

**Problem 2.22** Using a slotted line, the following results were obtained: distance of first minimum from the load = 4 cm; distance of second minimum from the load = 14 cm; voltage standing-wave ratio = 1.5. If the line is lossless and  $Z_0 = 50 \Omega$ , find the load impedance.

**Solution:** Following Example 2.6: Given a lossless line with  $Z_0 = 50 \Omega$ ,  $S = 1.5$ ,  $d_{\min(0)} = 4 \text{ cm}$ ,  $d_{\min(1)} = 14 \text{ cm}$ . Then

$$d_{\min(1)} - d_{\min(0)} = \frac{\lambda}{2}$$

or

$$\lambda = 2 \times (d_{\min(1)} - d_{\min(0)}) = 20 \text{ cm}$$

and

$$\beta = \frac{2\pi}{\lambda} = \frac{2\pi \text{ rad/cycle}}{20 \text{ cm/cycle}} = 10\pi \text{ rad/m}.$$

From this we obtain

$$\begin{aligned}\theta_r &= 2\beta d_{\min(n)} - (2n+1)\pi \text{ rad} = 2 \times 10\pi \text{ rad/m} \times 0.04 \text{ m} - \pi \text{ rad} \\ &= -0.2\pi \text{ rad} = -36.0^\circ.\end{aligned}$$

Also,

$$|\Gamma| = \frac{S-1}{S+1} = \frac{1.5-1}{1.5+1} = 0.2.$$

So

$$Z_L = Z_0 \left( \frac{1+\Gamma}{1-\Gamma} \right) = 50 \left( \frac{1+0.2e^{-j36.0^\circ}}{1-0.2e^{-j36.0^\circ}} \right) = (67.0 - j16.4) \Omega.$$

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