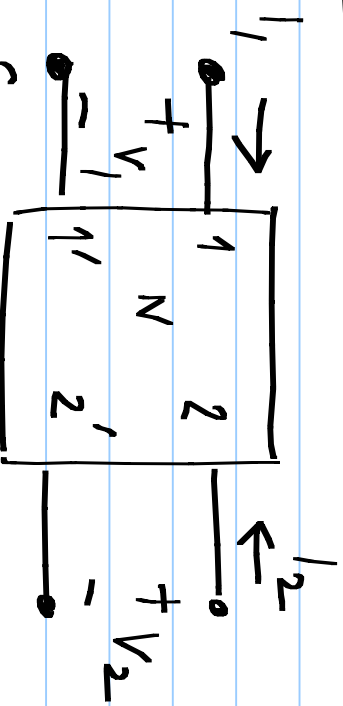


Lecture 15



hybrid parameters

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

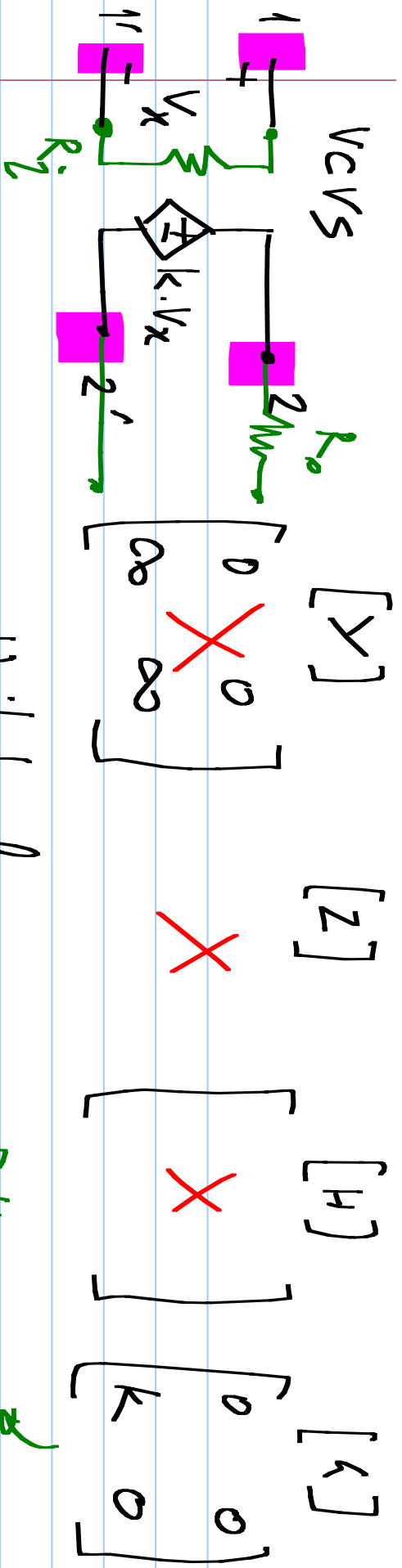
Y parameters (conductance)

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

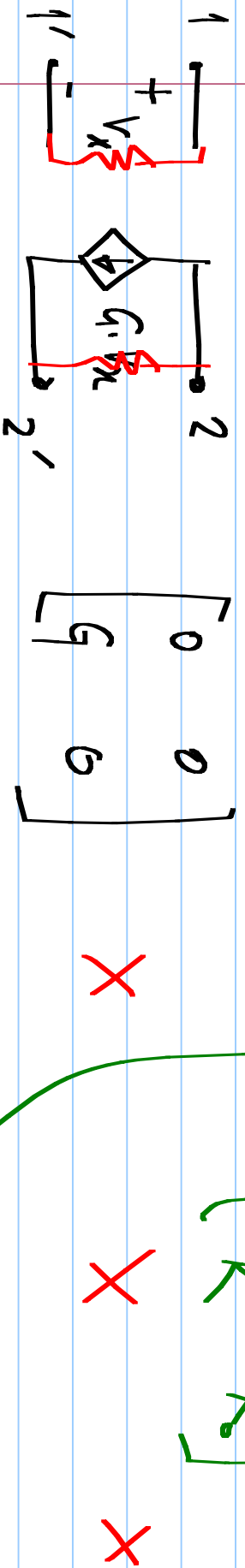
Z parameters (resistance)

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

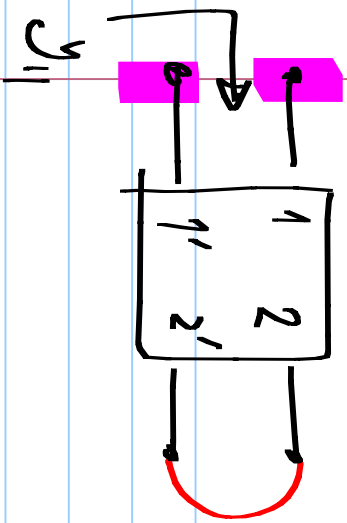
$$\begin{bmatrix} I_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ I_2 \end{bmatrix}$$



