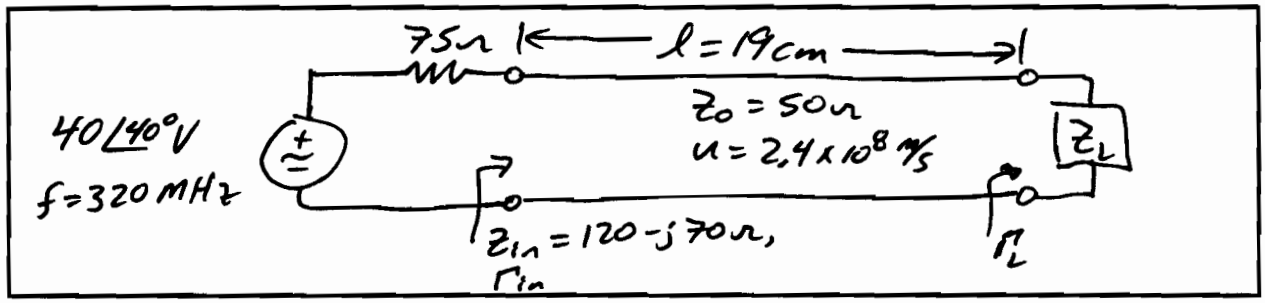
EE 381 Quiz #2 (Fall 2017)

Name Key A

Instructions: Closed book & notes (see back). Place answers in indicated spaces and show all work for credit.

A lossless 19 cm-long transmission line (50 Ω characteristic impedance and 2.4×10^8 m/s velocity of propagation) is terminated with an unknown load. It is driven by a generator with voltage $40\angle 40°$ V and impedance 75 Ω operating at 320 MHz. If the input impedance is measured to be $120 - j70$ Ω, sketch a fully labeled drawing of this transmission line circuit. Then, find the phase constant, input & load reflection coefficients, load impedance, and standing wave ratio. **Express reflection coefficients in polar/phasor format w/ angles in degrees, and impedances in rectangular format.**



$$\beta = \frac{\omega}{u} = \frac{2\pi(320\times10^6)}{2.4\times10^8} = 8.37758 \text{ rad/m}$$

$$\Gamma_{in} = \frac{Z_{in}-Z_0}{Z_{in}+Z_0} = \frac{(120-j70)-50}{(120-j70)+50} = 0.53846\angle -22.61986°$$

$$\Gamma_L = \Gamma_{in}e^{+j2\beta\ell} = (0.5385\angle -22.62°)e^{+j2(8.37758)(0.19)}$$

$$= 0.53846\angle 159.7801°$$

$$Z_L = Z_0\left[\frac{1+\Gamma_L}{1-\Gamma_L}\right] = 50\left[\frac{1+0.5385\angle 159.78°}{1-0.5385\angle 159.78°}\right]$$

$$= 15.4327 + j8.0898\ \Omega$$

$$S = \frac{1+|\Gamma|}{1-|\Gamma|} = \frac{1+0.53846}{1-0.53846} = 3.333$$

$\beta =$ 8.3776 rad/m $\quad \Gamma_{in} =$ 0.5385∠-22.62° $\quad \Gamma_L =$ 0.5385∠159.78°

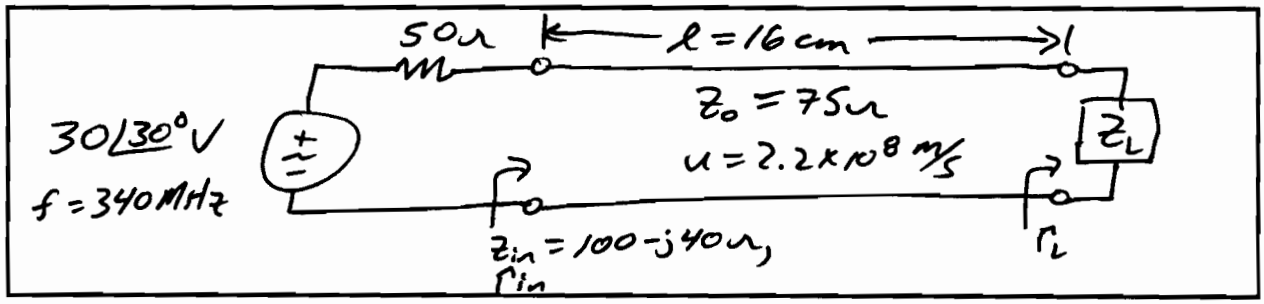
$Z_L =$ 15.433 + j8.0898 Ω $\quad S =$ 3.333

EE 381 Quiz #2 (Fall 2017)

Name Key C

Instructions: Closed book & notes (see back). Place answers in indicated spaces and show all work for credit.

A lossless 16 cm-long transmission line (75 Ω characteristic impedance and 2.2×10^8 m/s velocity of propagation) is terminated with an unknown load. It is driven by a generator with voltage $30\angle 30°$ V and impedance 50 Ω operating at 340 MHz. If the input impedance is measured to be $100 - j40$ Ω, sketch a fully labeled drawing of this transmission line circuit. Then, find the phase constant, input & load reflection coefficients, load impedance, and standing wave ratio. **Express reflection coefficients in polar/phasor format w/ angles in degrees, and impedances in rectangular format.**



$$\beta = \frac{\omega}{u} = \frac{2\pi(340\times10^6)}{2.2\times10^8} = 9.7104 \text{ rad/m}$$

$$\Gamma_{in} = \frac{Z_{in} - Z_0}{Z_{in} + Z_0} = \frac{(100 - j40) - 75}{(100 - j40) + 75} = 0.26277\angle -45.1196°$$

$$\Gamma_L = \Gamma_{in} e^{+j2\beta\ell} = (0.263\angle -45.1°)\, e^{j2(9.71)0.16}$$

$$= 0.26277\angle 132.9167°$$

$$Z_L = Z_0\left[\frac{1+\Gamma_L}{1-\Gamma_L}\right] = 75\left[\frac{1+0.263\angle 132.9°}{1-0.263\angle 132.9°}\right]$$

$$= 48.9324 + j\,20.2293\ \Omega$$

$$S = \frac{1+|\Gamma|}{1-|\Gamma|} = \frac{1+0.26277}{1-0.26277} = 1.7128$$

$\beta =$ 9.7104 rad/m $\Gamma_{in} =$ 0.2628∠−45.12° $\Gamma_L =$ 0.2628∠132.92°

$Z_L =$ 48.932 + j20.229 Ω $S =$ 1.7128