

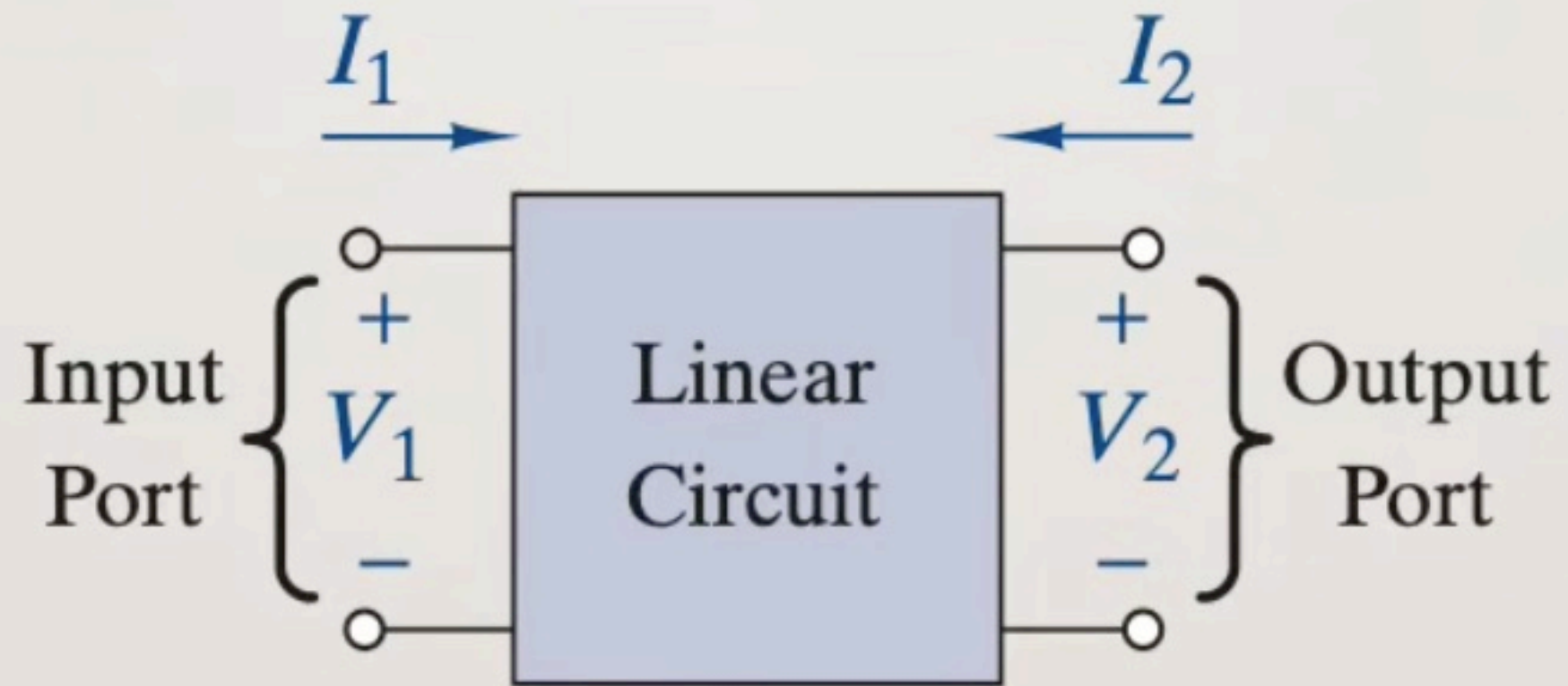
# TWO-PORT NETWORKS

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Z, Y, T, H

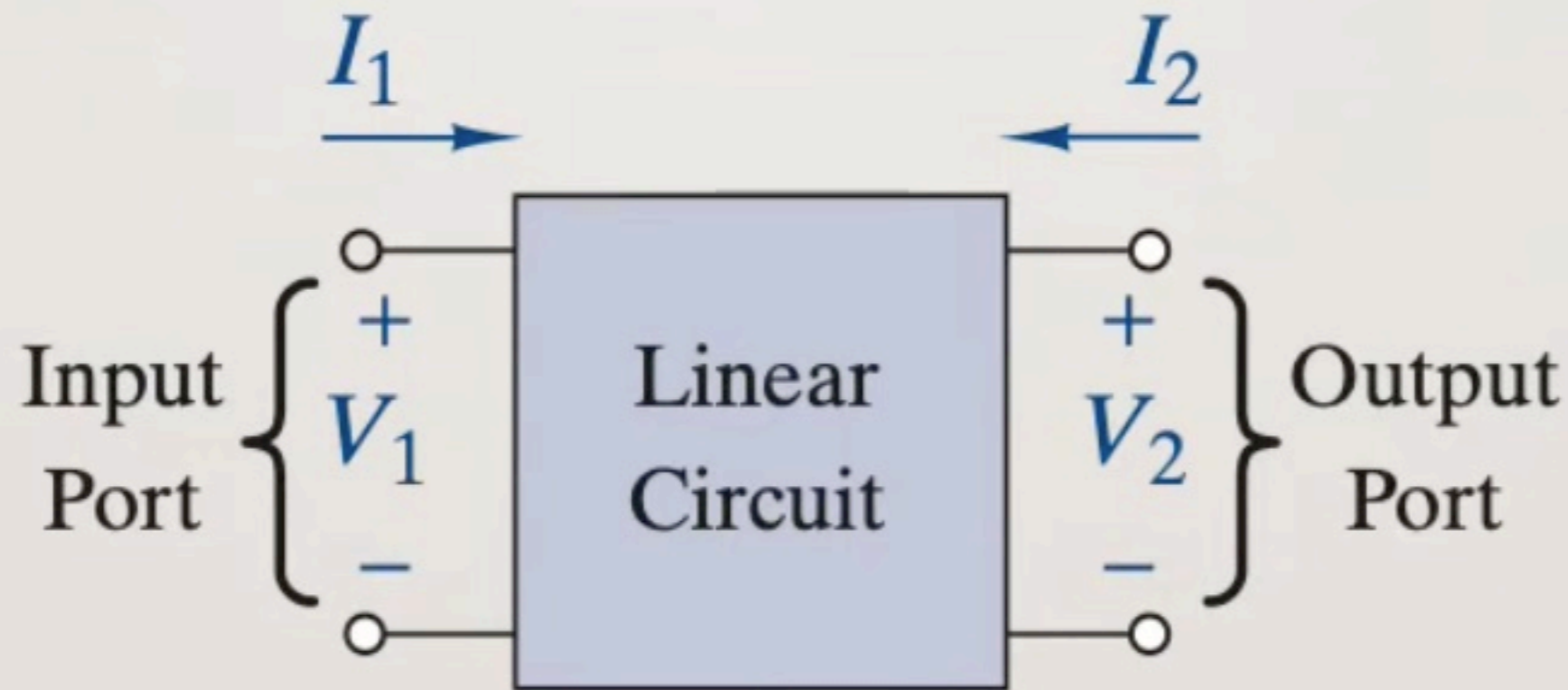
# CONCEPTO BASICO

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# PARAMETROS DE IMPEDANCIA, Z