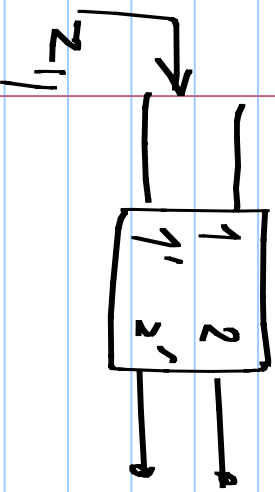
Unilateral:



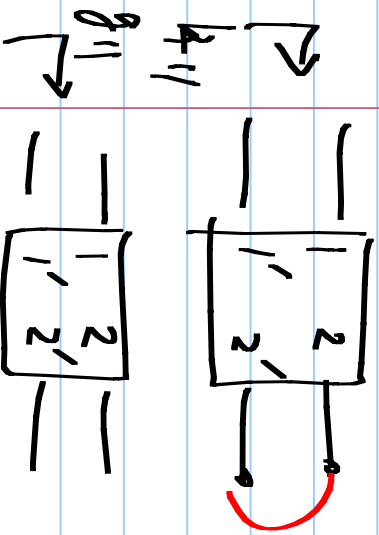
Only one of $\{h_{21}, h_{12}\}$ is non zero



y_{11} : Conductance looking into port 1 (with port 2 shorted)

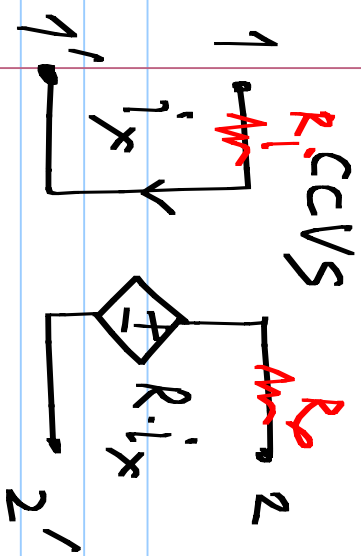


Z_{11} : resistance looking into port 1 with port 2 open



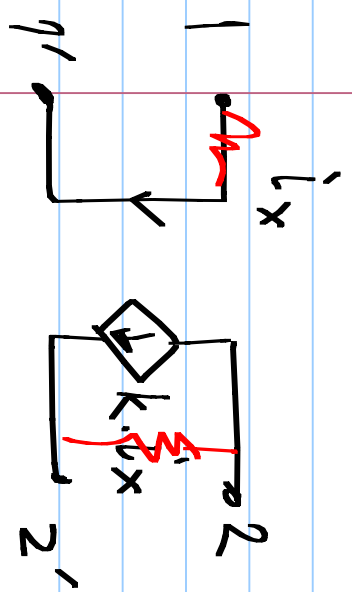
h_{11} : Resistance looking into port 1 with port 2 shorted

g_{11} : Conductance into port 1 (port 2 open)

