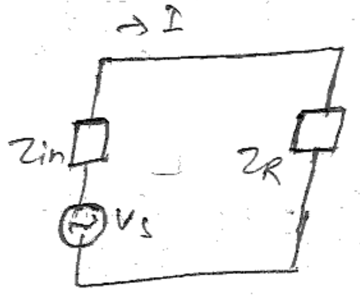
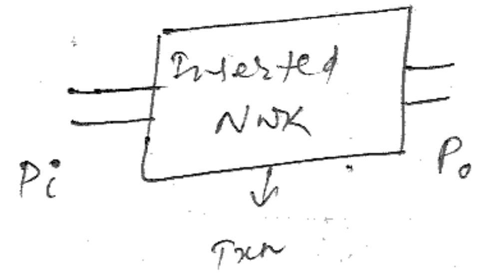
Insertion loss (I_L) :(loss of energy in txn. line)

$I_L = 20\log \frac{P_i}{P_o}$



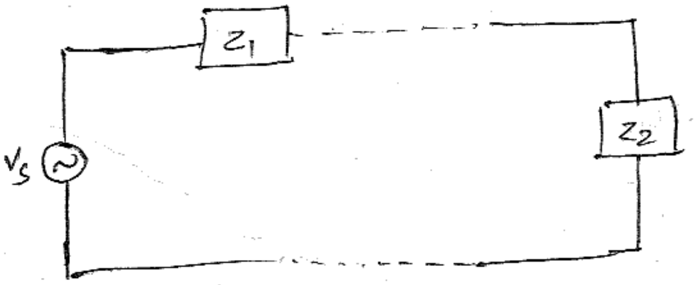
when Zin & ZR are in same phase.



J. S.
09/07/11

11/07/11.

Reflection factor and Reflection loss



$\frac{I_2}{I_1} = \sqrt{\frac{Z_1}{Z_2}}$

$I_1 = \frac{V_s}{2Z_1}$ ← source end

without matching: $|I_2'| = I_1 \sqrt{\frac{Z_1}{Z_2}} = \frac{V_s}{2\sqrt{Z_1 \cdot Z_2}}$

with matching condition,

$$|I_2| = \frac{V_s}{Z_1+Z_2}$$

$$\boxed{\begin{array}{l} 1\,\text{neper} = 8.686\,dB \\ 1\,dB = 0.115\,\text{neper} \end{array}}$$

$$\left|\frac{I_2}{I_2'}\right| = K = \frac{V_s}{Z_1+Z_2} \times \frac{2\sqrt{Z_1 Z_2}}{V_s}$$

$$\boxed{\left|\frac{I_2}{I_2'}\right| = \frac{2\sqrt{Z_1 Z_2}}{Z_1+Z_2}}$$

$$\boxed{\text{Reflection loss} = \frac{1}{K} = \frac{Z_1+Z_2}{2\sqrt{Z_1 Z_2}}}$$

Q) $R = 10\,\Omega/km$, $L = 0.004\,H/km$

$G = 0.4\times10^{-6}$ mho/km, $C = 0.008\times10^{-6}$ F/km.

Determine Z_0, α, β at 2KHz

$Z = R + j\omega L$

$Y = G + j\omega C$

Soln:

$Z = R + j\omega L$ ← Rectangular form. $[\omega = 2\pi f]$

$= 10 + j\times2\times3.14\times1000\times0.004$

$= 10 + j25.12$ [∵ Pol (10, 25.12)] & press α and tan]

$\boxed{\cancel{Z = 27.03}}$

$$\boxed{Z = 27.03\ \angle 68.3^\circ}$$

Similarly

$Y = \cancel{50.24 \times 10^{-6} \sqrt{89.54}}$

$Y = 50.24 \times 10^{-6} \angle 89.54^\circ$

$Z_0 = \sqrt{Z/Y}$

$= \sqrt{\dfrac{27.04 \angle 68.3}{50.24 \times 10^{-6} \angle 89.54^\circ}}$

$= \sqrt{5.38 \times 10^5} \angle \left(\dfrac{-21.24}{2}\right)$ $\left[\because \angle \dfrac{68.3 - 89.54}{2}\right]$

$= \sqrt{53.8 \times 10^4} \angle (-10.62)$

$\boxed{Z_0 = 7.3 \times 10^2 \angle -10.62}$

$\boxed{\gamma = 0.0368 \angle 78.92^\circ}$

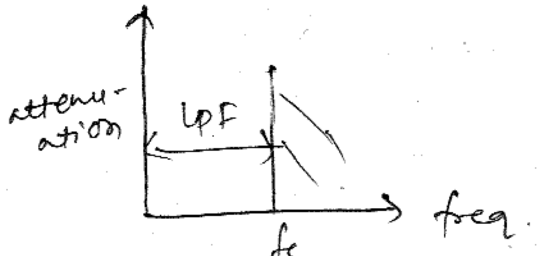
7]

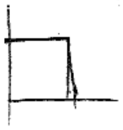
14/07/11.

