→ It is the ratio of reflected voltage at the load to the incident voltage at the load.
It can be denoted as 'k'.

i.e. $k = \frac{V_R}{V_S}$, $-k = \frac{I_R}{I_S}$

Also, $K = \frac{Z_R - Z_0}{Z_R + Z_0}$

incident voltage

reflected voltage

$$V = \frac{V_R}{2}\left[\frac{Z_R+Z_0}{Z_R}\cdot e^{\gamma x} + \frac{Z_R-Z_0}{Z_0} e^{-\gamma x}\right]$$

$$= \frac{V_R(Z_R+Z_0)}{2Z_R} e^{\gamma x} + \frac{V_R(Z_R-Z_0)}{2Z_0} e^{-\gamma x}$$

J.S
02/07/11

04/07/2011.

By defn. of K,

$$= \frac{\frac{V_R(Z_R - Z_0)}{2Z_R}}{\frac{V_R(Z_R + Z_0)}{2Z_R}}$$

$$\therefore \boxed{K = \frac{Z_R - Z_0}{Z_R + Z_0}}$$

If transmission line is terminated by its characteristic eqn, then the value of K is,

$$K = 0/_{Z_R+Z_0}$$

$$\therefore \boxed{K = 0}$$

04/07/2011.

Transmission line solution

[Distortionless line

$\frac{R}{L} = \frac{G}{C}$

$RC = LG$]

$\gamma = \alpha + j\beta$

$\gamma = \sqrt{ZY}$

$Y = G + j\omega C$

$Z = R + j\omega L$

$\gamma = \sqrt{(R+j\omega L)(G+j\omega C)}$

$\gamma^2 = (R+j\omega L)(G+j\omega C)$

$\gamma^2 = RG + j\omega RC + j\omega LC - \omega^2 LC$

$\gamma^2 = RG - \omega^2 LC + j(\omega RC + \omega LC)$

$\gamma^2 = RG + 2j\omega \cancel{}\sqrt{RCLG} - \omega^2 LC$

$\gamma^2 = (\sqrt{RG} + j\omega\sqrt{LC})^2$

$(\alpha + j\beta)^2 = (\sqrt{RG} + j\omega\sqrt{LC})^2$

$\alpha + j\beta = \sqrt{RG} + j\omega\sqrt{LC}$

Now By equating

$$\boxed{\begin{aligned}\alpha &= \sqrt{RG} \\ \beta &= \omega\sqrt{LC}\end{aligned}}$$

//

$\lambda = c/f$ $\boxed{\lambda = 2\pi/\beta}$ //

c or $v = \lambda f$

$= \lambda f \times \frac{2\pi}{2\pi}$

$= 2\pi f \cdot \lambda/2\pi$

Velocity of propagation $= \omega/\beta$ $\left[\because \beta = 2\pi/\lambda\right]$

$= \frac{\omega}{\omega\sqrt{LC}}$

$$\boxed{V = \frac{1}{\sqrt{LC}} = V_p.}$$ //

Wavelength: Distance travelled by electromagnetic wave along the transmission line with the phase change of 2π rad.

Waveform Distortion:

when the received signal is not the exact replica of transmitted signal, then we can say distortion occurs in a transmission line.

Phase Distortion: was due to the variation of phase (β).

Frequency distortion: due to ~~vath~~ variation of ~~α~~ attenuation (α).

$$\alpha = \sqrt{\frac{RG - \omega^2 LC + \sqrt{(RG - \omega^2 LC)^2 + \omega^2 (LR + GC)^2}}{2}}$$

$$\beta = \sqrt{\frac{\omega^2 LC - RG + \sqrt{(RG - \omega^2 LC)^2 + \omega^2 (LG + RC)^2}}{2}}$$

Distortionless line:

The line in which there is no phase or frequency distortion and also the line is ~~also~~ properly terminated. Then the line is said to be distortionless line.

then $\beta =$ $(RG - \omega^2 LC)^2 + \omega^2 (LG + RC)^2$ equal to $(RG + \omega^2 LC)^2$.

For β to be a direct function of frequency,

[illegible].

$$(RG - \omega^2 LC)^2 + \omega^2 (LG + RC)^2 = (RG + \omega^2 LC)^2$$

$$\Rightarrow \cancel{R^2G^2} - 2\omega^2 \cancel{RGLC} + \cancel{\omega^4 L^2 C^2} + \omega^2 L^2 G^2 + 2\omega^2 LGRC + \omega^2 R^2 C^2 = \cancel{R^2G^2} + 2\omega^2 LCRG + \cancel{\omega^4 L^2 C^2}$$

$$\Rightarrow \omega^2 L^2 G^2 + \omega^2 R^2 C^2 = 2\omega^2 LCRG$$

$$\omega^2 (L^2 G^2 + R^2 C^2) = 2\omega^2 LCRG$$

$\Rightarrow L^2G^2 + R^2C^2 - 2\,LGRC = 0$

$\Rightarrow (LG - RC)^2 = 0$

$LG = RC$

$$\boxed{\frac{R}{L} = \frac{G}{C}}$$

//.

TELEPHONE CABLE

They are twisted in pair combined together and covered by external loading. This construction results in negligible value of conductance (G) and Inductance.

