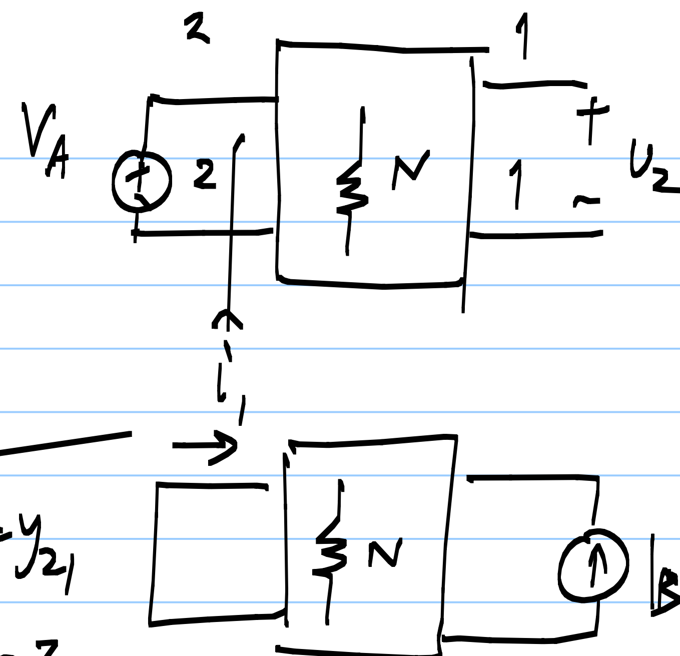
EC1010 : Lecture 16

$$\begin{bmatrix} v_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ v_2 \end{bmatrix}$$

$$\begin{bmatrix} i_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{bmatrix} \begin{bmatrix} v_1 \\ i_2 \end{bmatrix}$$