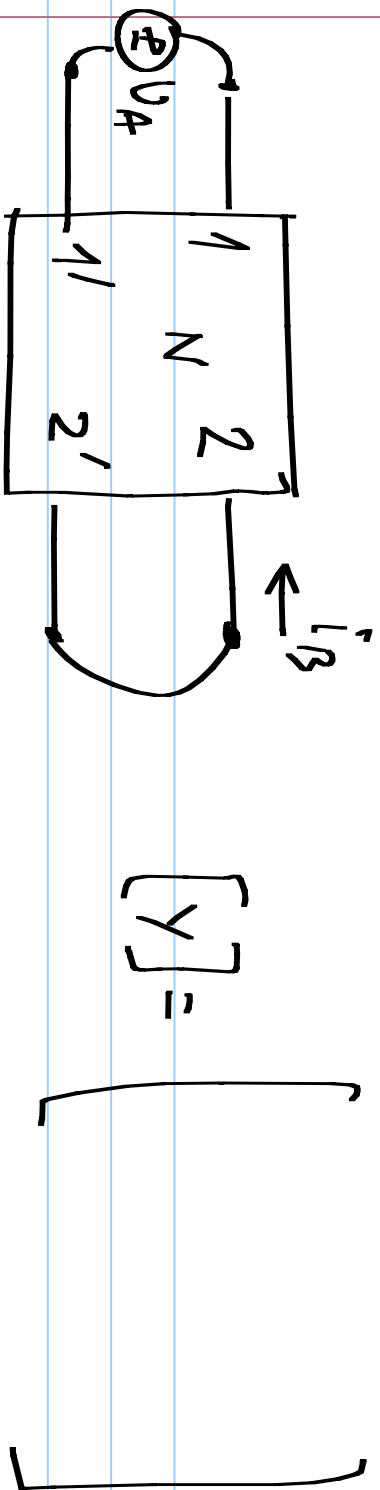


$$[Z] = \begin{bmatrix} 0 & 0 \\ R & 0 \end{bmatrix}$$

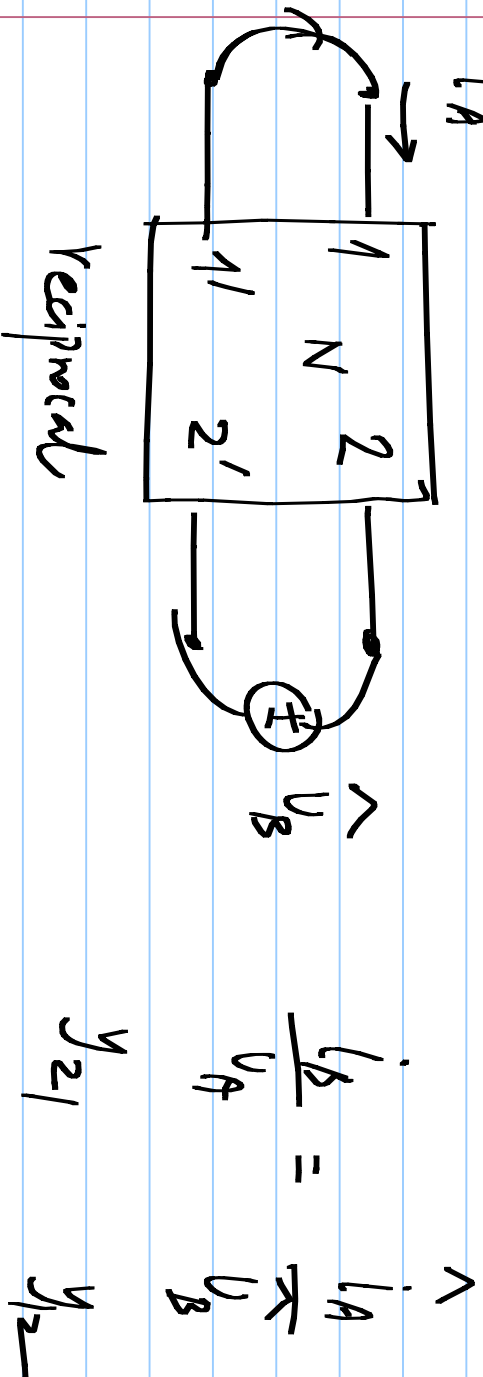
$$[Y] = \begin{bmatrix} 1/R_1 & 0 \\ -R/R_1 R_2 & 1/R_2 \end{bmatrix}$$



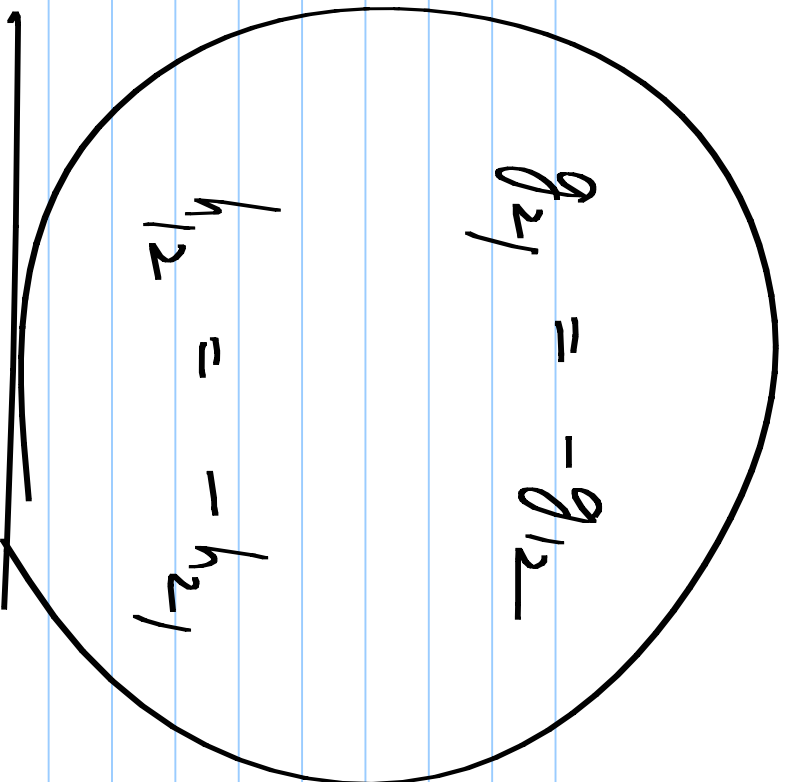
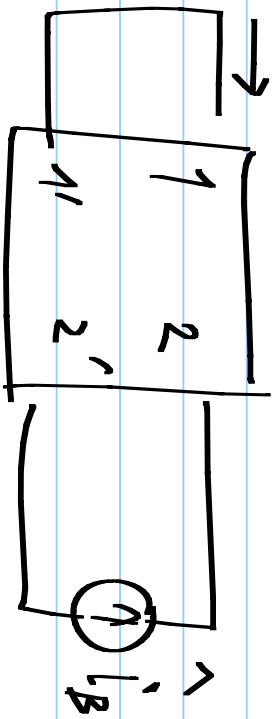
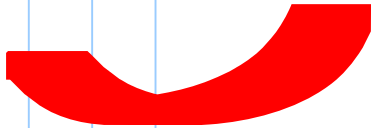
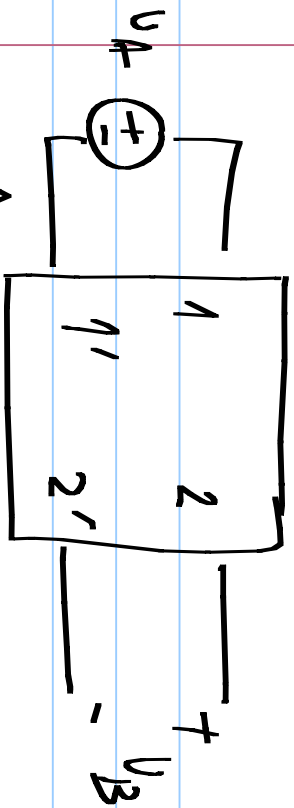
$$[H] = \begin{bmatrix} 0 & 0 \\ k & 0 \end{bmatrix}$$