UNIT-I

FILTER.

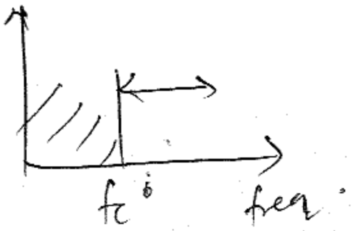
LPF, BPF,
BSF.
Band elimination filter



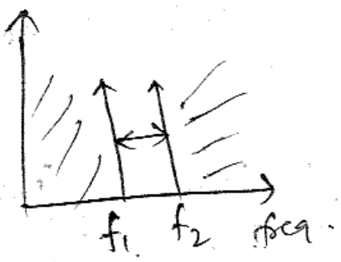


LPF

freq. passes below fc (cut-off)



HPF



BPF

filter
- active
  - transistor, op-amp.
- passive

~~Attenuation~~ Filter: The n/w which freely passes with the desired value of freq. & it supresses the rest of frequencies.

~~Attenuation~~
in (~~Nepers~~)

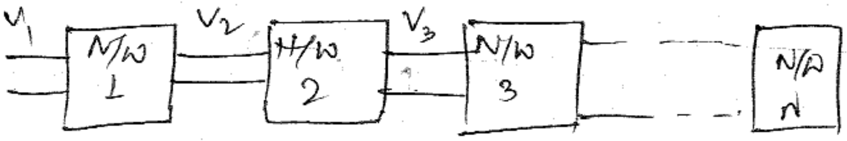
Attenuation in (Neper) $= \ln\left(\frac{V_1}{V_2}\right)$ (or) $\ln\left(\frac{I_1}{I_2}\right)$

$$\frac{P_1}{P_2} = e^{2N}$$

$\log e^m$
$m \log e$

Attenuation (dB)

$$N = 10\log_{10}\left(\frac{P_1}{P_2}\right)$$



$N_1 =$

$N_2 =$

Total Attn $= N = N_1 + N_2$

$$\log(P_1/P_2) = \log e^{2N}$$

$$\log(P_1/P_2) = 2N \log e \quad [\because \log e = 1]$$

$$2N = \log(P_1/P_2)$$

$$N = 1/2 \log(P_1/P_2)$$

i.e. $\boxed{N = 1/2 \ln (P_1/P_2)}$

he
ences

$$N_1 = \ln\left(\frac{V_1}{V_2}\right)$$

$$N_2 = \ln\left|\frac{V_2}{V_3}\right|$$

$$N = \ln\left(\frac{V_1}{V_2}\right) + \ln\left(\frac{V_2}{V_3}\right)$$

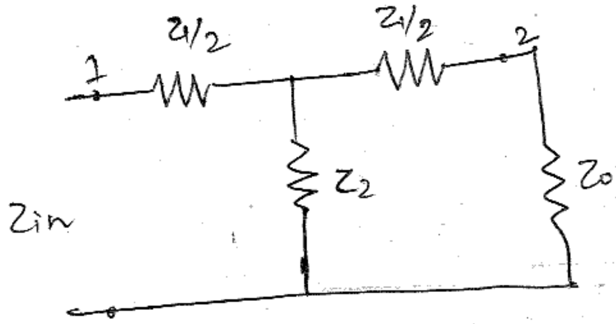
$$= \ln\left(\frac{V_1}{\cancel{V_2}} \times \frac{\cancel{V_2}}{V_3}\right) = \ln\left(V_1/V_3\right)$$

$$\boxed{N = \ln\left(V_1/V_3\right)}$$

//,

Characteristic Impedence of T-section

Symmetrical Networks:



Zin =

$\boxed{Z_{in} = Z_0}$ (for symmetric N/W)

~~Z0~~

$$Z_{0T} = \sqrt{Z_1 Z_2 + \frac{Z_1^2}{4}}$$

$$Z_{in} = \frac{Z_1}{2} + Z_2 \parallel \frac{Z_1}{2}\left(Z_1/2 + Z_0\right)$$

$$Z_{in} = \frac{Z_1}{2} + \frac{Z_2(Z_1/2 + Z_0)}{Z_2 + \frac{Z_1}{2} + Z_0}$$

For a symmetric n/w.