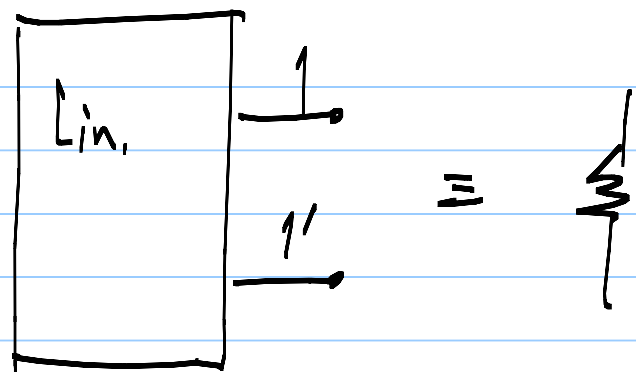
$y_{12} = y_{21}$

$z_{12} = z_{21}$

$h_{21} = -h_{12}$

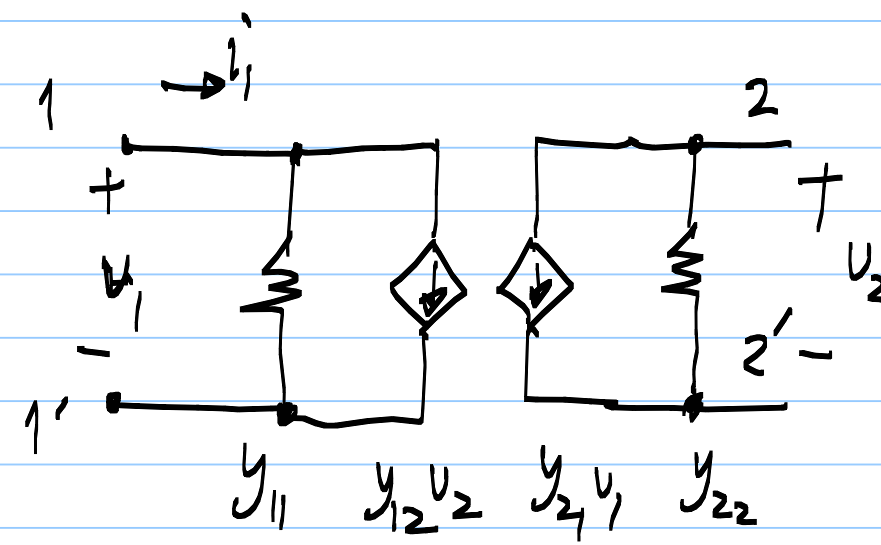
$$\frac{v_2}{V_A} = -\frac{i_1}{I_B}$$

$g_{21} = -g_{12}$

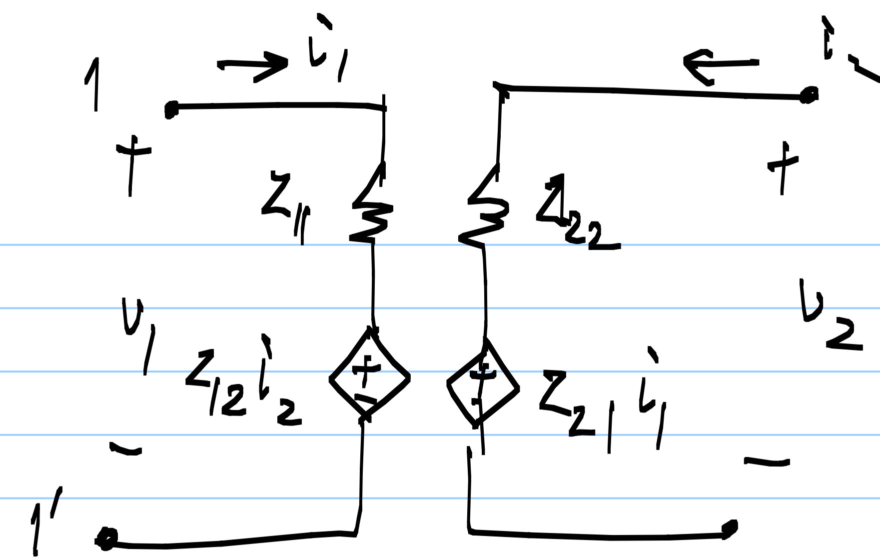


$$\begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$$

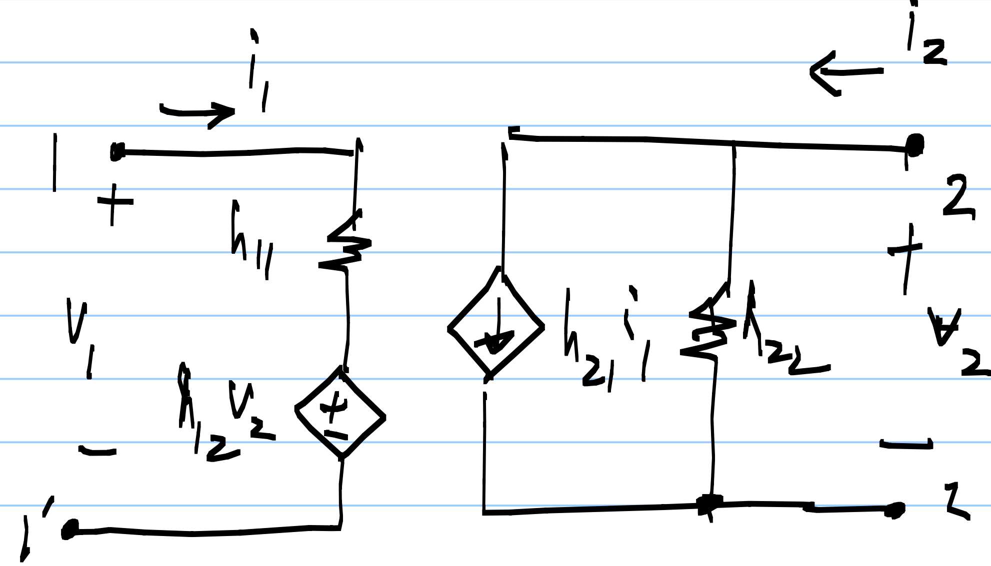
$$i_1 = \underline{y_{11} v_1} + \underline{y_{12} v_2}$$

