Unit - 3

1) What is attenuator? and what type elements are used in attenuators and why?

Ans → An attenuator is a two-port network and is used to reduce the signal level by a given amount. It is necessary to introduce a specified loss between source and a matched load without altering impedance relationship. In attenuators only resistances are used to reduce. Signal strength Attenuation is always expressed in dB or Neper

$$\text{Attenuation in dB} = 10 \log_{10} (P_1/P_2)$$

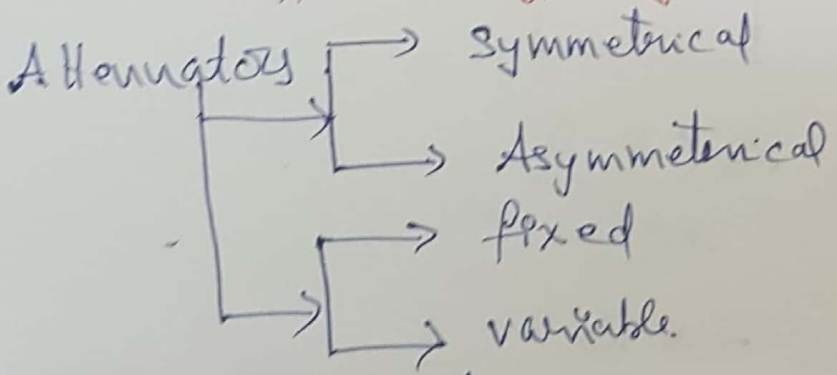
where P_1 is i/p power P_2 is o/p power

$$\text{or dB} = 20 \log V_1/V_2$$

$$\frac{V_1}{V_2} = \frac{I_1}{I_2} = N$$

$$\text{so} \Rightarrow N = \text{antilog}_{10}\left(\frac{dB}{20}\right)$$

2) Write different types of attenuators



A fixed attenuator with constant attenuation is called 'pad'

Variable attenuators are used in volume control circuits

3) Write any four applications of attenuator

Ans → ① Fixed attenuator are called pad. They are used to introduce fixed attenuation factor in the n/w. Generally to measure high voltage (or) current we use attenuator at front end.

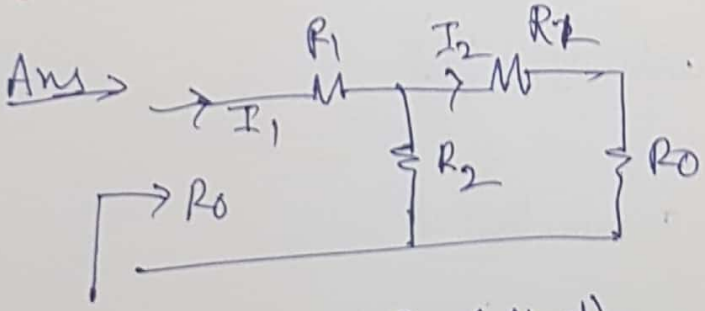
② Variable attenuator are used in volume control, Automatic control, gain control circuits

③ In communication networks like radio broadcasting, telephone sections

④ In laboratory to obtain small value of voltage or current for testing circuits

4) Write the T-type symmetrical attenuator with circuit and formulae for R_1 & R_2 (design resistance)

Ans →



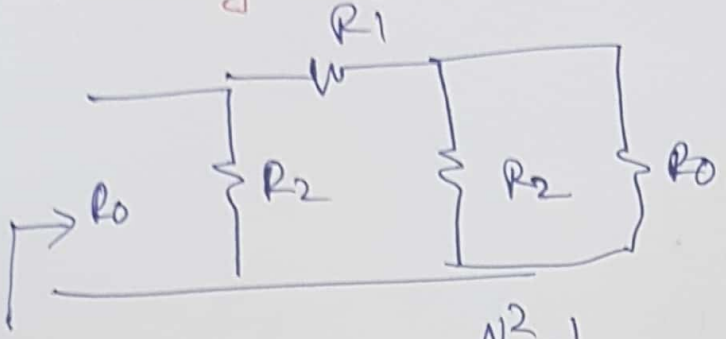
$$\frac{I_1}{I_2} = N$$

$$R_1 = \frac{R_0 (N-1)}{N+1}$$

$$R_2 = \frac{2N R_0}{N^2 - 1}$$

theory

(5) Write π - type Symmetrical attenuator network with design resistance R_1 & R_2 values in terms of R_0 & N (3)



wkt for π Sym N/w

$R_1 = R_0 \sinh\alpha$

$R_2 = R_0 \coth\alpha/2$

$e^{\alpha} = \frac{I_1}{I_2} = N$

$$R_1 = R_0 \frac{N^2-1}{2N}$$

$$R_2 = \frac{R_0 (N+1)}{(N-1)}$$

(6) Design π - type attenuator to give 20 dB attenuation and to have chs impedance R_0 of 100Ω