$$\boxed{Z_{in} = Z_0}$$

$$Z_0 = \frac{Z_1}{2} + \frac{Z_2(Z_1/2 + Z_0)}{Z_2 + \frac{Z_1}{2} + Z_0}$$

$$Z_0 = \frac{\frac{Z_1}{2}\left(Z_2 + \frac{Z_1}{2} + Z_0\right) + Z_2\left(Z_1/2 + Z_0\right)}{Z_2 + \frac{Z_1}{2} + Z_0}$$

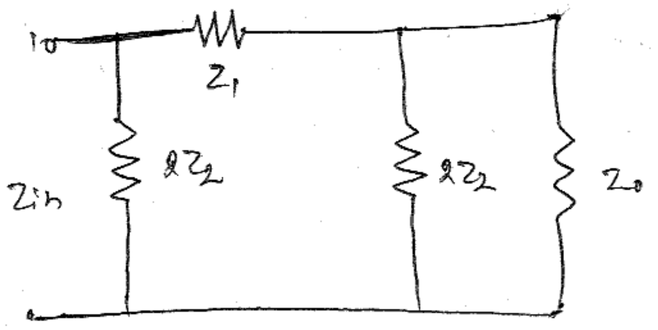
$$Z_0\left(Z_2 + \frac{Z_1}{2} + Z_0\right) = \frac{Z_1 Z_2}{2} + \frac{Z_1^2}{4} + \frac{Z_0 Z_1}{2} + \frac{Z_1 Z_2}{2} + Z_0 Z_2$$

$$\cancel{Z_0 Z_2} + \cancel{\frac{Z_1 Z_0}{2}} + Z_0^2 = \frac{Z_1 Z_2}{2} + \frac{Z_1^2}{4} + \cancel{\frac{Z_0 Z_1}{2}} + \frac{Z_1 Z_2}{2} + \cancel{Z_0 Z_2}$$

$$Z_0^2 = Z_1 Z_2 + \frac{Z_1^2}{4}$$

$$\boxed{Z_{0T} = \sqrt{Z_1 Z_2 + \frac{Z_1^2}{4}}}$$

For T-N/W



$\boxed{Z_{in} = Z_0}$

$\frac{Z_1Z_2}{2} + Z_0Z_2$

$+ Z_0Z_2$

$\boxed{HW}$

$$Z_{in} = \left[(Z_0 \| 2Z_2) + Z_1\right] \| 2Z_2$$

$$= 2Z_2 \| \left[Z_1 + \frac{Z_0 2Z_2}{Z_0 + 2Z_2}\right]$$

$$= \frac{2Z_2\left(Z_1 + \frac{2Z_0Z_2}{Z_0 + 2Z_2}\right)}{2Z_2 + Z_1 + \frac{2Z_0Z_2}{Z_0 + 2Z_2}}$$

$$= \frac{2Z_1Z_2 + \frac{4Z_0Z_2^2}{Z_0 + 2Z_2}}{\frac{2Z_0Z_2 + Z_0Z_1 + 2Z_1Z_2 + 2Z_0Z_2 + 4Z_2^2}{Z_0 + 2Z_2}}$$

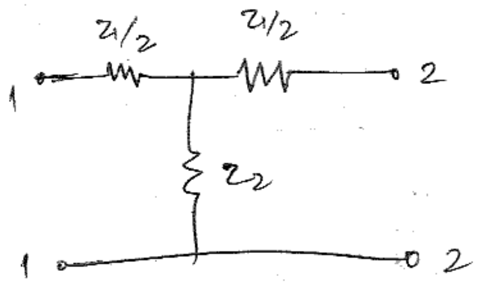
$$Z_0 = \frac{2Z_0Z_1Z_2 + 4Z_1Z_2^2 + 4Z_0Z_2^2}{2Z_0Z_2 + Z_0Z_1 + 2Z_1Z_2 + 4Z_2^2 + 2Z_0Z_2}$$

