Recall that the average power flow is constant at any point along a lossless TL. We have just discovered that the voltage oscillates on a mismatched line. Taken together, these two facts suggest that the impedance looking down the line will vary with position on a mismatched line!

At a distance $\ell = -z$ from the load, the input impedance seen looking toward the load is,

$$Z_{in} = \frac{V(-\ell)}{I(-\ell)} = \frac{V_0^+\left[e^{j\beta\ell} + \Gamma_L e^{-j\beta\ell}\right]}{V_0^+\left[e^{j\beta\ell} - \Gamma_L e^{-j\beta\ell}\right]} Z_0 = \frac{1 + \Gamma_L e^{-j2\beta\ell}}{1 - \Gamma_L e^{-j2\beta\ell}} Z_0$$

Also, $\Gamma_L = \dfrac{Z_L - Z_0}{Z_L + Z_0}$

$$\Rightarrow \boxed{Z_{in}(-\ell) = Z_0 \frac{Z_L + jZ_0 \tan\beta\ell}{Z_0 + jZ_L \tan\beta\ell}}$$

The TL Impedance Equation

<end lecture 6>

Special Cases of a lossless terminated TL

I. Open-circuit load $\rightarrow Z_L = \infty$

$$\Gamma_L = \frac{\infty - Z_o}{\infty + Z_o} = 1$$

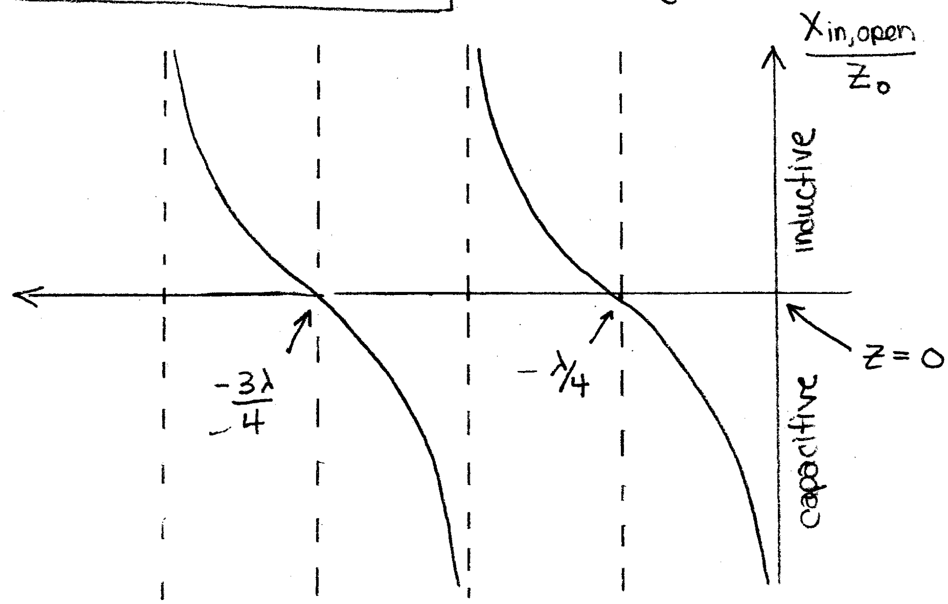
$\uparrow$ The reflection coefficient at the load

$$Z_o \frac{Z_L + jZ_o \tan\beta l}{Z_o + jZ_L \tan\beta l} \qquad Z_o \frac{1 + j\frac{Z_o}{Z_L}\tan}{Z_o/Z_L + j\tan\beta l}$$

$Z_l \Rightarrow$
$$Z_{in}(-l) = Z_o \frac{\infty + jZ_o \tan\beta l}{Z_o + j\infty \tan\beta l} = -jZ_o \cot\beta l$$

$$\boxed{Z_{in,\,open}(-l) = -jZ_o \cot\beta l}$$

Purely Reactive!



stop 9/18/08.

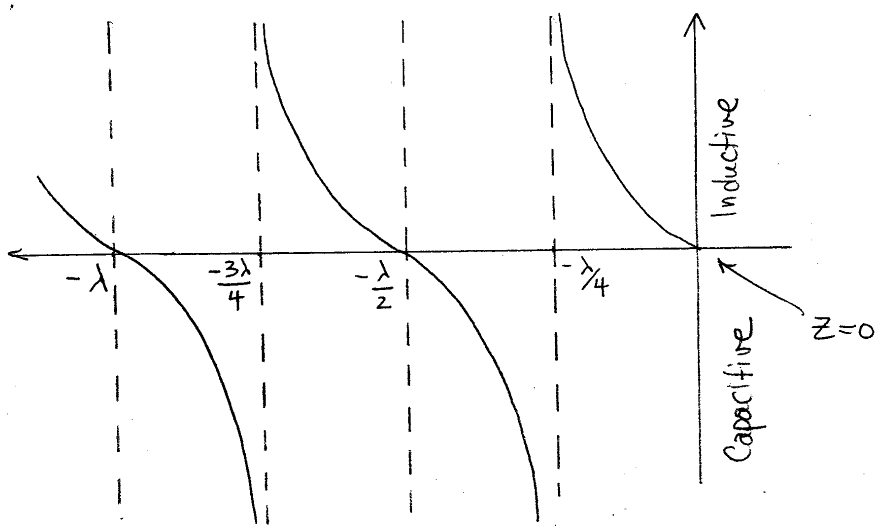
(32

II. Short-Circuit load $\rightarrow Z_L = 0$

$$\Gamma_L = \frac{0 - Z_o}{0 + Z_o} = -1$$

$$Z_{in}(-\ell) = Z_o \frac{0 + jZ_o \tan\beta\ell}{Z_o + j0\tan\beta\ell} = jZ_o \tan\beta\ell$$

$$\boxed{Z_{in,short}(-\ell) = jZ_o\tan\beta\ell}$$ Purely Reactive!



III. Matched Load $\rightarrow Z_L = Z_o$, $\Gamma = 0$, $\boxed{Z_{in,matched}(-\ell) = Z_o}$

* An important fact to remember is that an open-circuit or a short-circuit section of TL may provide <u>any</u> value of reactance. We will use this to our advantage in "stub matching."

4/23/08

36