THE EIGHT WAVE LINE: (λ/8)

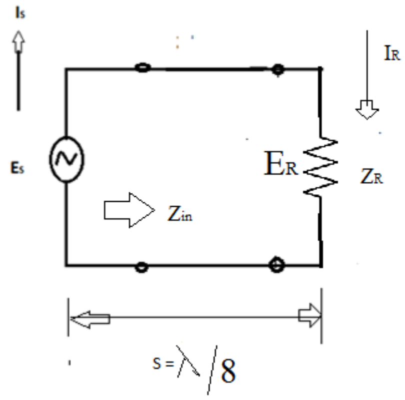

Fig: 3.1.1 The eight wave line

Fig 3.1.1 shows the circuit diagram of a transmission line with finite length λ/8 the input voltage is E_S and current I_S.
The input impedance of the circuit is Z_{in} The receiving end voltage and current is E_R and I_R.
The distance between sending and receiving end S = λ/8
We know, the input impedance of the lossless line is given by,

- $Z_{in} = \frac{E_S}{I_S} = R_O \left[\frac{Z_R + jR_O \tan\beta s}{R_O + jZ_R \tan\beta s}\right]$
- Sub, **S=** $\frac{\lambda}{8}$, $\beta = \frac{2\pi}{\lambda}$ in above

$$Z_{in} = R_O \left[\frac{Z_R + jR_O \tan\left(\frac{2\pi}{\lambda}\right)\left(\frac{\lambda}{8}\right)}{R_O + jZ_R \tan\left(\frac{2\pi}{\lambda}\right)\left(\frac{\lambda}{8}\right)}\right]$$

$$Z_{in} = R_O \left[\frac{Z_R + jR_O \tan\left(\frac{\pi}{4}\right)}{R_O + jZ_R \tan\left(\frac{\pi}{4}\right)}\right]$$

$$Z_{in} = R_O \left[\frac{Z_R + jR_O}{R_O + jZ_R}\right]$$

$$|Z_{in}| = |R_O| \left[\frac{|Z_R + jR_O|}{|R_O + jZ_R|}\right]$$

$$|Z_{in}| = R_O \left[\frac{\sqrt{R_O^2 + Z_R^2}}{R_O^2 + Z_R^2}\right]$$

$$|Z_{in}| = R_O$$

Thus the eighth wave line is generally used to transformer any resistance Z_R an impedance Z_{in} having its magnitude equal to characteristic resistance R_O of the line.