NETWORK THEORY

LECTURE 3

SECTION C

TOPIC COVERED : Transmission parameters, hybrid parameters, relationships between parameter sets,Inter-connection of two port networks.

Now, The Z-parameter eq. for network N_a is

$$\begin{bmatrix} V_{1a} \\ V_{2a} \end{bmatrix} = \begin{bmatrix} Z_{11a} & Z_{12a} \\ Z_{21a} & Z_{22a} \end{bmatrix} \begin{bmatrix} I_{1a} \\ I_{2a} \end{bmatrix}$$

Similarly for network N_b.

$$\begin{bmatrix} V_{1b} \\ V_{2b} \end{bmatrix} = \begin{bmatrix} Z_{11b} & Z_{12b} \\ Z_{21b} & Z_{22b} \end{bmatrix} \begin{bmatrix} I_{1b} \\ I_{2b} \end{bmatrix}$$

Then, series connection required that

$$I_1 = I_{1a} = I_{1b}.\ I_2 = I_{2a} = I_{2b}$$

$$V_1 = V_{1a} + V_{1b}.\ V_2 = V_{2a} + V_{2b}$$

Now, $$V_1 = V_{1a} + V_{1b} = (Z_{11a}\, I_{1a} + Z_{12a}\, I_{2a}) + (Z_{11b}\, I_{1b} + Z_{12b}\, I_{2b})$$

$$V_1 = (Z_{11a} + Z_{11b})\, I_1 + (Z_{12a} + Z_{12b}) I_2$$

Because $I_1 = I_{1a} = I_{1b}$ and $I_2 = I_{2a} = I_{2b}$

Similarly, $$V_2 = V_{2a} + b_{2b} = (Z_{21a} + Z_{21b})\, I_1 + (Z_{22a} + Z_{22b}) I_2$$

Z-parameters of the series connected combined network can be written in matrix form as follows.

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

Here $$Z_{11} = Z_{11a} + Z_{11b}$$

$$Z_{12} = Z_{12a} + Z_{12b}$$

$$Z_{21} = Z_{21a} + Z_{21b}$$

$$Z_{22} = Z_{22a} + Z_{22b}$$

so, in the matrix form

$$[Z] = [Z_a] + [Z_b]$$

- This is the generalised form for any number of two port network connected in series.

PARALLEL CONNECTION

Parallel connection of two-port networks a and b with short circuit admittance parameters Y_a and Y_b which is shown in Fig. 5.62. The Y-parameters of the parallel connection are

$$Y_{11} = Y_{11,a} + Y_{11,b}$$

$$Y_{12} = Y_{12,a} + Y_{12,b}$$

$$Y_{21} = Y_{21,a} + Y_{21,b}$$

$$Y_{22} = Y_{22,a} + Y_{22,b}$$

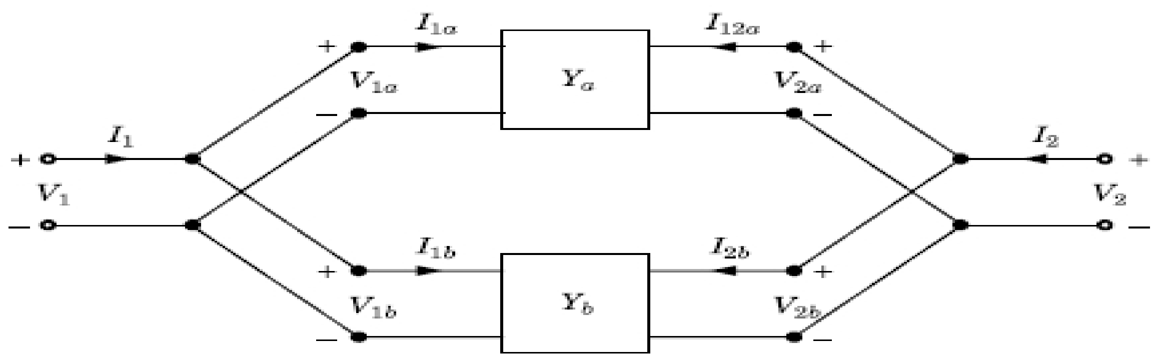

Fig. 5.62

or in the matrix form

$$[Y] = [Y_a] + [Y_b]$$

SERIES PARALLEL CONNECTION

Series parallel connection of two port networks is shown in Fig. 5.63.