Voltajes se suman en serie



$$V_1 = z_{11}I_1 + z_{12}I_2$$

$$V_2 = z_{21}I_1 + z_{22}I_2$$

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = [\mathbf{z}] \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

# DETERMINANDO LOS PARAMETROS Z

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

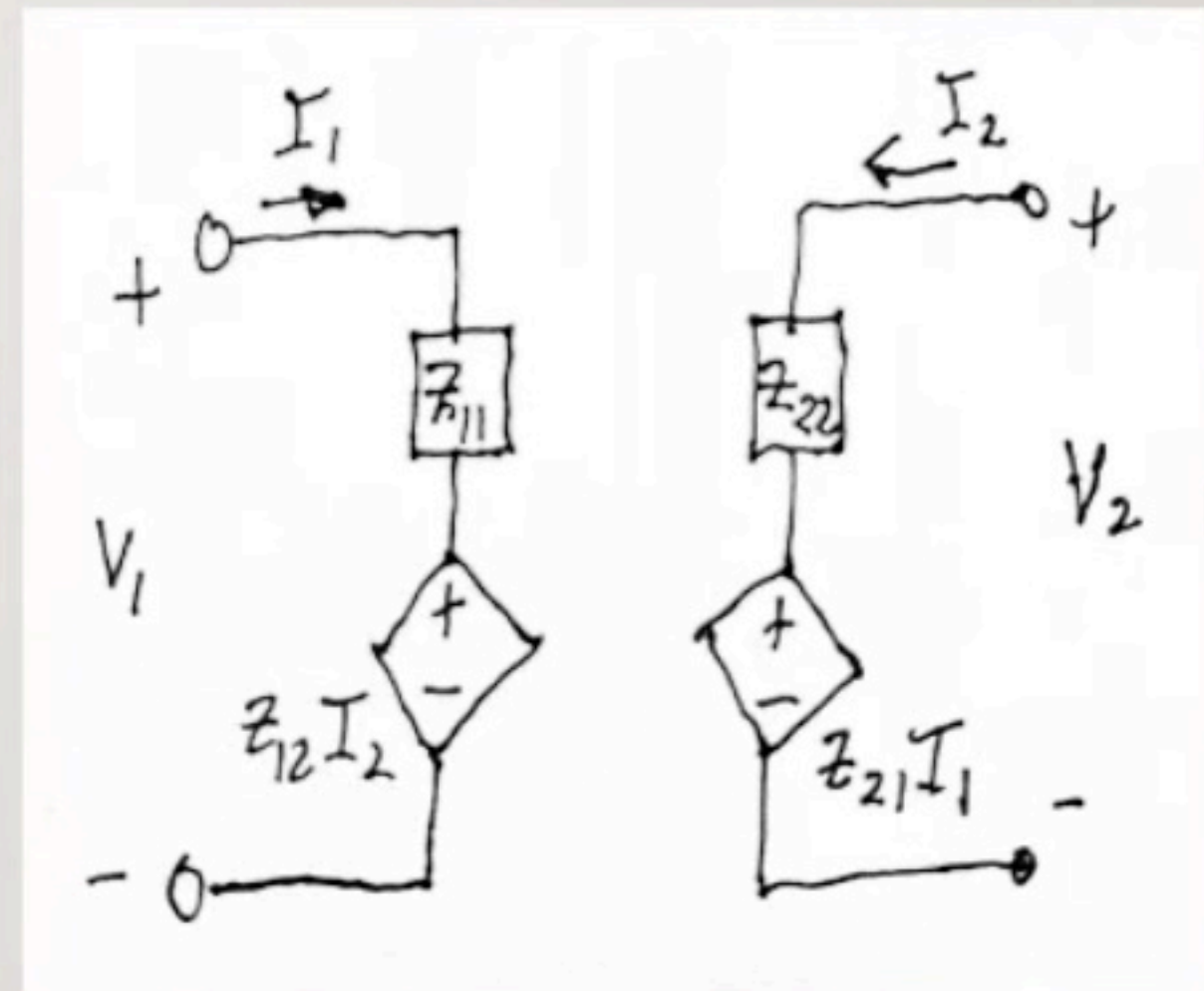
$$z_{12} = \left. \frac{V_1}{I_2} \right|_{I_1=0}$$