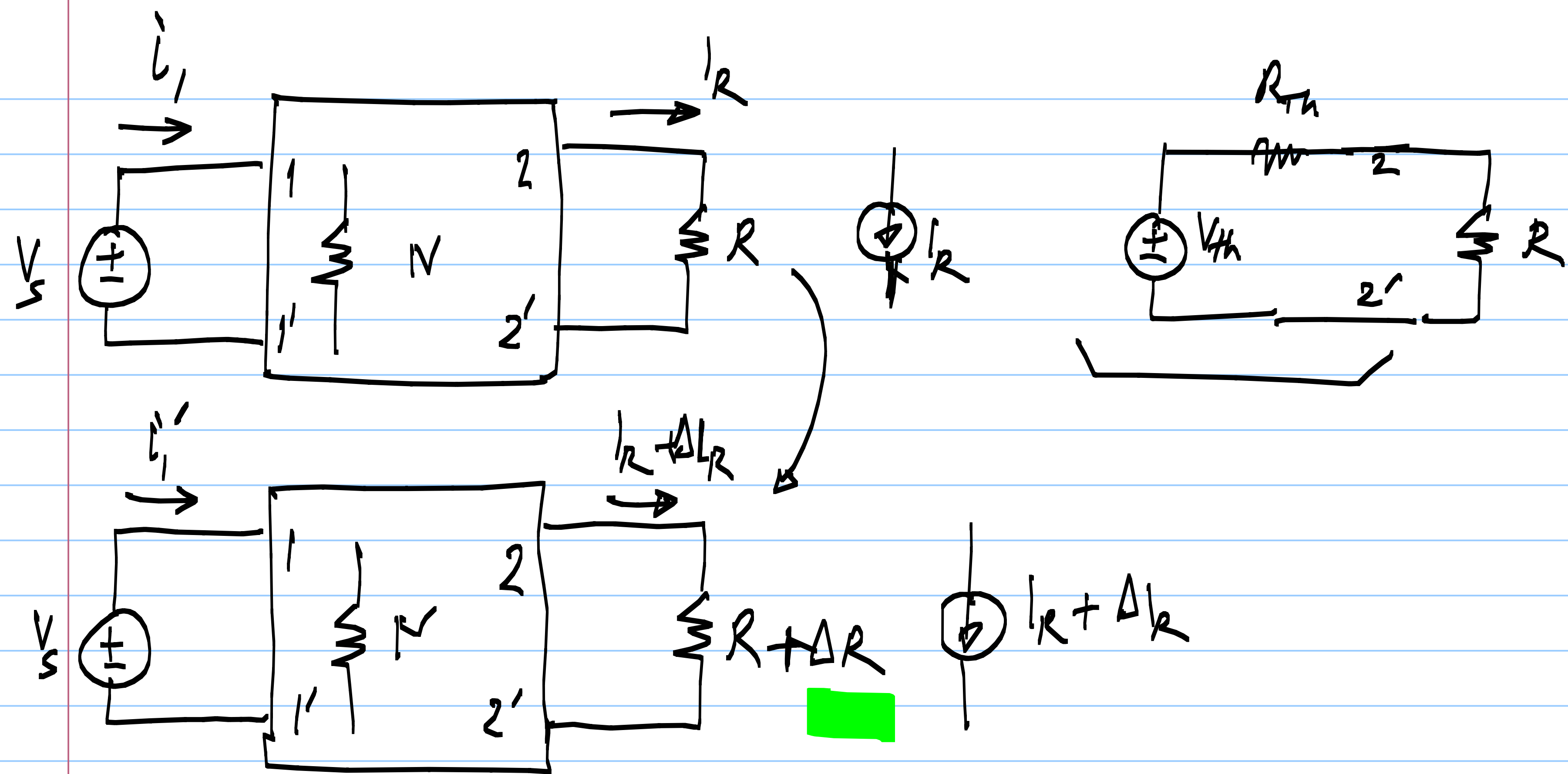


$$\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$$



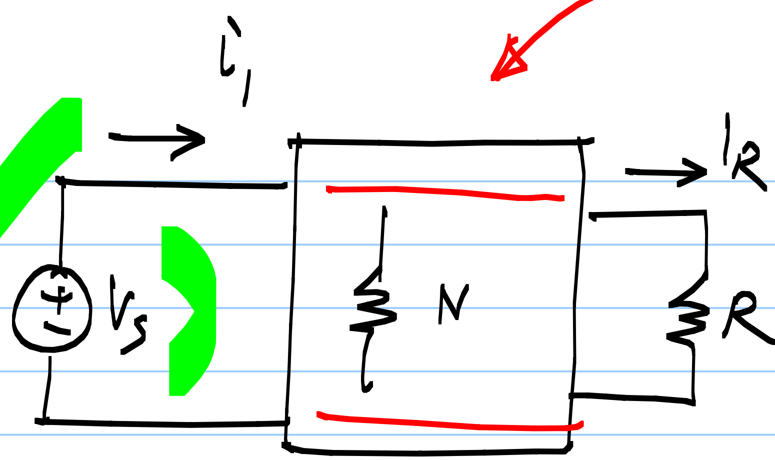
$$\begin{bmatrix} v_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ v_2 \end{bmatrix}$$

