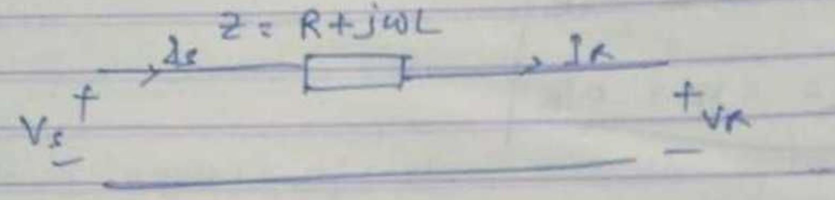
(1) ABCD parameters of Transmission Line

(1.) Short transmission Line-

In short transmission line only impedance is there



$$I_s = I_R = 0 \cdot V_R + 1 \cdot I_R.$$

applying KVL in above loop we get.

$$V_s = V_R + I_R Z = 1 \cdot V_R + Z I_R.$$

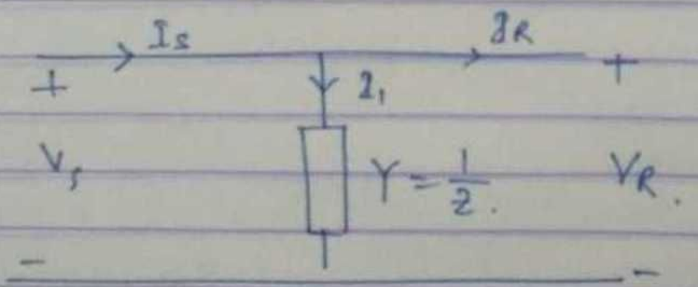
matrix form

**

$$\begin{bmatrix} V_s \\ I_s \end{bmatrix} = \begin{bmatrix} 1 & Z \\ 0 & 1 \end{bmatrix} \begin{bmatrix} V_R \\ I_R \end{bmatrix}$$

So, ABCD parameter is 1, Z, 0, 1.

(2) Admittance (Y) Network



$$V_R = V_s = 1 \cdot V_R + 0 \cdot I_R$$

$$I_s = I_R + I_1$$

$$= I_R + V_R Y$$

$$= Y V_R + 1 \cdot I_R.$$

$I = \frac{V}{Z}$ $\quad Y = \frac{1}{Z}$

$I = \frac{V}{1/Y}$

$I = V_R Y$

$V_s = 1 \cdot V_R + 0 \cdot I_R$

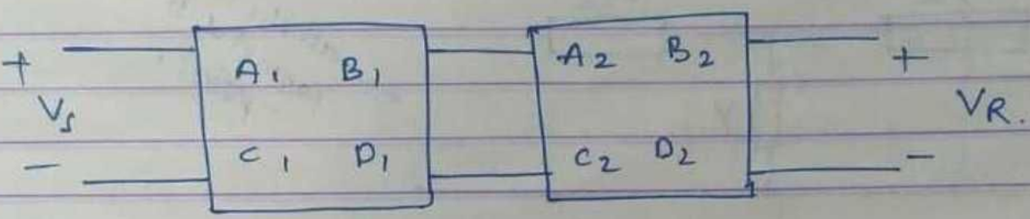
$$\begin{bmatrix} V_s \\ I_s \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ Y & 1 \end{bmatrix} \begin{bmatrix} V_R \\ I_R \end{bmatrix}$$

So, for the addmittance network ABCD parameter is

$$\begin{bmatrix} 1 & 0 \\ Y & 1 \end{bmatrix}$$

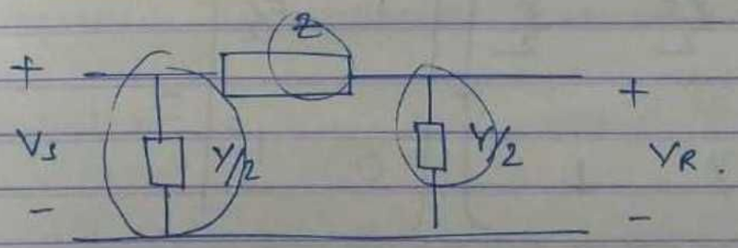
Y → Admittance.

(3) Cascading Network



$$\begin{bmatrix} A_1 & B_1 \\ C_1 & D_1 \end{bmatrix} \times \begin{bmatrix} A_2 & B_2 \\ C_2 & D_2 \end{bmatrix} = \text{overall ABCD Parameter.}$$

(4) Nominal π - Network.