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

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

$$V_1 = z_{11}I_1 + z_{12}I_2$$

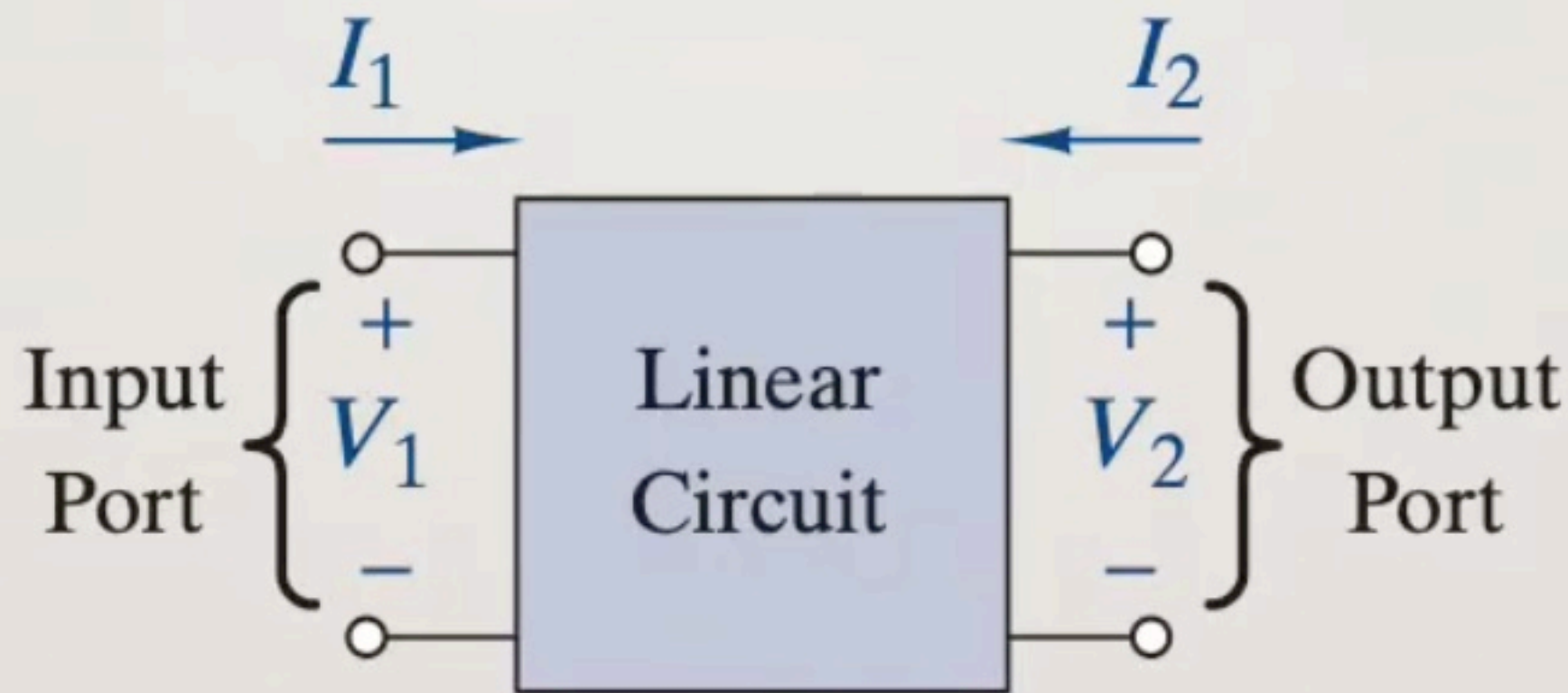
$$V_2 = z_{21}I_1 + z_{22}I_2$$





# PARAMETROS DE ADMITANCIA, Y

Corrientes se suman en paralelo



PC3105\_3\_1

$$I_1 = y_{11}V_1 + y_{12}V_2$$

$$I_2 = y_{21}V_1 + y_{22}V_2$$

$$Y = Z^{-1}$$

$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = [\mathbf{y}] \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$

# DETERMINANDO LOS PARAMETROS Y

$$y_{11} = \left. \frac{I_1}{V_1} \right|_{V_2=0}$$

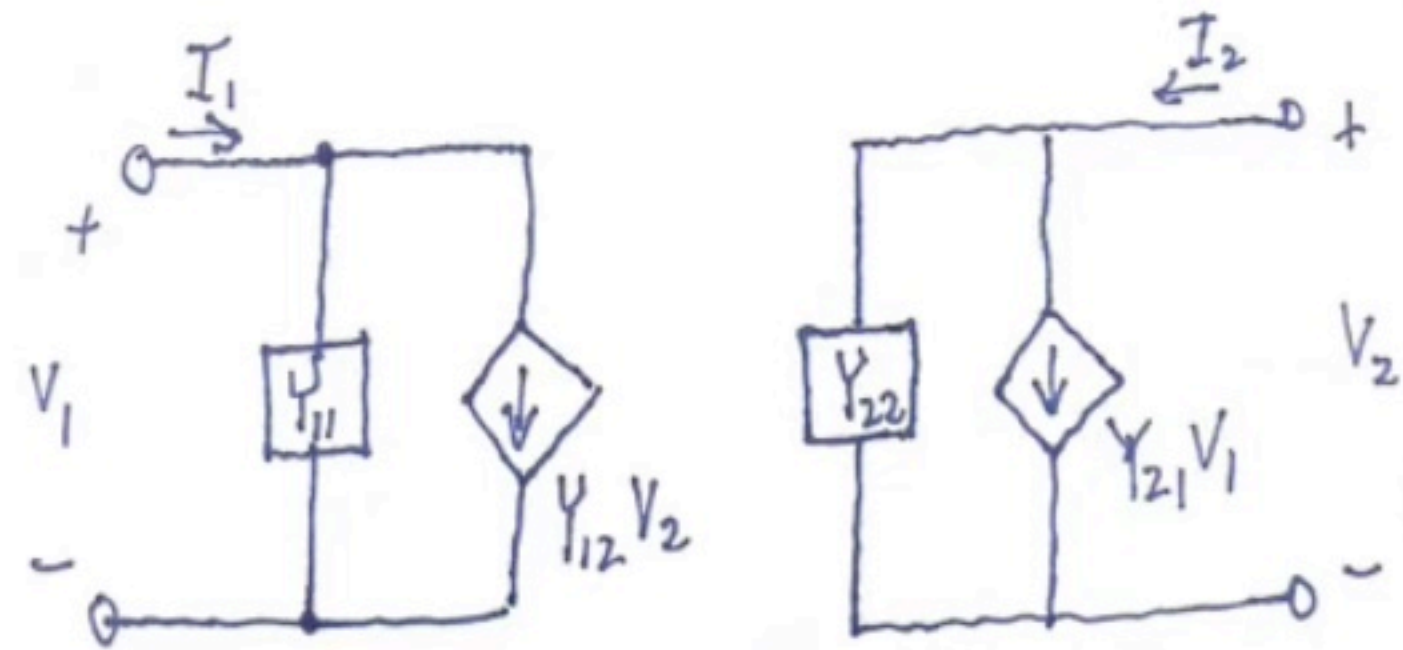
$$y_{12} = \left. \frac{I_1}{V_2} \right|_{V_1=0}$$

