{V_1}{V_2}\Big|_{I_1=0} \quad \begin{cases} V_1 - 0.1 V_2 = 0 \Rightarrow h_{12} = \frac{V_1}{V_2} = 0.1 \\ V_2 = 10^3 I_2 - 10 V_1 \end{cases}$$

$$h_{21} = \frac{I_2}{I_1}\Big|_{V_2=0} \quad \begin{cases} V_1 = 10^3 I_1 \\ 10^3 I_2 - 10 V_1 = 0 \end{cases} \Rightarrow 10^3 I_2 - 10^4 I_1 = 0$$

$$\Rightarrow 10^3 I_2 = 10^4 I_1 \Rightarrow h_{21} = \frac{I_2}{I_1} = \frac{10^4}{10^3} = 10$$

$$h_{22} = \frac{I_2}{V_2}\Big|_{I_1=0} \quad \begin{cases} V_1 - 0.1 V_2 = 0 \Rightarrow V_1 = 0.1 V_2 \\ V_2 = 10^3 I_2 - 10 V_1 \end{cases} \Rightarrow V_2 = 10^3 I_2 - V_2$$

$$2 V_2 = 10^3 I_2 \Rightarrow h_{22} = \frac{I_2}{V_2} = \frac{2}{10^3} = 2 \times 10^{-3}\ S$$



برای تعیین Z_{out} چون منبع وابسته داریم منبع مستقل برمیداریم

و از خروجی یک منبع 1A میگذاریم و با تعیین V_2 داریم:

$$Z_{out} = \frac{V_2}{1A}$$

$$1A = V_2 \times 2\times10^{-4} + 10i_1$$

$$200i_1 + 0.1V_2 = 0 \longrightarrow V_2 = 8.57K\Omega$$

$$Z_{out} = \frac{V_2}{1A} = 8.57\ K\Omega$$