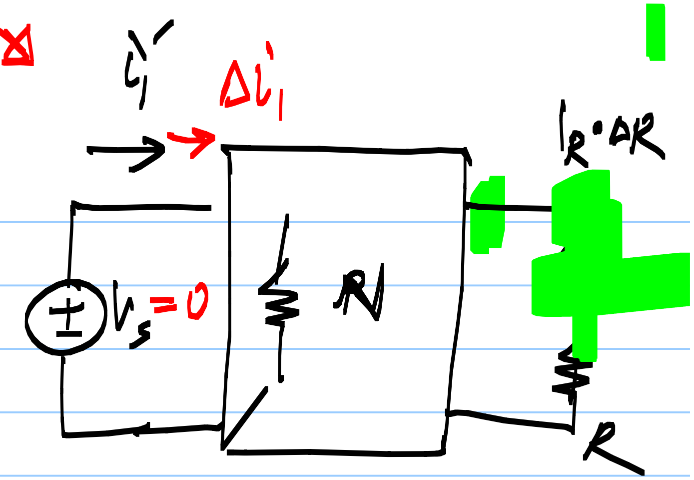




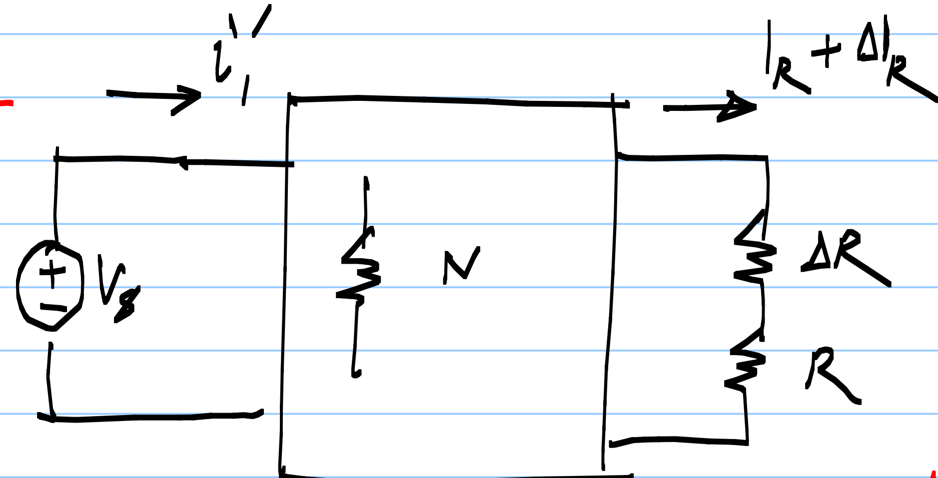
i_1
i_R
1
2
1'
2'
N
R
V_s
i_R
R_{Th}
V_{th}
2
2'
R
i_1'
$i_R+\Delta i_R$
$R+\Delta R$
$i_R+\Delta i_R$

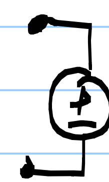
Known:





$$\frac{\Delta i_1'}{I_R \cdot \Delta R} = \frac{-I_R}{V_s}$$





$$(I_R + \Delta I_R)\cdot \Delta R \simeq I_R \cdot \Delta R$$

$$\Delta i_1' = -\frac{I_R^2}{V_s}\cdot \Delta R$$

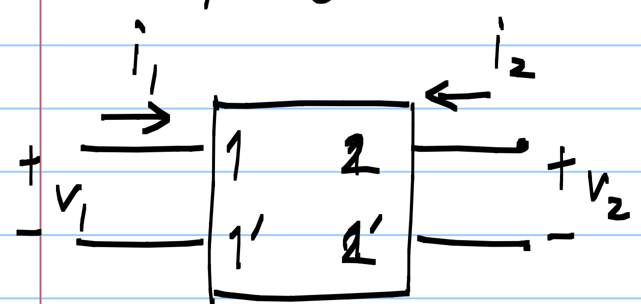
Compensation theorem

EC1010: Lecture 17

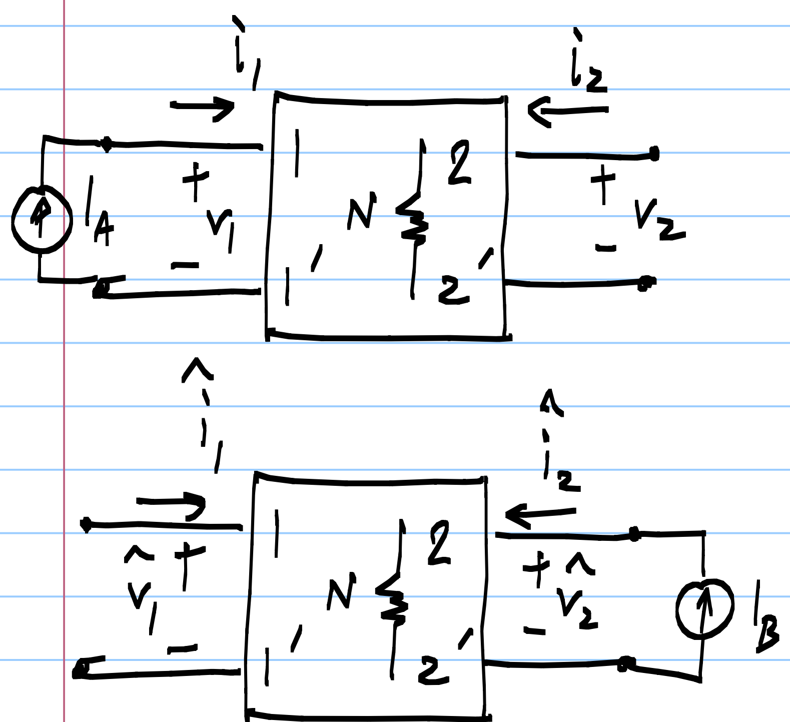
Reciprocity theorem :

(i) Excitation at port 1 & response @ port 2

(ii) Excitation at port 2 & response @ port 1



For reciprocal 2 port networks
(resistive networks are reciprocal)