$$I_1 = y_{11}V_1 + y_{12}V_2$$

$$I_2 = y_{21}V_1 + y_{22}V_2$$

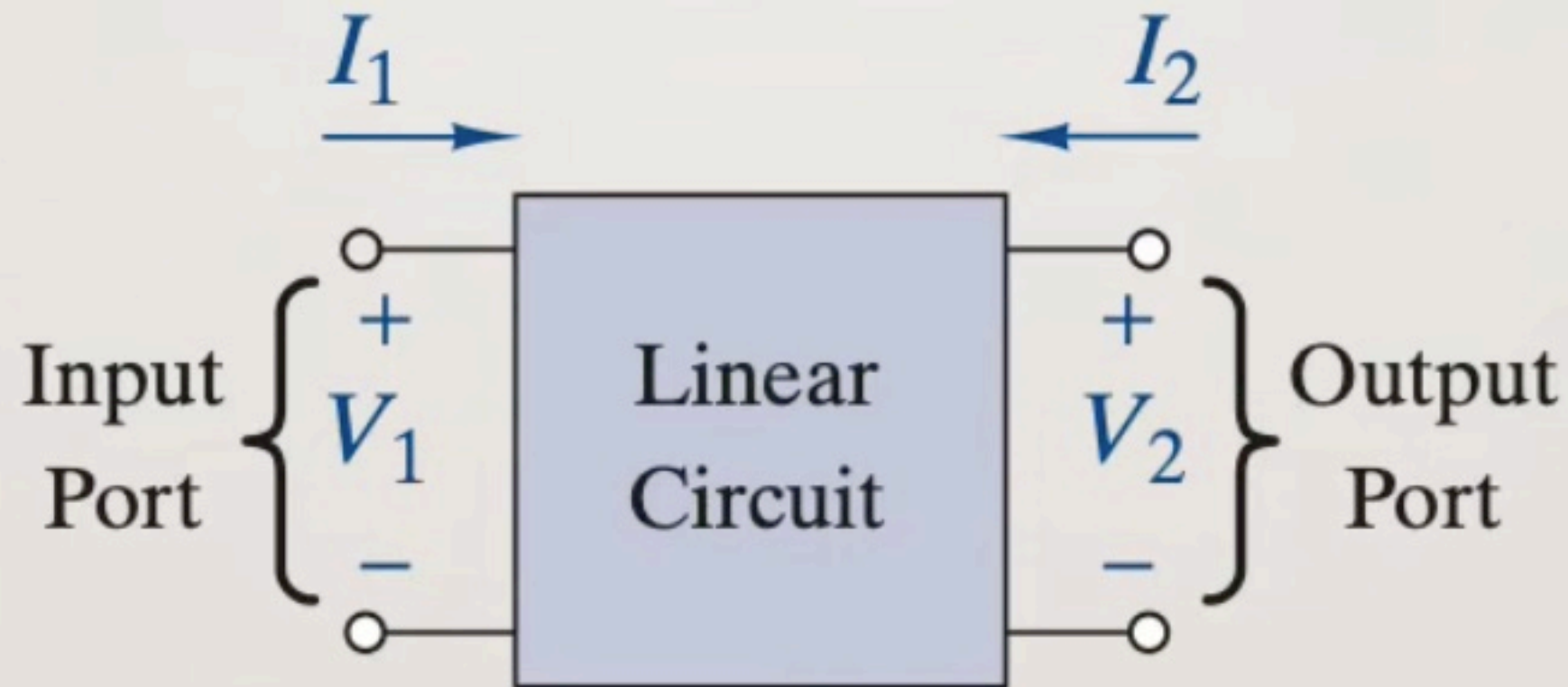
$$y_{21} = \left. \frac{I_2}{V_1} \right|_{V_2=0}$$

$$y_{22} = \left. \frac{I_2}{V_2} \right|_{V_1=0}$$



# PARAMETROS DE TRANSMISION, T

Transmision ocurre en casacada



$$V_1 = AV_2 - BI_2$$

$$I_1 = CV_2 - DI_2$$

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix} = [\mathbf{t}] \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$$



# DETERMINANDO LOS PARAMETROS T

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$$A = \left. \frac{V_1}{V_2} \right|_{-I_2=0}$$

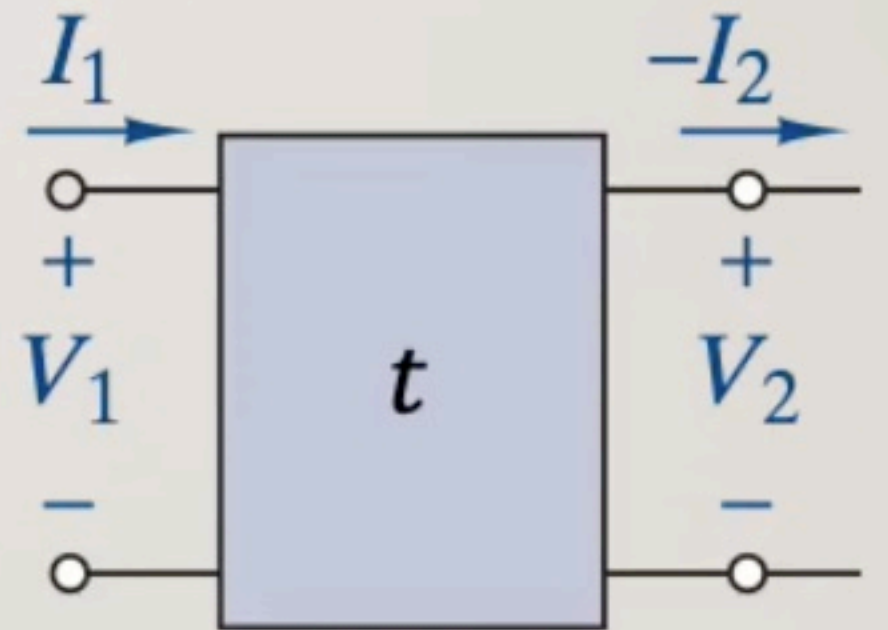
$$B = \left. \frac{V_1}{-I_2} \right|_{V_2=0}$$

