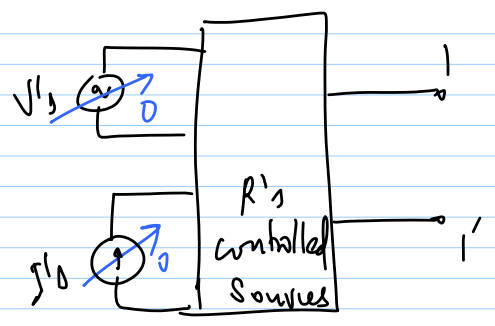
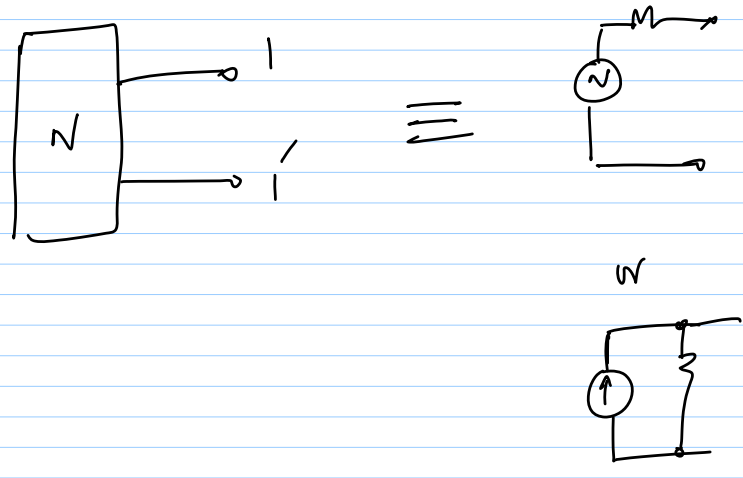


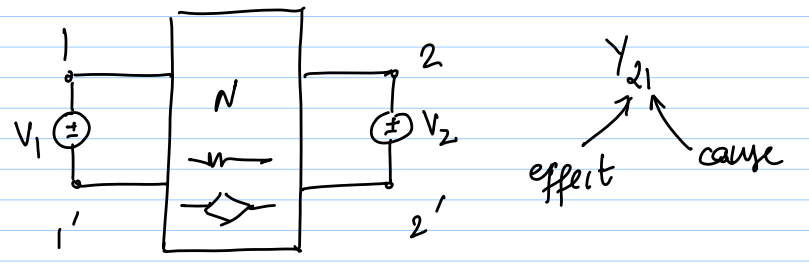
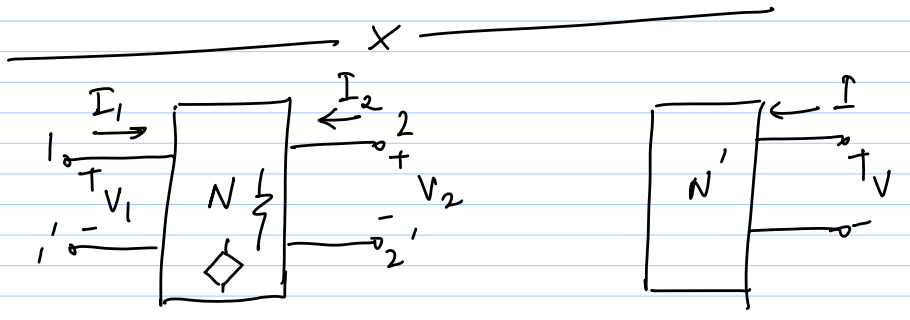
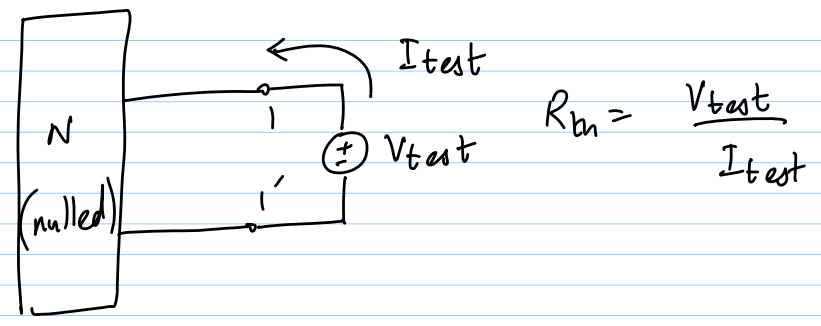
12-2-15

