

**Problem 2.62** At an operating frequency of 5 GHz, a  $50\text{-}\Omega$  lossless coaxial line with insulating material having a relative permittivity  $\epsilon_r = 2.25$  is terminated in an antenna with an impedance  $Z_L = 150\text{ }\Omega$ . Use the Smith chart to find  $Z_{in}$ . The line length is 30 cm.

**Solution:** To use the Smith chart the line length must be converted into wavelengths. Since  $\beta = 2\pi/\lambda$  and  $u_p = \omega/\beta$ ,

$$\lambda = \frac{2\pi}{\beta} = \frac{2\pi u_p}{\omega} = \frac{c}{\sqrt{\epsilon_r} f} = \frac{3 \times 10^8 \text{ m/s}}{\sqrt{2.25} \times (5 \times 10^9 \text{ Hz})} = 0.04 \text{ m}.$$

Hence,  $l = \frac{0.30 \text{ m}}{0.04 \text{ m}} \lambda = 7.5\lambda$ . Since this is an integral number of half wavelengths,

$$Z_{in} = Z_L = 150\text{ }\Omega.$$

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