$$V_1 = AV_2 - BI_2$$

$$I_1 = CV_2 - DI_2$$

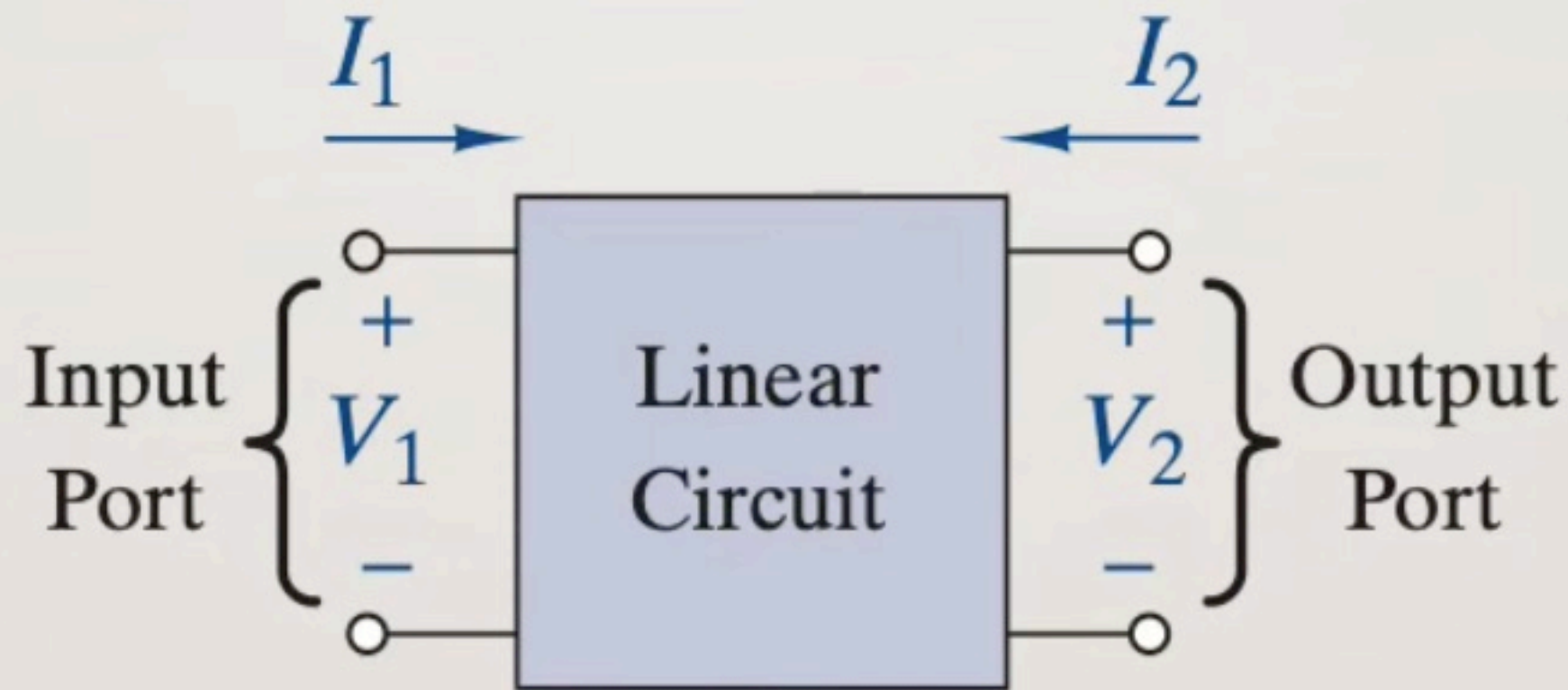
$$C = \left. \frac{I_1}{V_2} \right|_{-I_2=0}$$

$$D = \left. \frac{I_1}{-I_2} \right|_{V_2=0}$$





# PARAMETROS HIBRIDOS, H



$$V_1 = h_{11}I_1 + h_{12}V_2$$

$$I_2 = h_{21}I_1 + h_{22}V_2$$

$$\begin{bmatrix} V_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ V_2 \end{bmatrix} = [\mathbf{h}] \begin{bmatrix} I_1 \\ V_2 \end{bmatrix}$$

# DETERMINANDO LOS PARAMETROS H

$$h_{11} = \left. \frac{V_1}{I_1} \right|_{V_2=0}$$

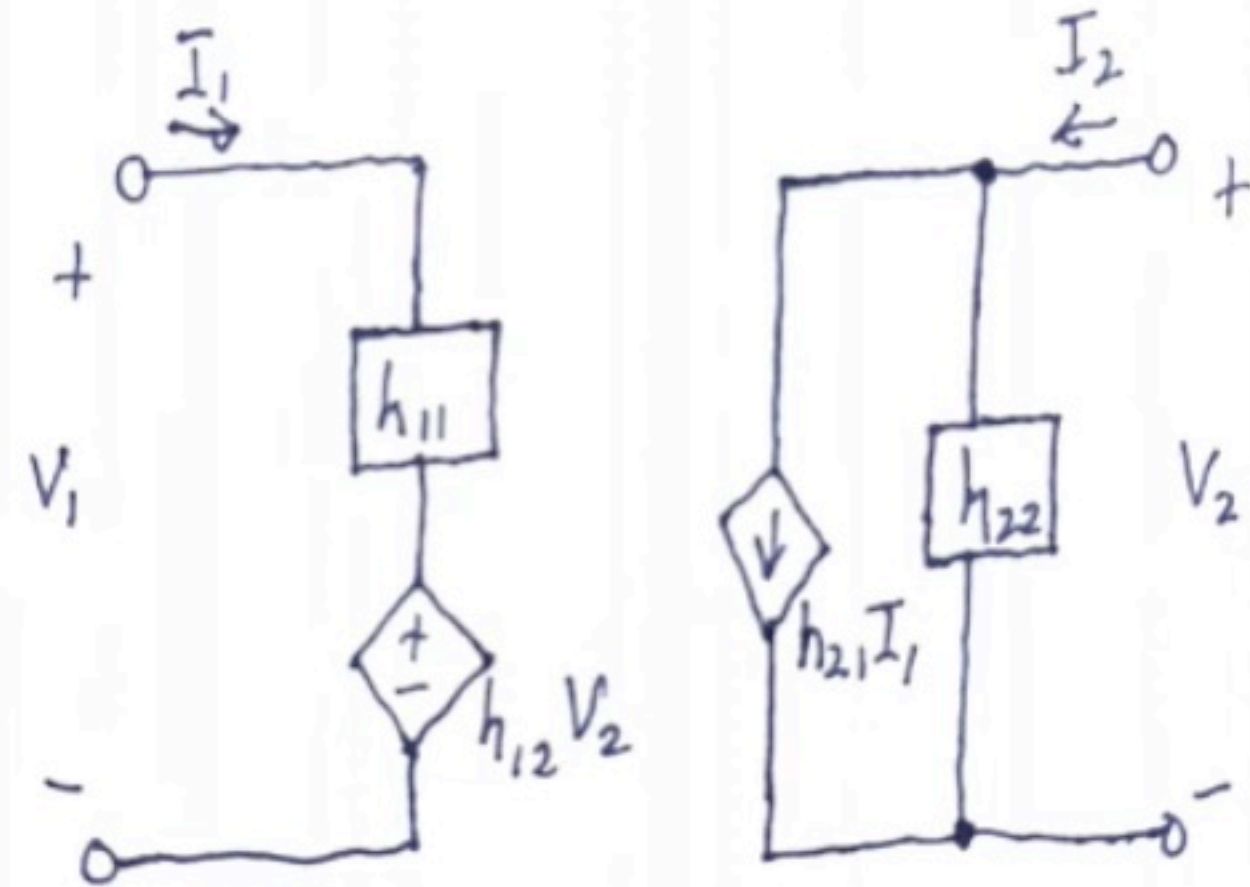
$$h_{12} = \left. \frac{V_1}{V_2} \right|_{I_1=0}$$