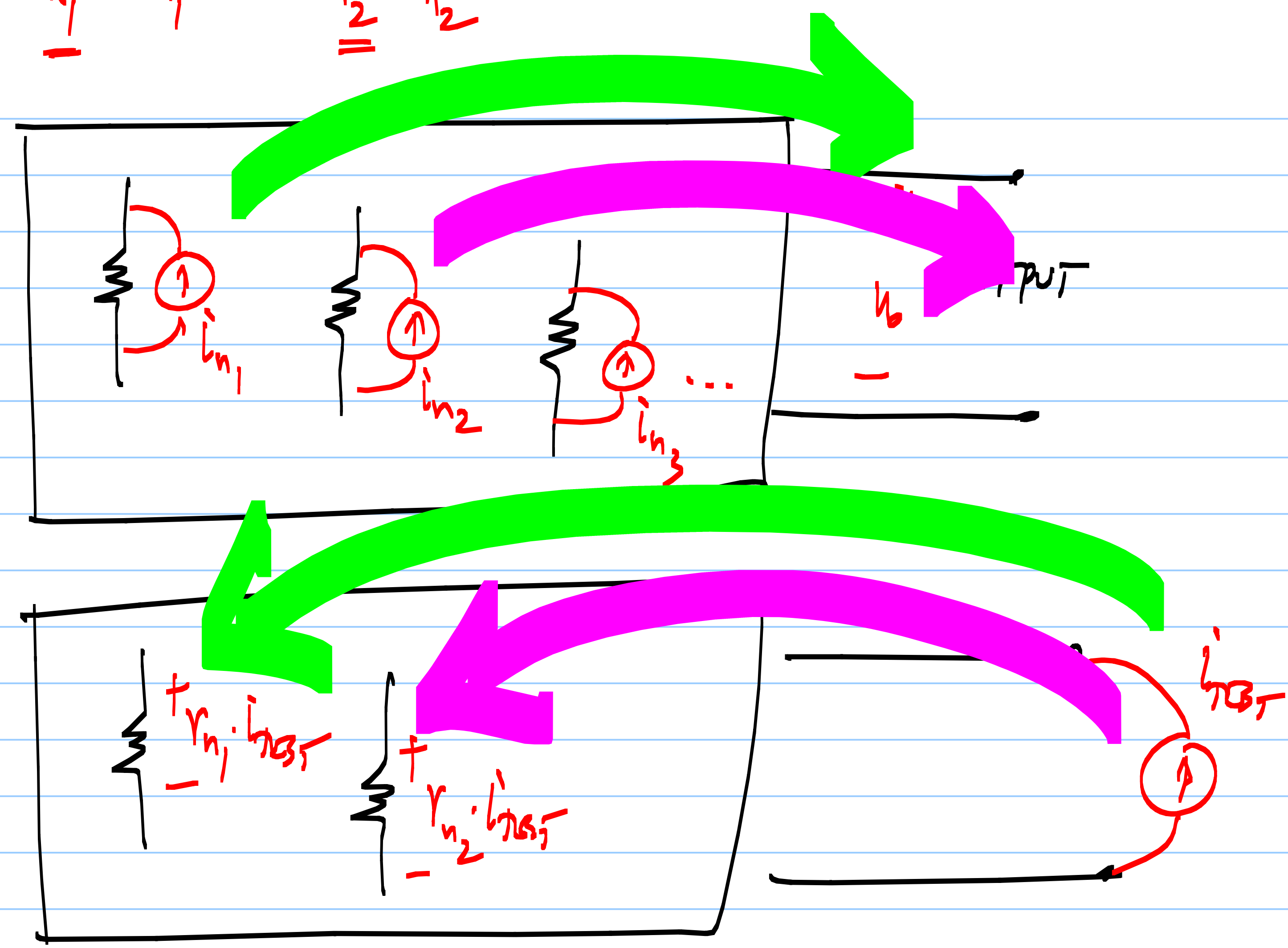


Excite port 1 (port 2) with a current &
leave port 2 (port 1) open circuited

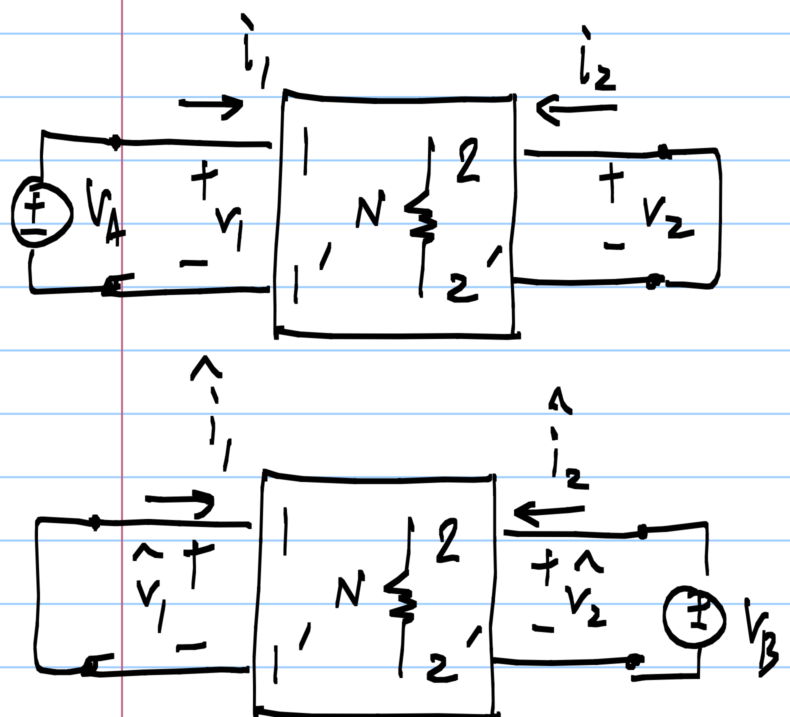
$$\frac{v_2}{I_A} = \frac{\hat{v}_1}{I_B}$$