Reciprocal $\implies y_{12} = y_{21} \quad / \quad z_{12} = z_{21}$

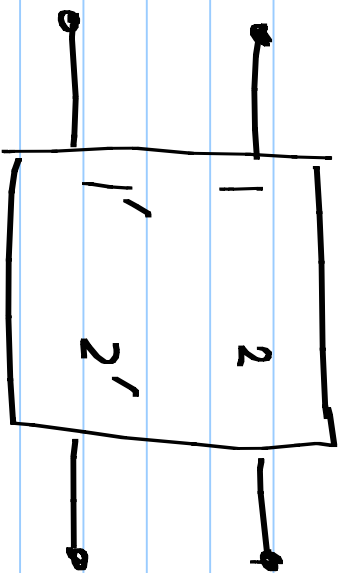


$$i_B = \frac{V_A}{R} = \frac{i_A}{K}$$



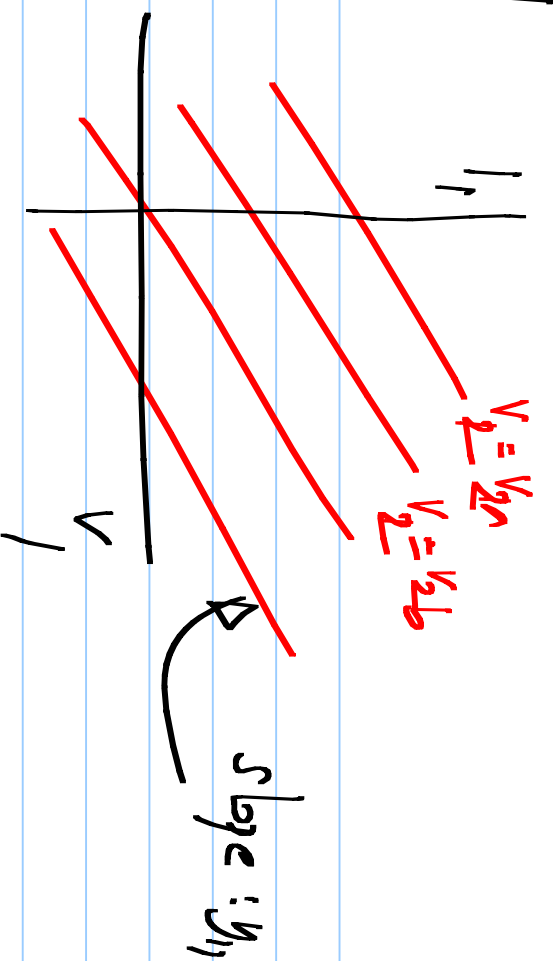
Reciprocity $\begin{matrix} 1 & \text{---} & 2 \\ 1' & \text{---} & 2' \end{matrix}$

$$\frac{V_B}{V_A} = - \frac{I_A}{I_B}$$



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

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



I_1 vs. V_1 for diff. V_2