$$V_1 = h_{11}I_1 + h_{12}V_2$$

$$I_2 = h_{21}I_1 + h_{22}V_2$$

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

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



**TABLE 17-2 TWO-PORT PARAMETER CONVERSION TABLE**

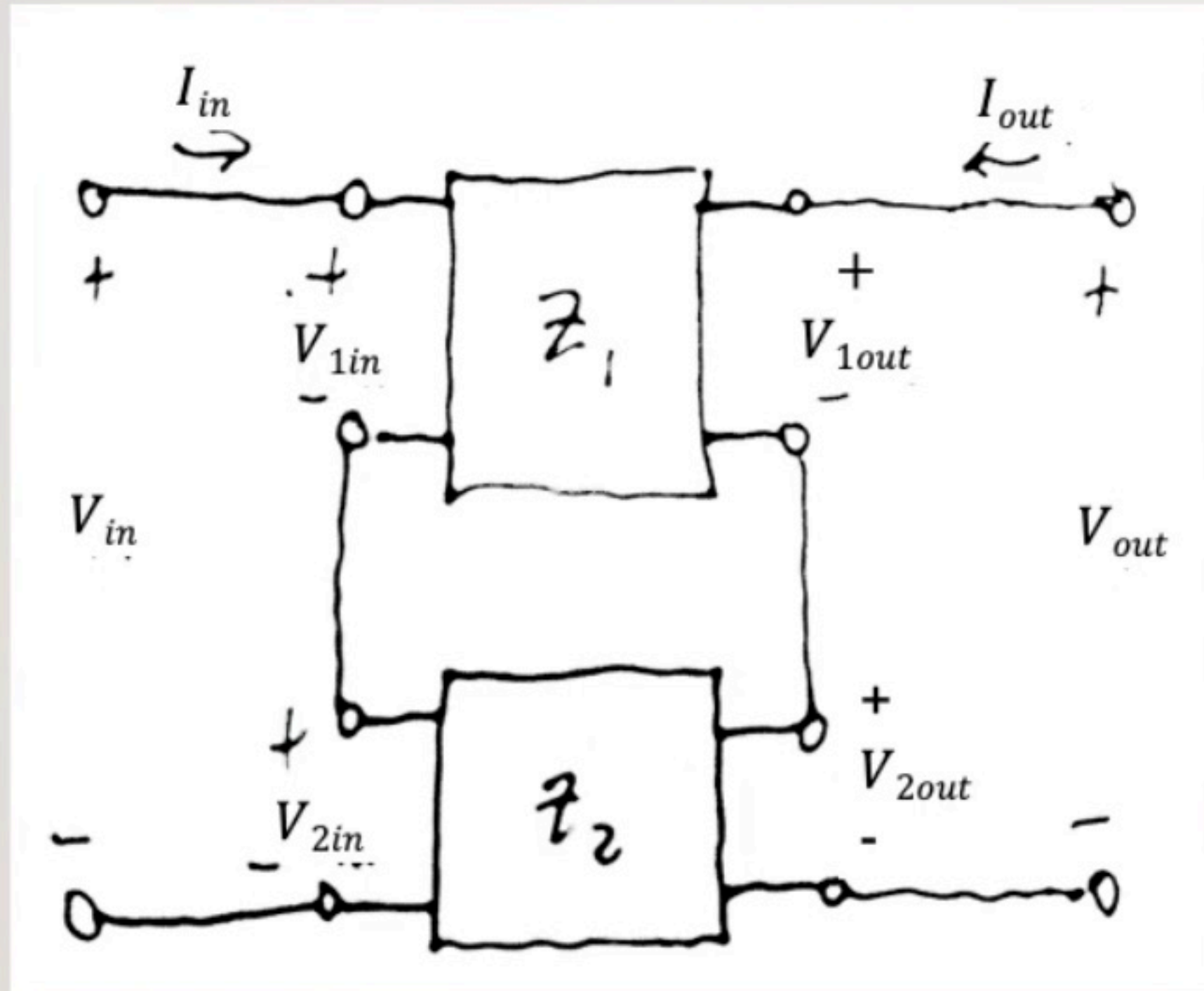
DESIRED PARAMETERS	GIVEN PARAMETERS			
	[z]	[y]	[h]	[t]
[z]	$\begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix}$	$\begin{bmatrix} \frac{y_{22}}{\Delta_y} & \frac{-y_{12}}{\Delta_y} \\ \frac{-y_{21}}{\Delta_y} & \frac{y_{11}}{\Delta_y} \end{bmatrix}$	$\begin{bmatrix} \frac{\Delta_h}{h_{22}} & \frac{h_{12}}{h_{22}} \\ \frac{-h_{21}}{h_{22}} & \frac{1}{h_{22}} \end{bmatrix}$	$\begin{bmatrix} \frac{A}{C} & \frac{\Delta_t}{C} \\ \frac{1}{C} & \frac{D}{C} \end{bmatrix}$
[y]	$\begin{bmatrix} \frac{z_{22}}{\Delta_z} & \frac{-z_{12}}{\Delta_z} \\ \frac{-z_{21}}{\Delta_z} & \frac{z_{11}}{\Delta_z} \end{bmatrix}$	$\begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix}$	$\begin{bmatrix} \frac{1}{h_{11}} & \frac{-h_{12}}{h_{11}} \\ \frac{h_{21}}{h_{11}} & \frac{\Delta_h}{h_{11}} \end{bmatrix}$	$\begin{bmatrix} \frac{D}{B} & \frac{-\Delta_t}{B} \\ \frac{-1}{B} & \frac{A}{B} \end{bmatrix}$
[h]	$\begin{bmatrix} \frac{\Delta_z}{z_{22}} & \frac{z_{12}}{z_{22}} \\ \frac{-z_{21}}{z_{22}} & \frac{1}{z_{22}} \end{bmatrix}$	$\begin{bmatrix} \frac{1}{y_{11}} & \frac{-y_{12}}{y_{11}} \\ \frac{y_{21}}{y_{11}} & \frac{\Delta_y}{y_{11}} \end{bmatrix}$	$\begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix}$	$\begin{bmatrix} \frac{B}{D} & \frac{\Delta_t}{D} \\ \frac{-1}{D} & \frac{C}{D} \end{bmatrix}$
[t]	$\begin{bmatrix} \frac{z_{11}}{z_{21}} & \frac{\Delta_z}{z_{21}} \\ \frac{1}{z_{21}} & \frac{z_{22}}{z_{21}} \end{bmatrix}$	$\begin{bmatrix} \frac{-y_{22}}{y_{21}} & \frac{-1}{y_{21}} \\ \frac{-\Delta_y}{y_{21}} & \frac{-y_{11}}{y_{21}} \end{bmatrix}$	$\begin{bmatrix} \frac{-\Delta_h}{h_{21}} & \frac{-h_{11}}{h_{21}} \\ \frac{-h_{22}}{h_{21}} & \frac{-1}{h_{21}} \end{bmatrix}$	$\begin{bmatrix} A & B \\ C & D \end{bmatrix}$