Ans → given $R_0 = 100\Omega$

D ~~Attn dB~~ = 20 dB

$N = \text{Antilog } \frac{D}{20} = \text{Antilog } \frac{20}{20}$

$= 10$

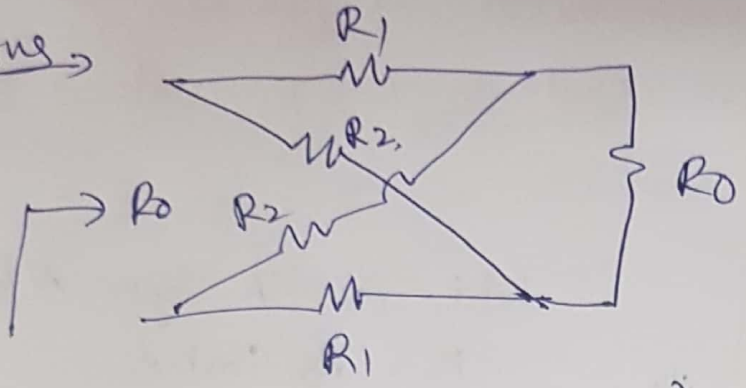
$R_1 = R_0 (N^2-1)/2N$

$= \frac{100}{20}(100-1) = 99 \times 5 = 495\Omega$

$R_2 = \frac{R_0 (N+1)}{N-1} = \frac{100 \times 11}{9} = 122.22\Omega$

(7) Write the Latice (Symmetrical) attenuator N/w and formulae for series and shunt arm resistances.

Ans →



WKT $R_0 = \sqrt{R_1 R_2}$

$$R_1 = R_0\left(\frac{N-1}{N+1}\right)$$

$$R_2 = R_0\left(\frac{N+1}{N-1}\right)$$

(8) Design a symmetrical latice attenuator to have Chs impedance of 800Ω and D = 20dB

Ans → $R_0 = 800\Omega$

$D = 20dB$

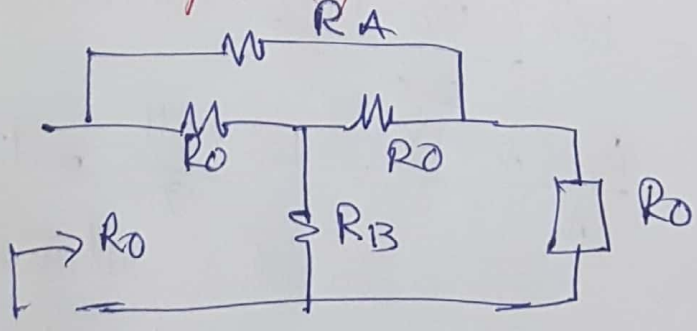
So $N = \text{Antilog}\frac{20}{20} = 10$

$$R_1 = R_0\left(\frac{N-1}{N+1}\right) = 800\left(\frac{9}{11}\right) = 655\Omega$$

$$R_2 = R_0\left(\frac{N+1}{N-1}\right) = 800\left(\frac{11}{9}\right) = 9782$$

(9) Write the Symmetric Bridge T attenuator with design formulae

Ans →



$$R_A = R_0(N-1) \quad \& \quad R_B = \frac{R_0}{N-1}$$

9) Design a symmetrical bridge T attenuator D = 20 & R_0 = 500Ω

Ans → $N = \text{Anti log } \frac{D}{20}$

$= \text{Anti log } \frac{20}{20}$

$= 10$

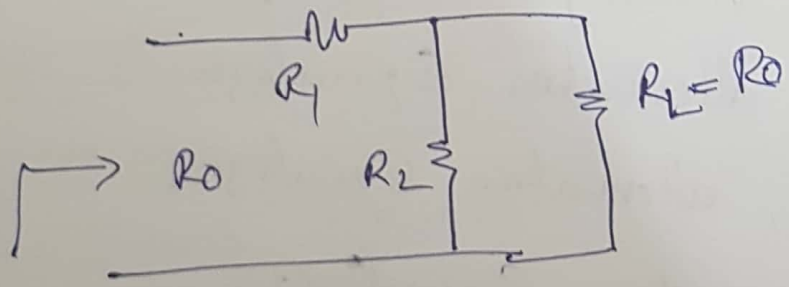
$R_A = R_0 (N-1) = 500\Omega (10-1)$

$= 4500\Omega$

$R_B = \frac{R_0}{N-1} = \frac{500}{(10-1)} = \frac{500}{9}$

$= 55.555\Omega$

11) Write L type (Asymmetrical) attenuator and its design formulae



$R_2 = \frac{R_0}{N-1}$

$R_1 = R_0 \left(\frac{N-1}{N}\right)$

12) Design L-type attenuator with load resistance of 600Ω with an attenuation of 20 dB