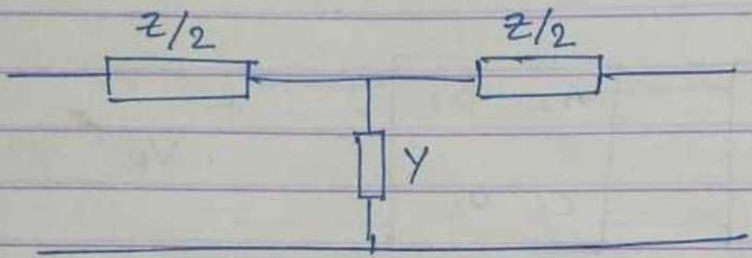


$$\begin{bmatrix} 1 & 0 \\ Y/2 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & Z \\ 0 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 0 \\ Y/2 & 1 \end{bmatrix} = \begin{bmatrix} 1 & Z \\ Y/2 & \frac{Y^2}{2}+1 \end{bmatrix} \times \begin{bmatrix} 1 & 0 \\ Y/2 & 1 \end{bmatrix} =$$

$$= \begin{bmatrix} 1+\frac{YZ}{2} & Z \\ \frac{Y}{2}+\frac{Y}{2}\left(1+\frac{YZ}{2}\right) & 1+\frac{YZ}{2} \end{bmatrix}$$

$$= \begin{bmatrix} 1+\frac{YZ}{2} & Z \\ Y\left(1+\frac{YZ}{4}\right) & 1+YZ \end{bmatrix}$$

5. <u>Nominal T Network</u>



← all the capacitance is connected to the point.

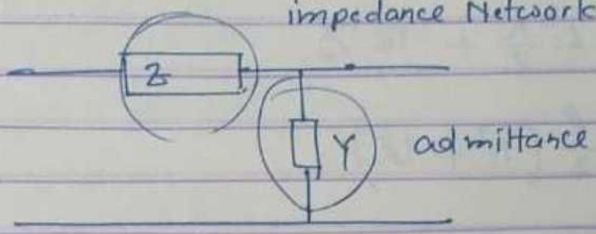
$$\begin{bmatrix} 1 & Z/2 \\ 0 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 0 \\ Y & 1 \end{bmatrix} \times \begin{bmatrix} 1 & Z/2 \\ 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1+\frac{YZ}{2} & \frac{Z}{2} \\ Y & 1 \end{bmatrix} \begin{bmatrix} 1 & Z/2 \\ 0 & 1 \end{bmatrix} = \Rightarrow$$

$$\begin{bmatrix} 1+\frac{YZ}{2} & \left(1+\frac{YZ}{2}\right)\frac{Z}{2}+\frac{Z}{2} \\ Y & 1+YZ/2 \end{bmatrix}$$

$$Z \begin{bmatrix} 1+\frac{YZ}{2} & Z\left(1+\frac{YZ}{4}\right) \\ Y & 1+\frac{YZ}{2} \end{bmatrix}$$

(b) <u>End condenser Networks</u>



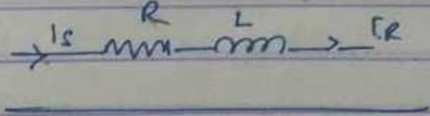
$$\begin{bmatrix} 1 & Z \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ Y & 1 \end{bmatrix} = \begin{bmatrix} 1+YZ & Z \\ Y & 1 \end{bmatrix}$$

$A \neq D$, so, this network is not symmetrical.

$AD - BC = 1 \longrightarrow$ Reciprocal.

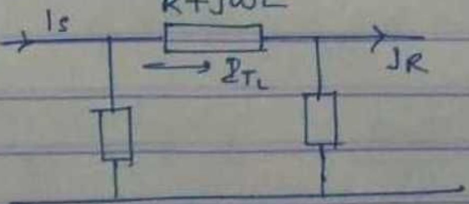
$\Rightarrow$ power losses in Transmission lines $\longrightarrow$

short TL $\rightarrow$



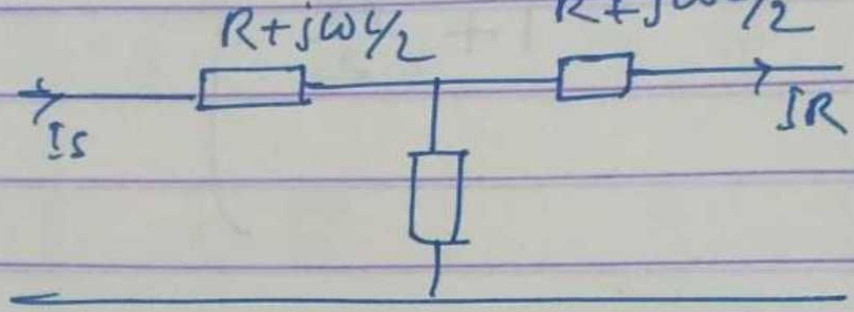
$$P_{Loss} = I_S^2 R = I_R^2 R.$$

Nominal π - Network $\longrightarrow$



$$P_L = I_{TL}^2 R.$$

Nominal T Network -



power loss.

$$P_L = I_s^2 \frac{R}{2} + I_R^2 R/2$$

$$= \frac{R}{2}\left(I_s^2 + I_R^2\right)$$