$$\Delta_z = z_{11}z_{22} - z_{12}z_{21} \quad \Delta_y = y_{11}y_{22} - y_{12}y_{21} \quad \Delta_h = h_{11}h_{22} - h_{12}h_{21} \quad \Delta_t = AD - BC$$



# INTERCONEXION DE MODULOS

[http://ece.uprm.edu/~jrosado/oldexams/3105/Materiales/Notas/3105\\_9\\_2.jpeg](http://ece.uprm.edu/~jrosado/oldexams/3105/Materiales/Notas/3105_9_2.jpeg)



$$V_1 = z_{11}I_1 + z_{12}I_2$$

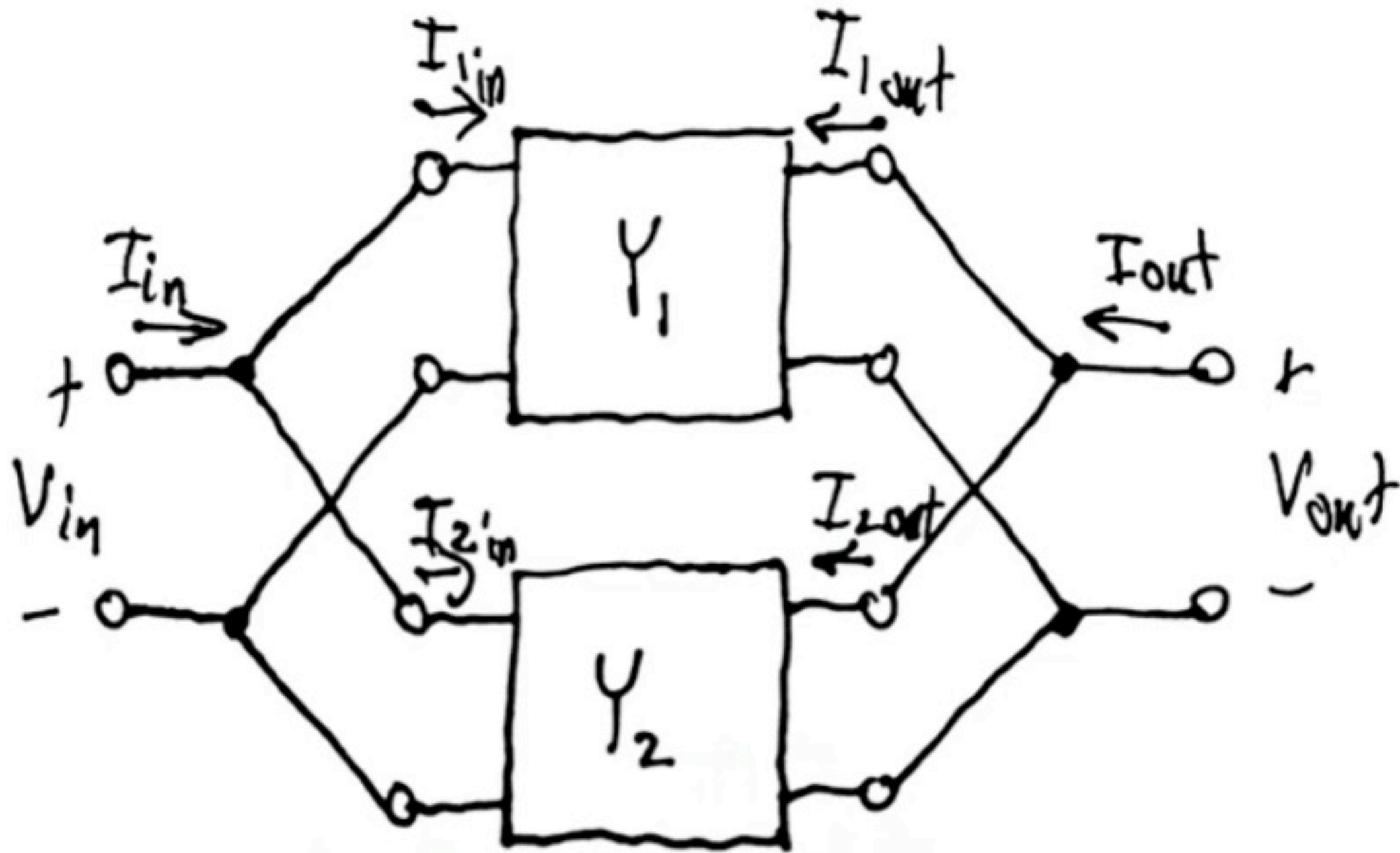
$$V_2 = z_{21}I_1 + z_{22}I_2$$

*En serie se suman las impedancias*

$$Z_{eq} = Z_1 + Z_2$$



# INTERCONEXION DE MODULOS



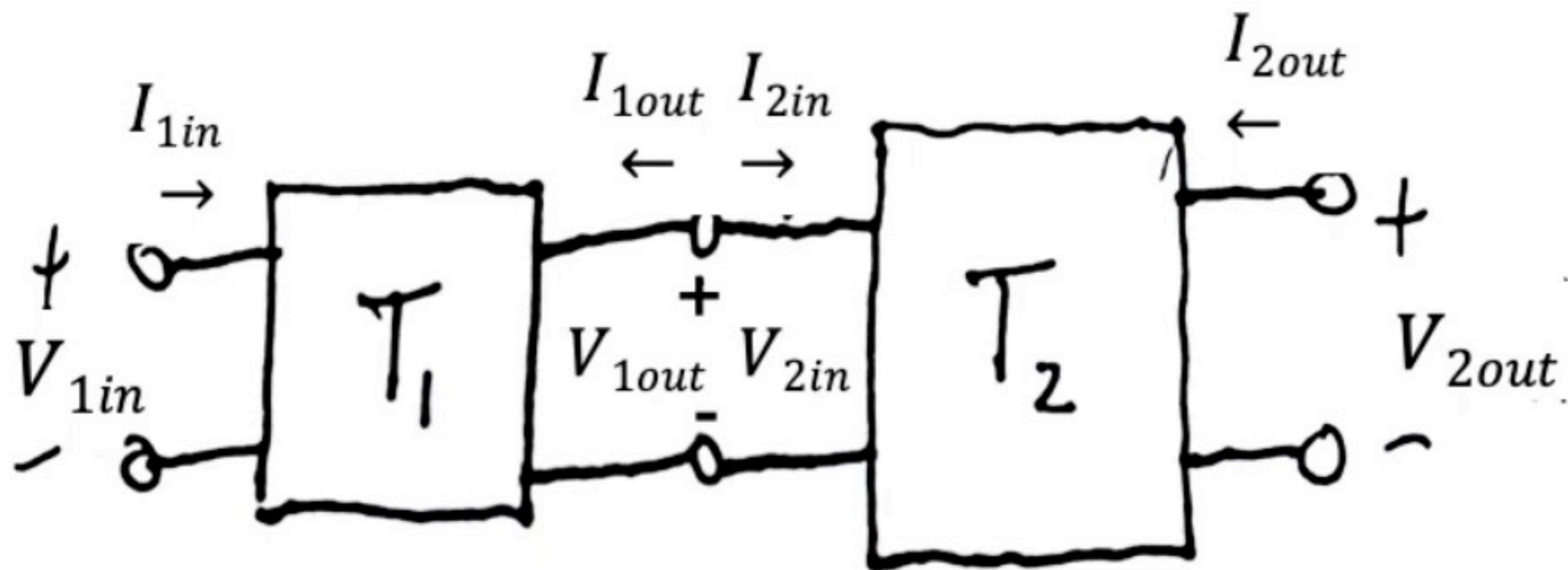