Lec 15

Two-part Networks



$V_{th} = V_{o.c. 1-1'}$ open circuit voltage
 $R_{th} =$ Effective resistance between 1-1' when N is "nulled"



$I_1 = f(V_1, V_2)$, $I_2 = g(V_1, V_2)$
 ← Conductance 's'
 $I_1 = (Y_{11}) V_1 + (Y_{12}) V_2$
 $I_2 = (Y_{21}) V_1 + (Y_{22}) V_2$
 's'

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

dependent variable

"Y-parameters"

independent variables

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

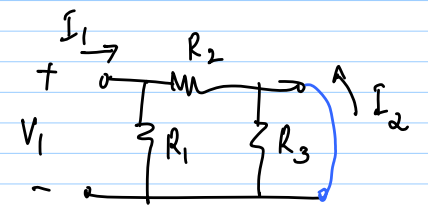
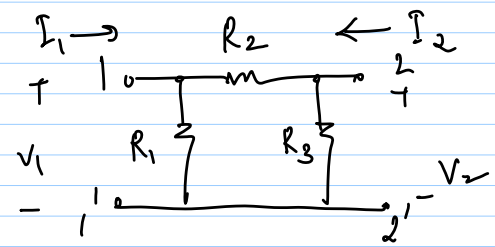
$$Y_{12} = \frac{I_1}{V_2} \Big|_{V_1=0}$$

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

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

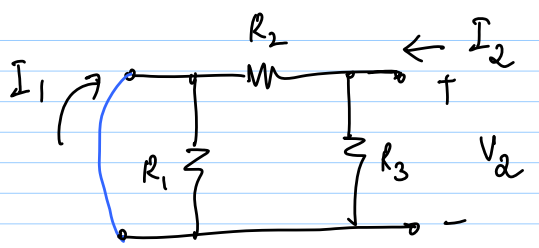
$V_1/V_2 = 0 \Rightarrow$ short-circuit ports 1 or 2 respectively

"short-circuit parameters"



$$Y_{11} = G_1 + G_2$$

$$Y_{21} = -G_2$$

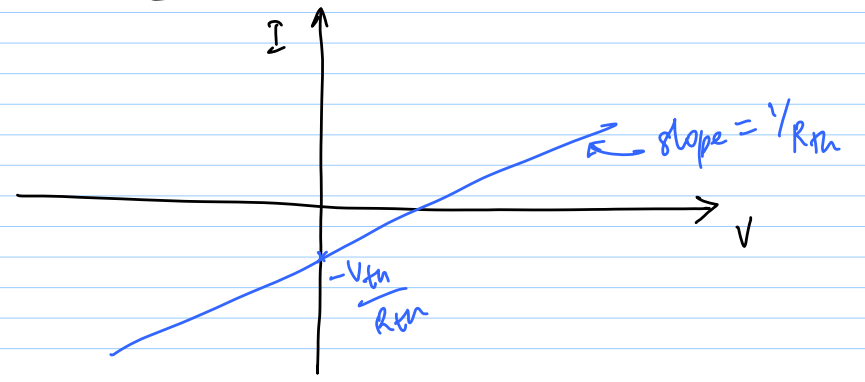
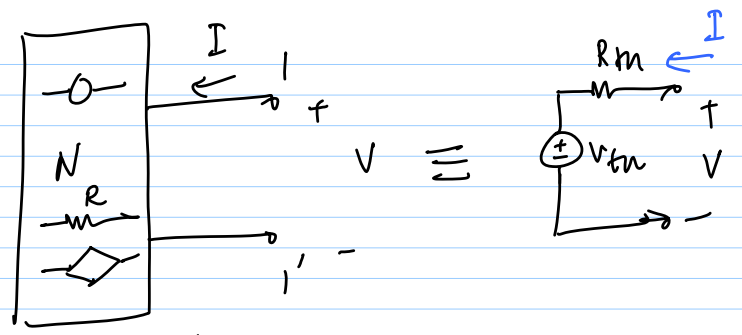