$Z = R + j\omega L$

$Y = G + j\omega C$

$L\omega << R$

$G << \omega C$

$\gamma = \sqrt{ZY} = \sqrt{j\omega RC} = \sqrt{\omega RC}\,\angle 90^\circ$

$= \cancel{\sqrt{\omega RC}\,\angle 45^\circ}\ \sqrt{\omega RC}\,\angle 45^\circ$

$= \sqrt{\omega RC}\,(\cos 45^\circ + j\sin 45^\circ)$

$= \sqrt{\omega RC}\,\left[\frac{1}{\sqrt{2}} + \frac{j}{\sqrt{2}}\right]$

$= \sqrt{\frac{\omega RC}{2}} + j\sqrt{\frac{\omega RC}{2}}$

$\gamma = \alpha + j\beta$

$\alpha = \sqrt{\frac{\omega RC}{2}}$ & $\beta = \sqrt{\frac{\omega RC}{2}}$

$$v_p = \omega/\beta = \frac{\omega}{\sqrt{\frac{\omega RC}{2}}}$$

$$= \sqrt{\frac{2\omega^2}{\omega RC}}$$

$$\boxed{V_p = \sqrt{\frac{2\omega}{RC}}}$$

$$Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}}$$

$j\omega L$ ← Negligible

G ↳ Negligible.

$$Z_0 = \sqrt{\frac{R}{j\omega C}}$$

$$\boxed{Z_0 = \sqrt{\frac{R}{\omega C}} \angle -45^\circ}$$

LOADED LINES (To achieve distortionless line)

$$\boxed{\uparrow L/C}$$

- Lumped Loading
- patch
- Continuous coding.

Input impedence of a transmission line:-

$$Z = V/I = \frac{E}{H}$$

$$Z_s \text{ (or) } Z_{in} = \frac{V_s}{I_s} =$$

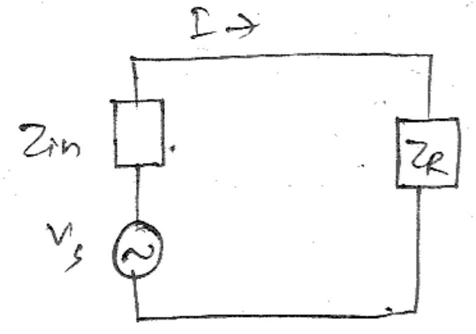
$$Z_s = \frac{V_s}{I_s} = \frac{V_R\left[\cosh \gamma l + \frac{Z_0}{Z_R} \sinh \gamma l\right]}{I_R\left[\cosh \gamma l + \frac{Z_R}{Z_0} \sinh \gamma l\right]}$$

$$\boxed{x = l}$$

$$= \frac{I_R Z_R}{I_R}\left[\frac{\dfrac{Z_R \cosh \sqrt{ZY}\, l + Z_0 \sinh \sqrt{ZY}\, l}{Z_R}}{\dfrac{Z_0 \cosh \sqrt{ZY}\, l + Z_R \sinh \sqrt{ZY}\, l}{Z_0}}\right]$$

$$\boxed{Z_s \text{ (or) } Z_{in} = Z_0\left[\frac{Z_R \cosh \sqrt{ZY}\, l + Z_0 \sinh \sqrt{ZY}\, l}{Z_0 \cosh \sqrt{ZY} + Z_R \sinh \sqrt{ZY}\, l}\right]} \quad -(1)$$

open and short ckted in Trn line:



$Z_{sc} \to Z_R = 0$ in $-(1)$

$Z_{sc} = Z_0 \tanh \sqrt{ZY}\, l$

$$Z_{oc} \to Z_R = \infty$$

$$= Z_0 \frac{Z_R}{Z_R}\left[\frac{\cosh \gamma l + Z_0/Z_R \sinh \gamma l}{\sinh \gamma l + \frac{Z_0}{Z_R}\cosh \gamma l}\right]$$

$$= Z_0 \left[\coth \gamma l\right]$$

$$\left[Z_{sc} \cdot Z_{oc} = Z_0^2 \right.$$

$$\boxed{Z_0 = \sqrt{Z_{sc} Z_{oc}}}$$

$$Z_T = \cancel{\frac{V_R}{I_S}}\ \frac{V_S}{I_R} = \frac{I_R Z_R}{I_R} \left[\text{transfer impedence } (Z_T)\right]$$

$$\cancel{V_S} = \frac{Z_R}{2} \cdot \frac{Z_R + Z_0}{Z_R}\left[e^{\gamma l} + K e^{-\gamma l}\right]$$

↳ Reflection coefficient $K = \frac{Z_R - Z_0}{Z_R + Z_0}$

$$= \frac{\cancel{Z_R}}{2\cancel{Z_R}}(Z_R + Z_0)\left[e^{\gamma l} + K e^{-\gamma l}\right]$$

$$= \left(\frac{Z_R + Z_0}{2}\right) e^{\gamma l} + \left(\frac{Z_R + Z_0}{2}\right) K e^{-\gamma l}$$

$$= \frac{Z_R + Z_0}{2} e^{\gamma l} + K\left(\frac{Z_R + Z_0}{2}\right)\frac{(Z_R - Z_0)}{Z_R + Z_0} e^{-\gamma l}$$

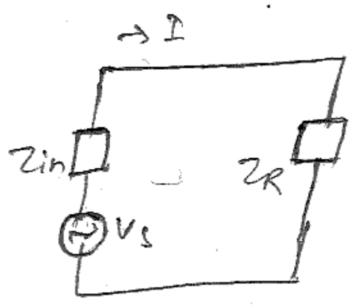
$$= Z_R\left[\frac{e^{\gamma l} + e^{-\gamma l}}{2}\right] + Z_0\left[\frac{e^{\gamma l} - e^{-\gamma l}}{2}\right]$$

$$\boxed{Z_T = Z_R \cosh \gamma l + Z_0 \sinh \gamma l}$$

//

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.