# NETWORK ANALYSIS AND SYNTHESIS

# Two Port Parameter Conversions:

To go from one set of parameters to another, locate the set of parameters you are in, move along the vertical until you are in the row that contains the parameters you want to convert to – then compare element for element

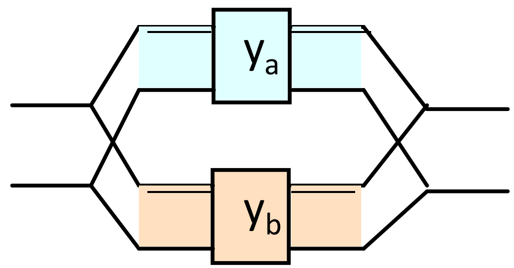
| | | | |
|---|---|---|---|
| $\begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix}$ | $\begin{bmatrix} \frac{y_{22}}{\Delta_Y} & \frac{-y_{12}}{\Delta_Y} \\ \frac{-y_{21}}{\Delta_Y} & \frac{y_{11}}{\Delta_Y} \end{bmatrix}$ | $\begin{bmatrix} \frac{A}{C} & \frac{\Delta_T}{C} \\ \frac{1}{C} & \frac{D}{C} \end{bmatrix}$ | $\begin{bmatrix} \frac{\Delta_H}{h_{22}} & \frac{h_{12}}{h_{22}} \\ \frac{-h_{21}}{h_{22}} & \frac{1}{h_{22}} \end{bmatrix}$ |
| $\begin{bmatrix} \frac{z_{22}}{\Delta_Z} & \frac{-z_{12}}{\Delta_Z} \\ \frac{-z_{21}}{\Delta_Z} & \frac{z_{11}}{\Delta_Z} \end{bmatrix}$ | $\begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix}$ | $\begin{bmatrix} \frac{D}{B} & \frac{-\Delta_T}{B} \\ -\frac{1}{B} & \frac{A}{B} \end{bmatrix}$ | $\begin{bmatrix} \frac{1}{h_{11}} & \frac{-h_{12}}{h_{11}} \\ \frac{h_{21}}{h_{11}} & \frac{\Delta_H}{h_{11}} \end{bmatrix}$ |
| $\begin{bmatrix} \frac{z_{11}}{z_{21}} & \frac{\Delta_Z}{z_{21}} \\ \frac{1}{z_{21}} & \frac{z_{22}}{z_{21}} \end{bmatrix}$ | $\begin{bmatrix} \frac{-y_{22}}{y_{21}} & \frac{-1}{y_{21}} \\ \frac{-\Delta_Y}{y_{21}} & \frac{-y_{11}}{y_{21}} \end{bmatrix}$ | $\begin{bmatrix} A & B \\ C & D \end{bmatrix}$ | $\begin{bmatrix} \frac{-\Delta_H}{h_{21}} & \frac{-h_{11}}{h_{21}} \\ \frac{-h_{22}}{h_{21}} & \frac{-1}{h_{21}} \end{bmatrix}$ |
| $\begin{bmatrix} \frac{\Delta_Z}{z_{22}} & \frac{z_{12}}{z_{22}} \\ \frac{-z_{21}}{z_{22}} & \frac{1}{z_{22}} \end{bmatrix}$ | $\begin{bmatrix} \frac{1}{y_{11}} & \frac{-y_{12}}{y_{11}} \\ \frac{y_{21}}{y_{11}} & \frac{\Delta_Y}{y_{11}} \end{bmatrix}$ | $\begin{bmatrix} \frac{B}{D} & \frac{\Delta_T}{D} \\ -\frac{1}{D} & \frac{C}{D} \end{bmatrix}$ | $\begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix}$ |

$$z_{11} = \frac{\Delta_H}{h_{22}}$$

# Interconnection Of Two Port Networks

Three ways that two ports are interconnected:

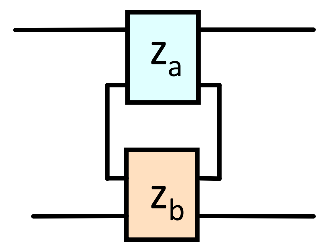
* Parallel




***Y parameters***

$$[y] = [y_a] + [y_b]$$

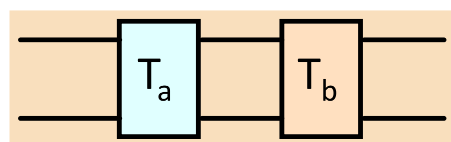
* Series




***Z parameters***

$$[z] = [z_a] + [z_b]$$

* Cascade



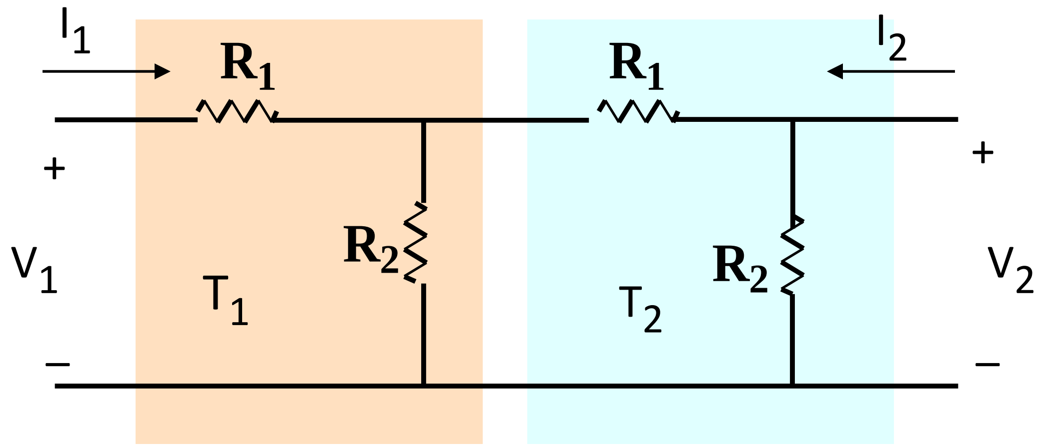

***ABCD parameters***

$$[T] = [T_a]\,[T_b]$$

# Interconnection Of Two Port Networks

Consider the following network:

Find $\frac{V_2}{V_1}$




Referring to slide 13 we have;

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} \frac{R_1 + R_2}{R_2} & R_1 \\ \frac{1}{R_2} & 1 \end{bmatrix} \begin{bmatrix} \frac{R_1 + R_2}{R_2} & R_1 \\ \frac{1}{R_2} & 1 \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$$

# Interconnection Of Two Port Networks

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} \dfrac{R_1 + R_2}{R_2} & R_1 \\ \dfrac{1}{R_2} & 1 \end{bmatrix} \begin{bmatrix} \dfrac{R_1 + R_2}{R_2} & R_1 \\ \dfrac{1}{R_2} & 1 \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$$

Multiply out the first row:

$$V_1 = \left[ \left[ \left( \frac{R_1 + R_2}{R_2} \right)^2 + \frac{R_1}{R_2} \right] V_2 \;+\; \left[ \left( \frac{R_1 + R_2}{R_2} \right) R_1 + R_1 \right] (-I_2) \right]$$

Set $I_2 =$ 0 ( as in the diagram)

$$\frac{V_2}{V_1} = \frac{R_2^{\;2}}{R_1^{\;2} + 3R_1R_2 \;\; R_2^{\;2}}$$

Can be verified directly by solving the circuit

# THANKS….

Queries Please…