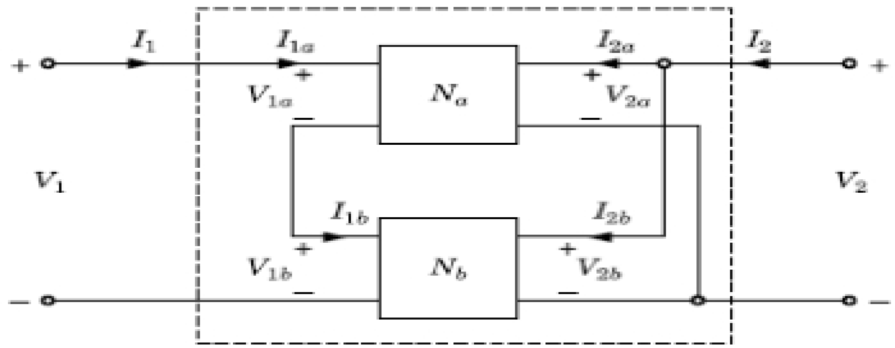

Fig. 5.63

Now, the connection require that

$$V_1 = V_{1a} + V_{1b}$$
$$I_1 = I_{1a} = I_{1b}$$
$$V_2 = V_{2a} = V_{2b}$$
$$I_2 = I_{2a} + I_{2b}$$

For Network N_a

$$\begin{bmatrix} V_{1a} \\ I_{2a} \end{bmatrix} = \begin{bmatrix} h_{11a} & h_{12a} \\ h_{21a} & h_{22a} \end{bmatrix} \begin{bmatrix} I_{1a} \\ V_{2a} \end{bmatrix}$$

imilarly, for network N_b,

$$\begin{bmatrix} V_{1b} \\ I_{2b} \end{bmatrix} = \begin{bmatrix} h_{11b} & h_{12b} \\ h_{21b} & h_{22b} \end{bmatrix} \begin{bmatrix} I_{1b} \\ V_{2b} \end{bmatrix}$$

o

$$\begin{bmatrix} V_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} V_{1a} \\ I_{2a} \end{bmatrix} + \begin{bmatrix} V_{1b} \\ V_{2b} \end{bmatrix} = \begin{bmatrix} h_{11a} + h_{11b} & h_{12a} + h_{12b} \\ h_{21a} + h_{21b} & h_{22a} + h_{22b} \end{bmatrix} \begin{bmatrix} I_1 \\ V_2 \end{bmatrix}$$

Now, h-parameters of the series-parallel connected network can be written in matrix form as ollows :

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

Here

$$h_{11} = h_{11a} + h_{11b}$$

$$h_{12} = h_{12a} + h_{12b}$$

$$h_{21} = h_{21a} + h_{21b}$$

$$h_{22} = h_{22a} + h_{22b}$$

r in the matrix form

$$[h] = [h_a] + [h_b]$$

PARALLEL SERIES CONNECTION

Parallel-series connection of two-port networks are shown in Fig. 5.64

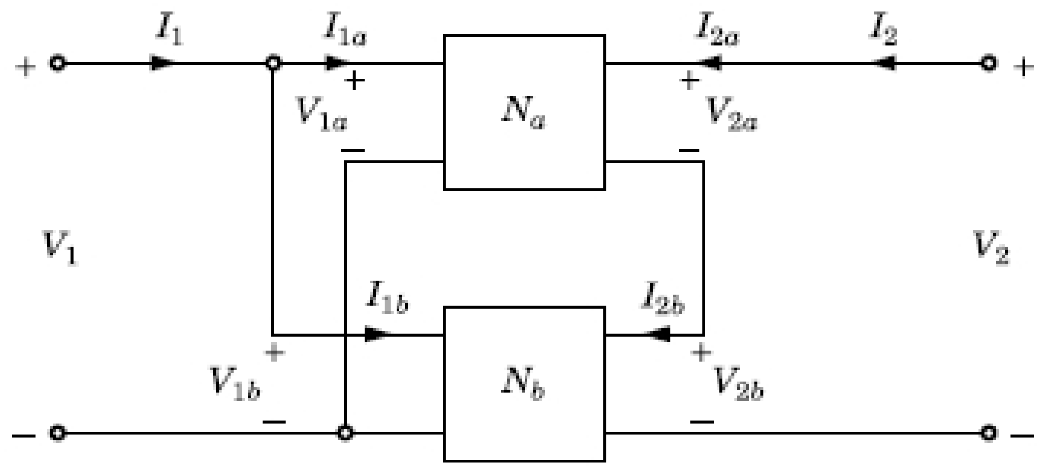

Fig. 5.64 Parallel series connection of two port

As similar to previous case, we get

$$[g] = [g_a] + [g_b]$$

SUMMARY

S. No.	*Inter Connection*	*Different Parameter Matrix*	*Overall Parameter Matrix*
1	Cascade	$[T_a]$, $[T_b]$	$[T] = [T_a]\ [T_b]$
2	Series	$[Z_a]$, $[Z_b]$	$[Z] = [Z_a] + [Z_b]$
3	Parallel	$[Y_a]$, $[Y_b]$	$[Y] = [Y_a] + [Y_b]$
4	Series-parallel	$[h_a]$, $[h_b]$	$[h] = [h_a] + [h_b]$
5	Parallel-series	$[g_a]$, $[g_b]$	$[g] = [g_a] + [g_b]$