Ans → Given $R_L = R_0 = 600\Omega$ & $D = 20$ (6)

$N = \text{Antilog}\left(\frac{D}{20}\right)$

$= 10$

$R_1 = R_0\left(\frac{N-1}{N}\right) = 600\left(\frac{10-1}{10}\right) = 60 \times 9 = 540\Omega$

$R_2 = \frac{R_0}{N-1} = \frac{600}{9} = 66.66\Omega$

13) What is Equalizer ? Write Different type of Equalizers.

Ans → Equalizers are network dengned to provide Compensation against distortions that occur on a signal while passing through an electrical network Different distortion accure are amplitude distortion frequency distortion and phase (delay distortion) So there are mainly three types of Equalizers

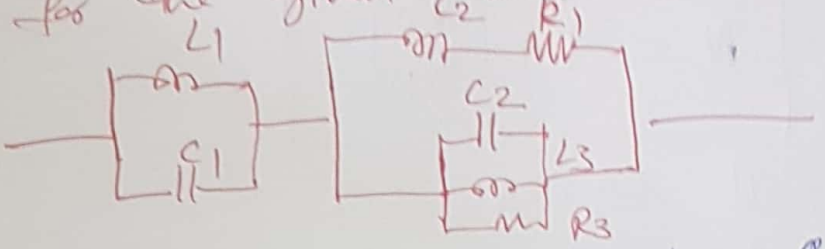
1) Amplitude attenuation Equalizer
2) frequency attenuation Equalizers
3) phasy distortion Equalizer

14) Write any four applications of Equalizer Networks

Ans → 1) medium and high freq carrier telephone Systems 2) Amplifiers, transmission lines
3) Speech reproduction Systems.
4) Phase distortion Equalizers are used in phase distortion network

(7)

a) What is inverse network, obtain the inverse network for the given L_2 network

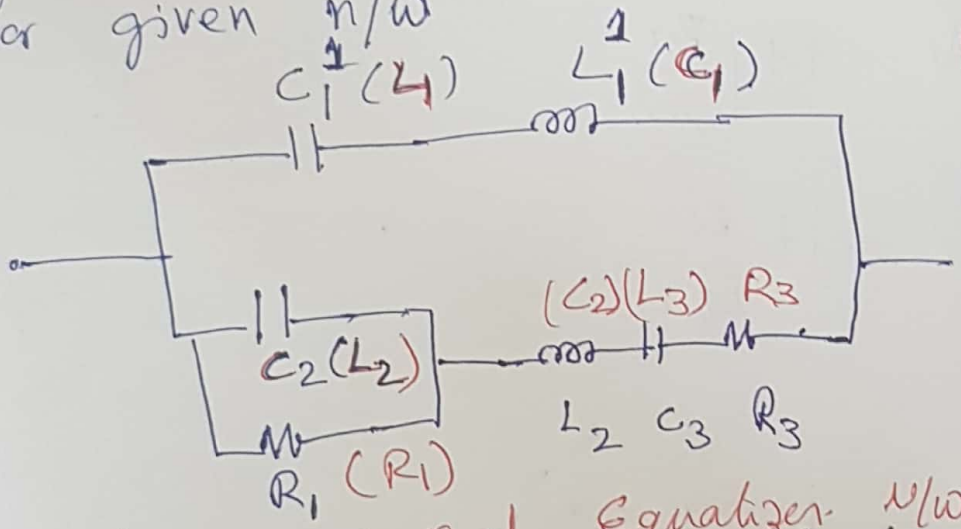


Ans> The geometrical mean of two impedance Z_1 & Z_2 is a real number and they said to inverse if

$$Z_1 Z_2 = R_0^2$$

$$Z_1 Z_2 = \frac{j\omega L}{j\omega C} = \frac{L}{C}$$

for given n/w

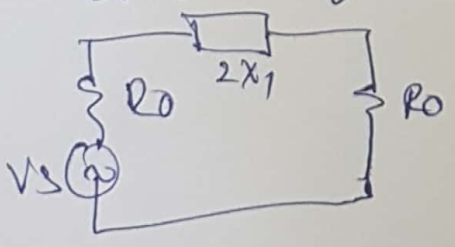


R – given (i/p value)