$$Z_{21} = Z_{12}$$

$$V_o = \gamma_{n_1} \cdot i_{n_1} + \gamma_{n_2} i_{n_2} + \ldots$$



$$y_{11} v_A + y_{12} v_B$$
$$y_{21} v_A + y_{22} v_B$$

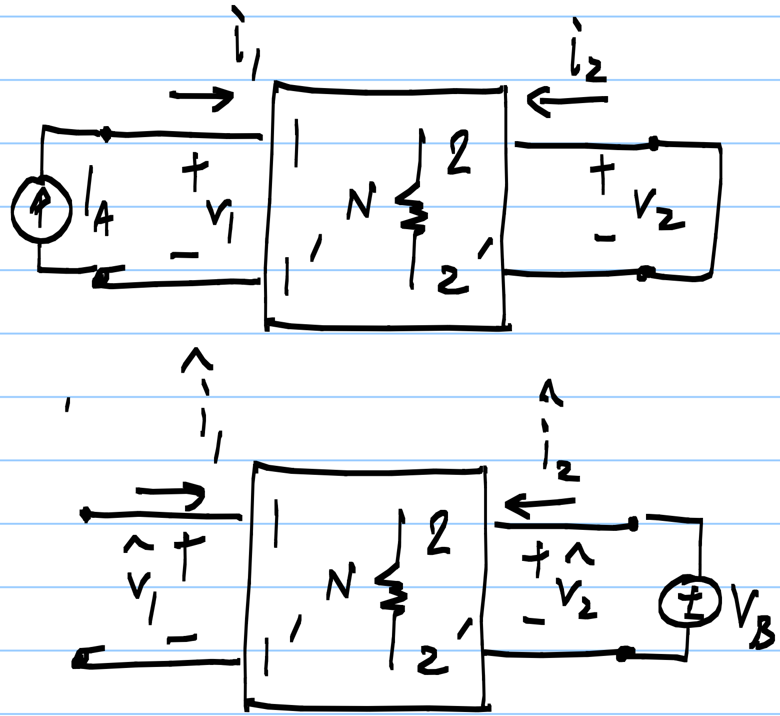


Excite port 1 (port 2) with a voltage & leave port 2 (port 1) short circuited

$$\frac{i_2}{v_A} = \frac{\hat{i}_1}{v_B}$$

$$y_{21} = y_{12}$$

Excite port 1 with a current & leave port 2 short circuited

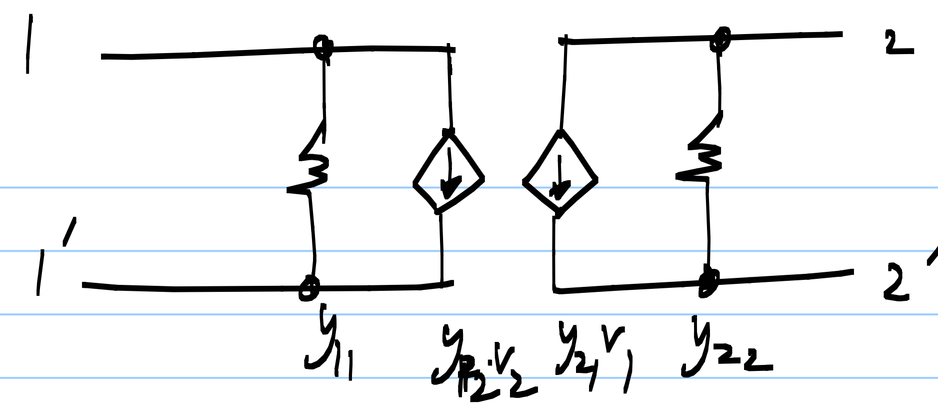


$$\frac{i_2}{I_A} = -\frac{\hat{v}_1}{V_B}$$

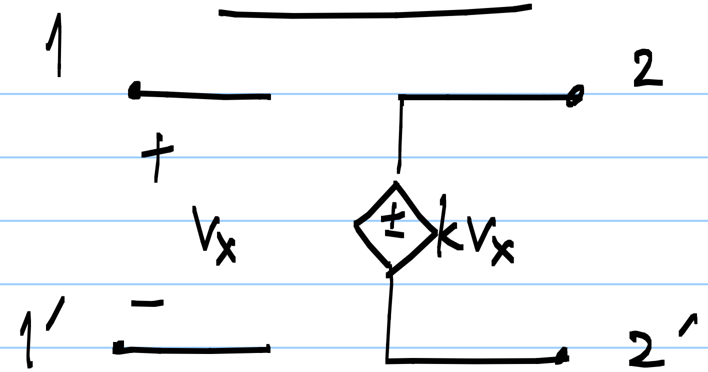
$$h_{21} = -h_{12}$$

$$g_{21} = -g_{12}$$

$$\begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$$



Ideal VCVS



g-parameters

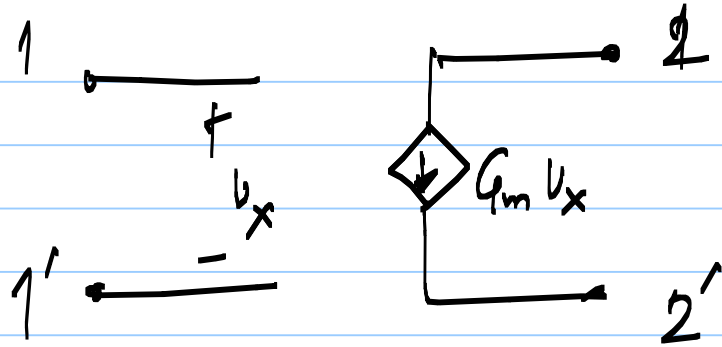
$$\begin{bmatrix} 0 & 0 \\ k & 0 \end{bmatrix}$$