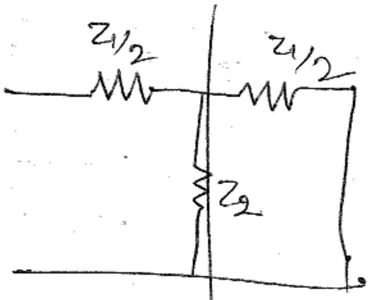
$$Z_0 \cancel{\; 4Z_0^2Z_2 + Z_0^2Z_1 = 2Z_0Z_1Z_2 + 4Z_1Z_2^2 + 4Z_0Z_2^2}$$

$$Z_{0T}^2 = \frac{Z_1^2Z_2^2}{Z_{0T}^2}$$

$$Z_{0T} = \frac{Z_1 Z_2}{Z_{0T}}$$

In terms of open and short ckt. Impedence





$$Z_{oc} = \frac{Z_1}{2} + Z_2 + \frac{Z_1}{2} + Z_2$$

$$Z_{oc} = \frac{2Z_1}{2} + 2Z_2$$

$$Z_{oc} = Z_1 + 2Z_2$$

$$Z_{oc} = \frac{Z_1}{2} + Z_2 + \frac{Z_1}{2} + Z_2$$

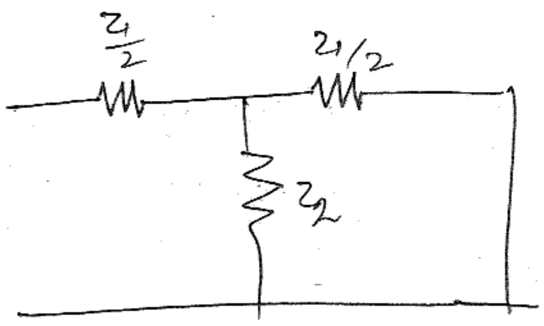
$$= 2\frac{Z_1}{2} + 2Z_2$$

$$\boxed{Z_{oc_1} = Z_{oc_2} = Z_{oc} = \frac{Z_1}{2} + Z_2}$$

$$Z_{sc} = \frac{Z_1}{2} + \left[\frac{\frac{Z_1}{2} \cdot Z_2}{\frac{Z_1}{2} + Z_2}\right]$$

$$= \frac{Z_1}{2} + \frac{Z_2 \cdot \frac{Z_1}{2}}{\frac{Z_1}{2} + Z_2}$$

$$= \frac{\left(\frac{Z_1}{2}\right)^2 + \frac{Z_1}{2} Z_2 + Z_2 \frac{Z_1}{2}}{\frac{Z_1}{2} + Z_2}$$



$$Z_{sc} = \frac{Z_1}{2} + \left[\frac{\frac{Z_1}{2}\cdot Z_2}{\frac{Z_1}{2}+Z_2}\right]$$

$$= \frac{Z_1}{2} + \frac{\frac{Z_1 Z_2}{2}}{\frac{Z_1+2Z_2}{2}}$$

$$= \frac{Z_1}{2} + \frac{Z_1 Z_2}{Z_1+2Z_2}$$

$$= \frac{Z_1^2 + 2Z_1Z_2 + 2Z_1Z_2}{2(Z_1+2Z_2)}$$

$$Z_{sc} = \frac{Z_1^2 + 4Z_1Z_2}{2(Z_1+2Z_2)} = \frac{4\left[\frac{Z_1^2}{4} + Z_1Z_2\right]}{4\left(\frac{Z_1}{2}+Z_2\right)}$$

$$= \frac{Z_1^2/4 + Z_1Z_2}{\frac{Z_1}{2}+Z_2} = \frac{Z_{oT}^2}{Z_{oc}}$$

$$Z_{oT}^2 = Z_{oc}\cdot Z_{sc}$$

$$Z_{oT} = \sqrt{Z_{oc}\cdot Z_{sc}}$$

$$\therefore \boxed{Z_{oT} = \sqrt{Z_{oc}\cdot Z_{sc}}}$$

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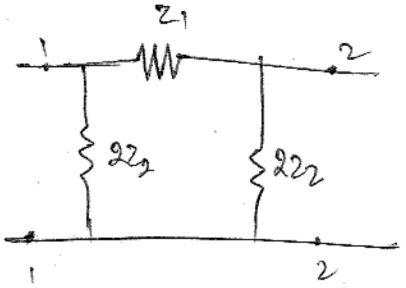
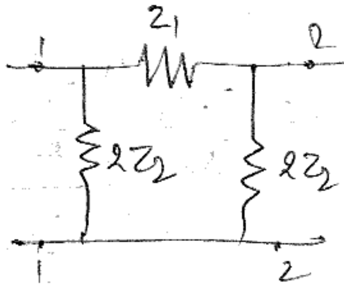
18/07/11.

Characteristic impedance of π-N/W. w.r. to S.C. and O.C. Impedance.



for open ckt. impedance



For short ckt impedance.