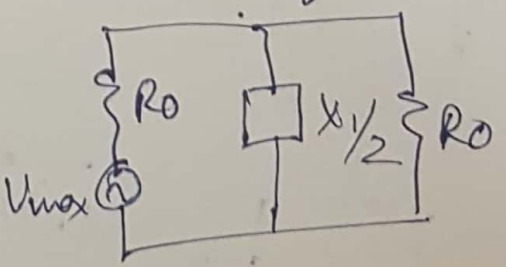
B – converted values

b) Write two terminal Equalizer n/w along with design formulae

Series equalizer



Shunt equalizer



$$N = \frac{P_i}{R_0} = \frac{P_i}{P_L}$$

$$N = \text{Antilog } \frac{D}{20}$$

$$N = 1 + \frac{X_1^2}{R_0^2}$$

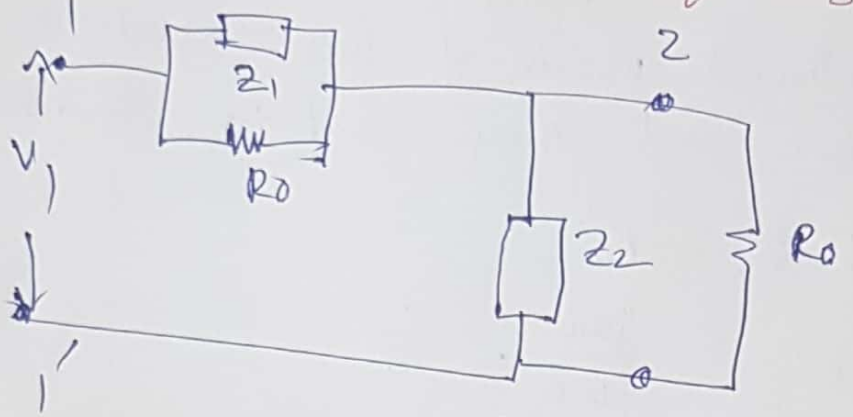
for Series equalizer (two terminal)

Shunt (two terminal) Equalizer

(8)

$$N = 1 + \left(\frac{R_0}{X_1}\right)^2$$

17) Write Full Series Equalizer with formulae



$$N = 1 + \left(\frac{R_0}{X_2}\right)^2$$

$$N = 1 + \frac{R_0^2}{\omega_0^2 L_1^2}$$

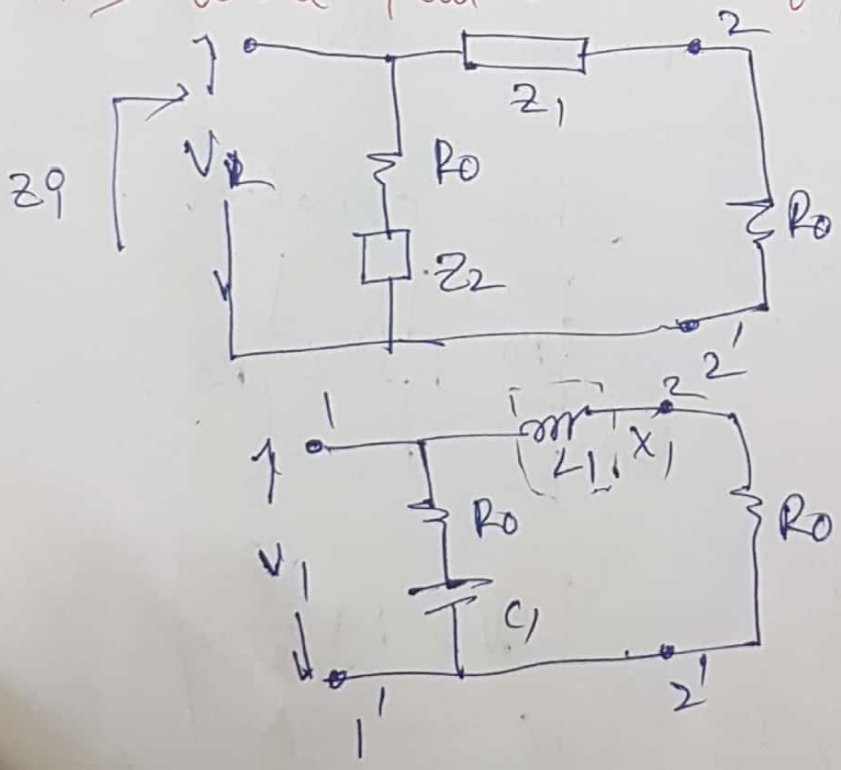
$$Z_1 Z_2 = R_0^2$$

L_1 / C_1

if Z_1 = Inductor

Z_2 is capacitor

18) Write full shunt equalizer with design formulae.



$$N = 1 + \frac{R_0^2}{X_0^2}$$