Unilateral

$$\begin{bmatrix} i_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{bmatrix} \begin{bmatrix} v_1 \\ i_2 \end{bmatrix}$$

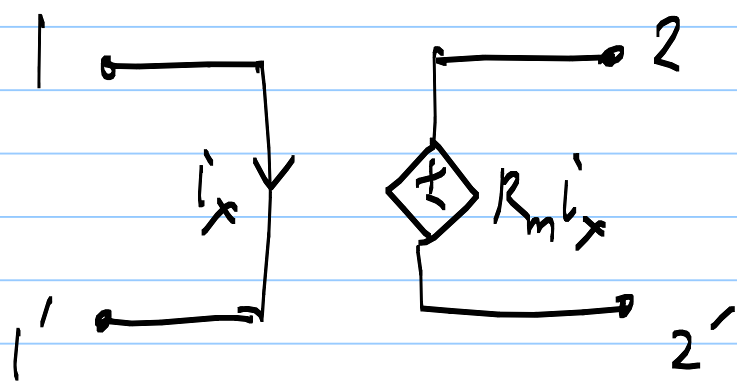
$$\begin{bmatrix} v_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ v_2 \end{bmatrix}$$

VCCS



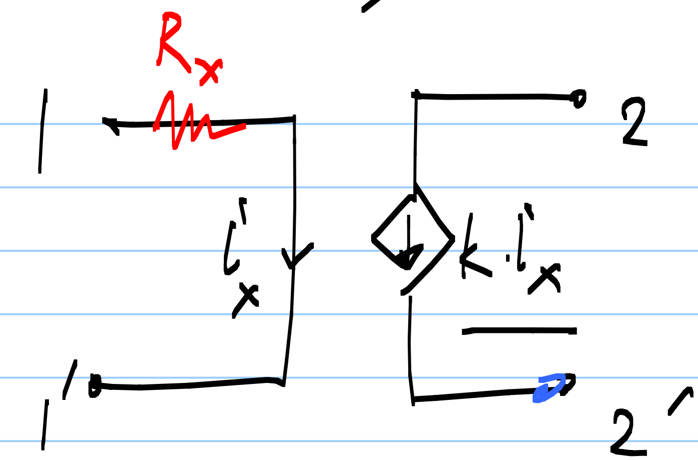
$$y: \begin{bmatrix} 0 & 0 \\ G_m & 0 \end{bmatrix}$$

CCVS



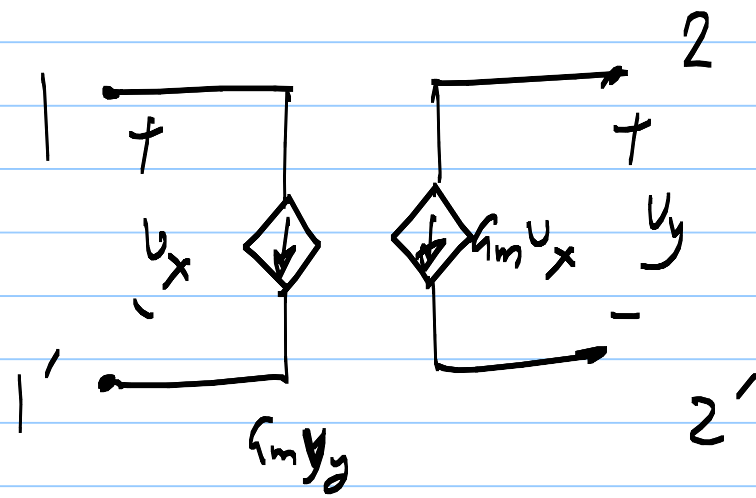
$$z: \begin{bmatrix} 0 & 0 \\ R_m & 0 \end{bmatrix}$$

CCCS



h:
$$\begin{bmatrix} R_x & 0 \\ k & \frac{1}{R_y} \end{bmatrix}$$

$$[Z]^{-1} = [y]: \begin{bmatrix} \frac{1}{R_x} & 0 \\ \frac{k}{R_x} & 0 \end{bmatrix}$$



y:
$$\begin{bmatrix} 0 & G_m \\ G_m & 0 \end{bmatrix}$$