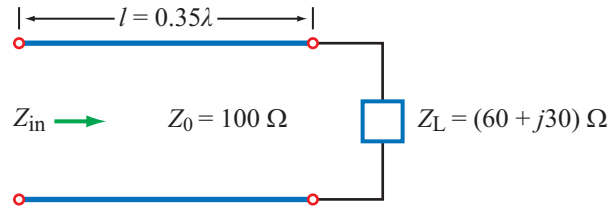


**Problem 2.28** A lossless transmission line of electrical length  $l = 0.35\lambda$  is terminated in a load impedance as shown in Fig. P2.28. Find  $\Gamma$ ,  $S$ , and  $Z_{\text{in}}$ . Verify your results using CD Modules 2.4 or 2.5. Include a printout of the screen's output display.



**Figure P2.28:** Circuit for Problem 2.28.

**Solution:** From Eq. (2.59),

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{(60 + j30) - 100}{(60 + j30) + 100} = 0.307e^{j132.5^\circ}.$$

From Eq. (2.73),

$$S = \frac{1 + |\Gamma|}{1 - |\Gamma|} = \frac{1 + 0.307}{1 - 0.307} = 1.89.$$

From Eq. (2.79)

$$\begin{aligned} Z_{\text{in}} &= Z_0 \left( \frac{Z_L + jZ_0 \tan \beta l}{Z_0 + jZ_L \tan \beta l} \right) \\ &= 100 \left[ \frac{(60 + j30) + j100 \tan \left( \frac{2\pi \text{ rad}}{\lambda} 0.35\lambda \right)}{100 + j(60 + j30) \tan \left( \frac{2\pi \text{ rad}}{\lambda} 0.35\lambda \right)} \right] = (64.8 - j38.3) \Omega. \end{aligned}$$

Module 2.4
Transmission Line Simulator

Options:
Set Input / Output

d =

$d = 0.35 \lambda = 28.0 \text{ mm}$ 
 $Z_g = 50.0 + j 0.0 \ \Omega$ 
 $\tilde{V}_g = 1.0 + j 0.0 \text{ V}$ 
 $Z_0 = 100.0 + j 0.0 \ \Omega$ 
 $\epsilon_r = 1.0$ 
 $f = 3.75 \text{ GHz}$ 
 $\lambda = 80.0 \text{ mm}$ 
 $Z_L = 60.0 + j 30.0 \ \Omega$

Set Line
Length units:
☒ [  $\lambda$  ]
☐ [ m ]

Low Loss Approximation

Characteristic Impedance
 $Z_0 = 100 \ \Omega$

Frequency
 $f = 3.75\text{E}9 \text{ Hz}$

Relative Permittivity
 $\epsilon_r = 1.0$

Line Length
 $l = 0.35 \ [\lambda]$

Update

$Z_L = 60 + j 30 \ \Omega$ 
☒ Impedance
☐ Admittance

Update

Set Generator

$\tilde{V}_g = 1.0 + j 0.0 \text{ V}$ 
 $Z_g = 50 + j 0.0 \ \Omega$ 

Update

Output
Transmission Line Data 1

Cursor
 $d = 0.35 \lambda = 28.0 \text{ mm}$

Impedance
 $Z(d) = 64.841222 - j 38.282867 \ \Omega$ 
 $= 75.29915 \ \angle -0.5333 \text{ rad}$

Admittance
 $Y(d) = 0.011436 + j 0.006752 \text{ S}$ 
 $= 0.01328 \ \angle 0.5333 \text{ rad}$

Reflection Coefficient
 $\Gamma_d = -0.15119794 - j 0.2673552$ 
 $= 0.30714756 \ \angle -2.085486 \text{ rad}$ 
 $= 0.30714756 \ \angle -119.489553^\circ$

Voltage
 $\tilde{V}(d) = 0.60816 - j 0.130622 \text{ V}$ 
 $= 0.622029 \ \angle -0.2116 \text{ rad}$

Current
 $\tilde{I}(d) = 0.007837 + j 0.002612 \text{ A}$ 
 $= 0.008261 \ \angle 0.3218 \text{ rad}$

Power Flow
 $P_{av} = 2.212394 \text{ mW}$