$$Y_{12} = -G_2$$

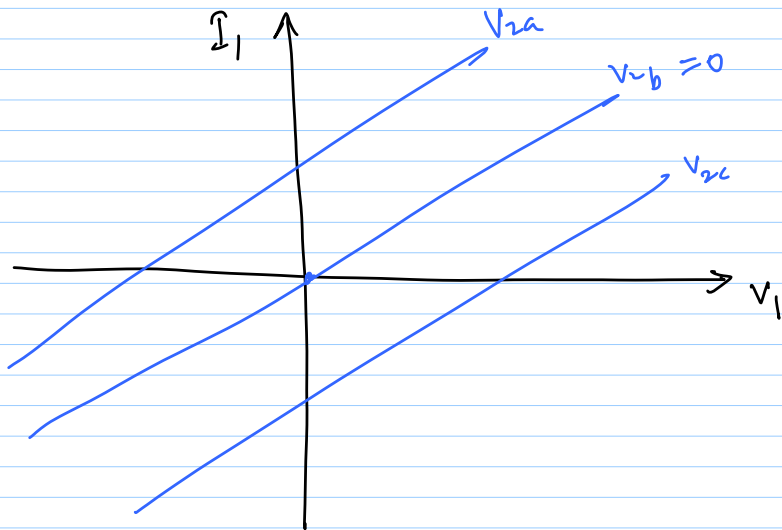
$$Y_{22} = G_2 + G_3$$

$$Y_{21} = Y_{12}$$

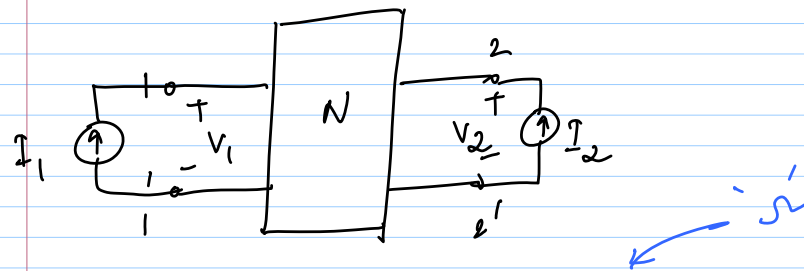
"Reciprocity"



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



Choose I_1 & I_2 as independent variables



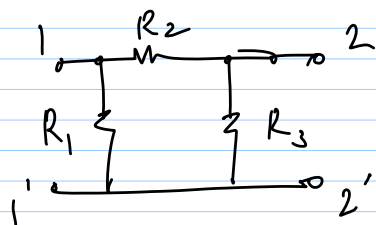
$$V_1 = Z_{11} I_1 + Z_{12} I_2$$

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

$$Z_{11} = \frac{V_1}{I_1} \Big|_{I_2=0} \text{ and so on.}$$

"Z - parameters"

or "open-ckt parameters"



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

$$\left. \begin{array}{l} Y: [I] = [Y][V] \\ Z: [V] = [Z][I] \end{array} \right\} [Y] = [Z]^{-1}$$

$$Z_{11} = \frac{1}{Y_{11}} \quad \times$$

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

Hybrid parameters or H-parameters.
 Annotations: Ω (dimensionless) above H_{11} and H_{12} ; S (dimensionless) below H_{21} and H_{22} .

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

Inverse-hybrid parameters or G-parameters.