EE 331 – LECT. #11 FEB. 7, 2020

exam next friday.

from example #6 (Z_{in})

$$Z_{in} = Z_0 \left\{ \frac{Z_L + jZ_0 \tan(\beta \ell)}{Z_0 + jZ_L \tan(\beta \ell)} \right\} \; [\Omega]$$

for short ckt load, $Z_L = 0$:

$$Z_{in}^{sc} = j \underbrace{Z_0 \tan(\beta \ell)}_{\text{real}} \; [\Omega] \rightarrow \text{purely reactive}$$

for open ckt load, $Z_L \rightarrow \infty$

$$Z_{in}^{oc} = -jZ_0 \cot(\beta \ell) \; [\Omega] \rightarrow \text{purely reactive}$$

2 useful things

1. C, L are reactive → can use open-ckt'd or short-ckt'd line as inductor or capacitor!

2. cool trick

$$Z_{in}^{sc} \cdot Z_{in}^{oc} = (jZ_0 \tan(\beta \ell))(-jZ_0 \cot(\beta \ell))$$
$$= Z_0^2$$

$$\rightarrow Z_0 = \sqrt{Z_{in}^{oc} Z_{in}^{sc}} \quad [\Omega]$$

$\lambda/4$ transformer (quarter-wave transformer)

consider $\ell = \lambda/4$

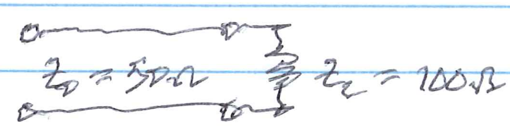
$$\tan(\beta\ell) = \tan\left(\frac{2\pi}{\lambda}\cdot\lambda/4\right) = \tan(\pi/2) \to \infty$$

$$\to Z_{in} = Z_0\left\{\frac{Z_L + jZ_0\tan(\pi/2)}{Z_0 + jZ_L\tan(\pi/2)}\right\} = Z_0\left\{\frac{0 + jZ_0}{0 + jZ_L}\right\}$$

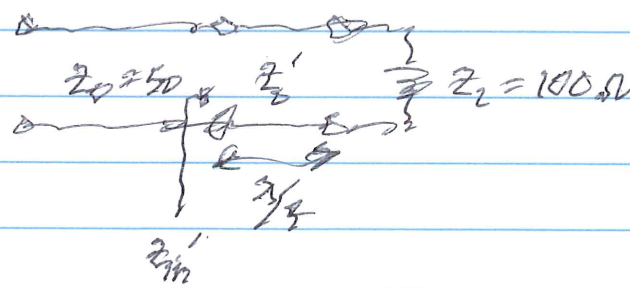
$$= Z_0^2/Z_L$$

use $\lambda/4$ transf to match real (resistive) load to TL.

eg/



add $\lambda/4$ transf w/ Z_0'



$$Z_{in}' = Z_0'^2/Z_L \to 50 = \frac{Z_0'^2}{100}$$

$$\to Z_0' = \sqrt{(50)(100)} = 70.7\ \Omega$$