$$I_1 = y_{11}V_1 + y_{12}V_2$$

$$I_2 = y_{21}V_1 + y_{22}V_2$$

*En paralelo se suman las admitancias*

$$Y_{eq} = Y_1 + Y_2$$

# INTERCONECCION DE MODULOS



$$V_1 = AV_2 - BI_2$$

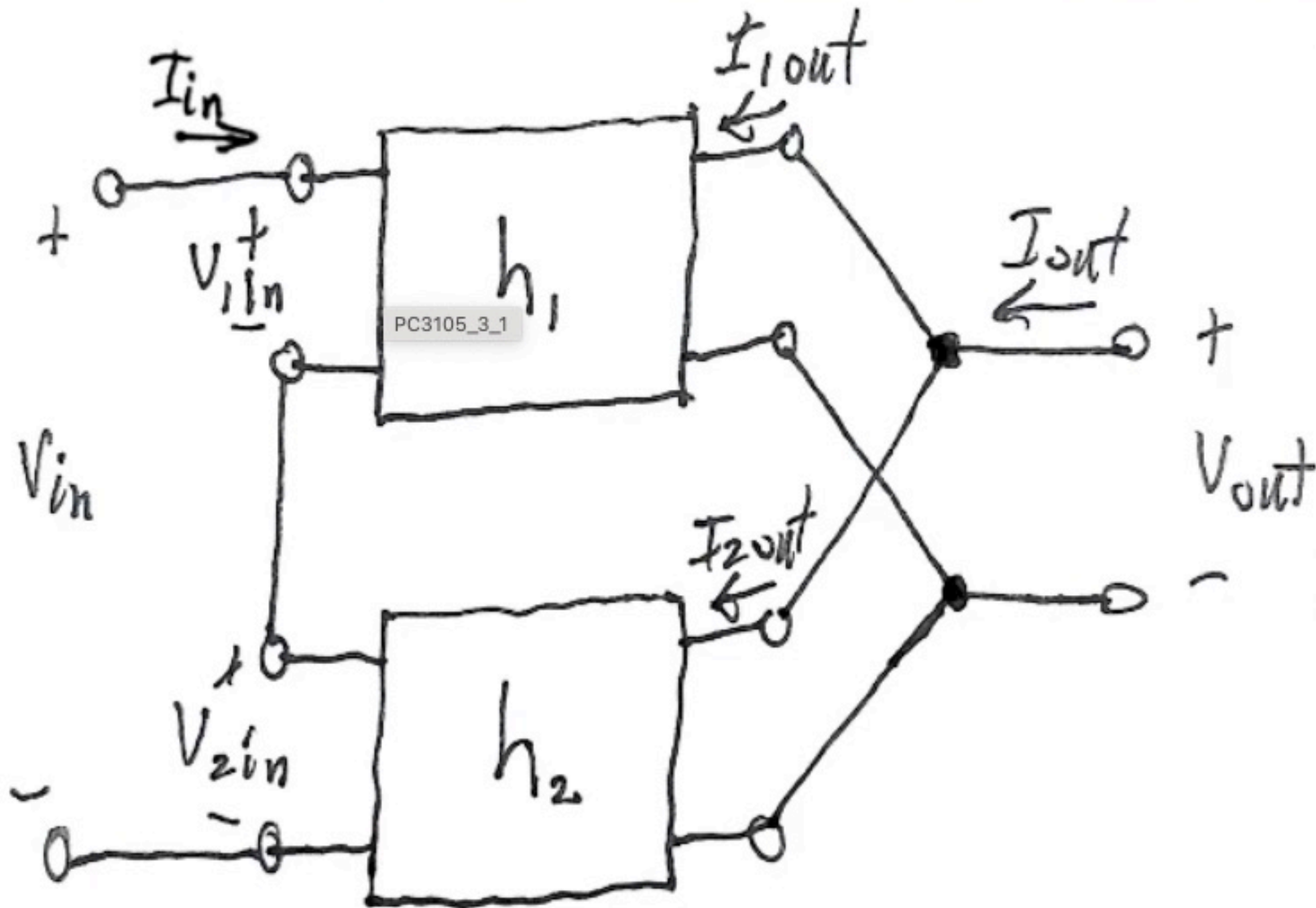
$$I_1 = CV_2 - DI_2$$

*En cascada se multiplican las matrices de transmisión*

$$T_{eq} = T_1 T_2$$



# INTERCONECCION DE MODULOS



$$V_1 = h_{11}I_1 + h_{12}V_2$$

$$I_2 = h_{21}I_1 + h_{22}V_2$$

*Para sumar modulos  $h$ ,  
las entradas en serie y  
las salidas en paralelo*

$$h_{eq} = h_1 + h_2$$