O.C π-Network:

$2Z_2 \parallel (Z_1 + 2Z_2)$

$$\frac{2Z_2\,(Z_1+2Z_2)}{2Z_2+Z_1+2Z_2}$$

S.C. π-Network

$2Z_2 \parallel Z_1$

$$\frac{2Z_1Z_2}{2Z_2+Z_1}$$

So now,

$$S.C \times O.C = \frac{2Z_1Z_2}{2Z_2+Z_1} \cdot \frac{2Z_2(Z_1+2Z_2)}{Z_1+4Z_2}$$

$$= \frac{2Z_1Z_2 \cdot 2Z_2\,\cancel{(Z_1+2Z_2)}}{(Z_1+4Z_2)\cancel{(Z_1+2Z_2)}}$$

$$= \frac{4Z_1Z_2^2}{Z_1+4Z_2}$$

Now, multiply and divide by '$\frac{Z_1}{4}$'

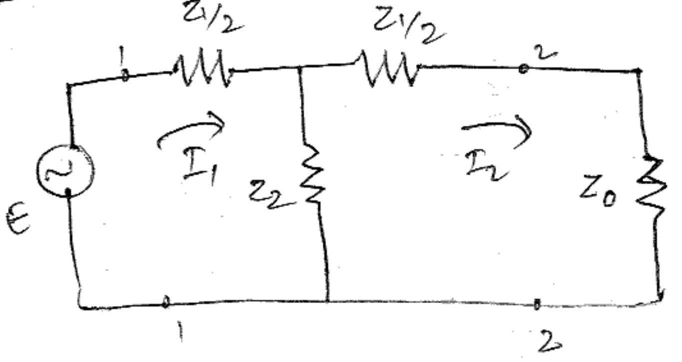
$$Z_{0\pi}^2 = \frac{Z_1^2 Z_2^2}{\frac{Z_1^2}{4} + Z_1 Z_2}$$

$$Z_{0\pi} = \frac{Z_1 Z_2}{\sqrt{Z_1 Z_2 + \frac{Z_1^2}{4}}}$$

$$\boxed{Z_{0\pi} = \frac{Z_1 Z_2}{Z_{0T}}}$$

& [$\because Z_{0T} = \sqrt{Z_{sc} \cdot Z_{oc}}$
(or)
$Z_{0\pi} = \sqrt{Z_{sc} \cdot Z_{oc}}$].

properties of symmetrical Network



$$E = I_1\left(\frac{Z_1}{2} + Z_2\right) - I_2 Z_2 \quad \text{—} ①$$

$$0 = I_2\left(Z_1/2 + Z_0 + Z_2\right) - I_1 Z_2 \quad \text{—} ②$$

$$I_1 Z_2 = I_2\left[Z_1/2 + Z_0 + Z_2\right]$$

[$\because$ sum of individual propagation const = individual const]

$$\frac{I_1}{I_2} = \left[\frac{Z_1/2 + Z_0 + Z_2}{Z_2}\right]$$

[$\because \frac{I_1}{I_2} = e^{\gamma}$]

$\therefore \frac{Z_1}{2} + Z_0 + Z_2 = Z_2 e^{\gamma}$

$$\boxed{e^{\gamma} = 1 + \frac{Z_0}{Z_2} + \frac{Z_1}{2Z_2}}$$

$$e^{\gamma} = 1 + \frac{Z_1}{2Z_2} + \frac{\sqrt{\frac{Z_1^2}{4} + Z_1 Z_2}}{Z_2}$$

$$e^{\gamma} = 1 + \frac{Z_1}{2Z_2} + \sqrt{\frac{Z_1^2}{4Z_2^2} + \frac{Z_1}{Z_2}} \quad \text{— (1)}$$

$$e^{-\gamma} = 1 + \frac{Z_1}{2Z_2} - \sqrt{\frac{Z_1^2}{4Z_2^2} + \frac{Z_1}{Z_2}} \quad \text{— (2)}$$

$$e^{\gamma} + e^{-\gamma} = 2\left[1 + \frac{Z_1}{2Z_2}\right]$$

$$\frac{e^{\gamma} + e^{-\gamma}}{2} = 1 + \frac{Z_1}{2Z_2}$$

$$\boxed{\cosh\gamma = 1 + \frac{Z_1}{2Z_2}}$$

$$\frac{e^{\gamma} - e^{-\gamma}}{2} = \sqrt{\frac{Z_1^2}{4Z_2^2} + \frac{Z_1}{Z_2}}$$

$$\boxed{\sinh\gamma = \sqrt{\frac{Z_1^2}{4Z_2^2} + \frac{Z_1}{Z_2}}}$$

$$\sinh \gamma = \frac{1}{Z_2}\sqrt{\frac{Z_1^2}{4Z_2^2} + Z_1 \cdot Z_2}$$

$$\boxed{\sinh \gamma = \frac{Z_0}{Z_2}}$$

//