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Chapter 5
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1) **A 50Ω lossless line is terminated in $\boldsymbol{Z_2 = 15 - j20\ \Omega}$.**
  a) Plot the normalized impedance on a Smith chart.
  b) Using the Smith chart, determine the corresponding normalized admittance y_2.
  c) Using the result of (b), determine the actual admittance Y_2.

a) $z_2 = \frac{Z_2}{R_o} = \frac{15-j20}{50} = .3 - j.4$
b) $y_2 = 1.2 + j1.6$
c) $G_o = \frac{1}{R_o} = \frac{1}{50} = 0.02\ S$

$$Y_2 = G_o y_2 = 0.02\ S\ (1.2 + j1.6) = .024 + j.032$$

2) A 50Ω lossless line is terminated in $\boldsymbol{Y_2 = 0.01 + j0.02\ S}$.
  a) Plot the normalized admittance on a Smith chart.
  b) Using the Smith chart, determine the corresponding normalized impedance z_2.
  c) Using the result of (b), determine the actual impedance Z_2.

a) $y_2 = \frac{Y_2}{G_o} = \frac{0.01+j0.02}{0.02} = .5 + j1$
b) $z_2 = 0.4 - j0.8$
c) $Z_2 = Z_o z_2 = 50(0.4 - j0.8) = 20 - j40$

3) For the system of Problem 5.1, determine the VSWR and the reflection coefficient.

$$VSWR = 3.9$$

$$\Gamma_2 = \frac{S-1}{S+1} = \frac{3.9-1}{3.9+1} = 0.592\angle{-133^\circ}$$

4) For the system of Problem 5.1, determine the VSWR and the reflection coefficient.

$$VSWR = 4.3$$

$$\Gamma_2 = \frac{S-1}{S+1} = \frac{4.3-1}{4.3+1} = 0.623\angle{-97^\circ}$$

5) A 50-Ω lossless line is terminated in a real load impedance $Z_2=R_2=150\Omega$. Using a Smith chart, determine the input impedance for each of the following line lengths:

$$z_2 = \frac{Z_2}{R_o} = \frac{150}{50} = 3$$

a)

$0.15\lambda = 0.25 + 0.15 = 0.4$

$z_{in} = 0.46 - j0.62$

$Z_{in} = R_o z_{in} = 50 \times (0.46 - j0.62) = 23 + j31$

b)

$0.25\lambda = 0.25 + 0.25 = 0.5 \; or \; 0$

$z_{in} = 0.32$

$Z_{in} = R_o z_{in} = 50 \times 0.32 = 16$

c)

$0.35\lambda = 0.25 + 0.35 = 0.6 - 0.5 = 0.1$

$z_{in} = 0.475 + j0.625$

$Z_{in} = R_o z_{in} = 50 \times (0.475 + j0.625) = 23.75 + j31.25$

d)

$0.45\lambda = 0.25 + 0.45 = 0.7 - 0.5 = 0.2$

$z_{in} = 1.7 + j1.4$

$Z_{in} = R_o z_{in} = 50 \times (1.7 + j1.4) = 85 + j70$

6) A 50-Ω lossless line is terminated in a real load admittance $Y_2= 0.01$ S. Using a Smith chart, determine the input admittance for the following line lengths:

$$G_o = \frac{1}{R_o} = \frac{1}{50} = 0.02$$

$$y_2 = \frac{Y_2}{G_o} = \frac{0.01}{0.02} = 0.5$$

a)

0.125λ

$y_{in} = 0.8 + j0.6$

$Y_{in} = G_o y_{in} = 0.02 \times (0.8 + j0.6) = 0.16 + j0.12$

b)
0.25λ
$Y_{in} = 2$

$Y_{in} = G_o y_{in} = 0.02 \times 2 = 0.04$

c)
0.375λ
$y_{in} = 0.8 - j0.6$

$Y_{in} = G_o y_{in} = 0.02 \times (0.8 - j0.6) = 0.16 - j0.12$

d)
0.50λ
$y_{in} = 0.5$

$Y_{in} = G_o y_{in} = 0.02 \times 0.5 = 0.01$

7) A 50-Ω lossless line is terminated in a load impedance $\boldsymbol{Z_2 = 75 + j100\Omega}$.
a) Using a Smith chart, determine the input impedance for a line of length 0.2λ.
b) Determine the VSWR and the reflection coefficient at the load.

a)

$$z_2 = \frac{Z_2}{R_o} = \frac{75 + j100}{50} = 1.5 - j2$$

$$z_{in} = 0.34 - j0.68$$

$$Z_{in} = R_o z_{in} = 50(0.34 - j0.68) = 17 - j34$$

b)

$$VSWR = 4.6$$

$$\Gamma_2 = \frac{S-1}{S+1} = \frac{4.6-1}{4.6+1} = 0.643\angle 37°$$

8) A 300-Ω lossless line is terminated in a load impedance $\boldsymbol{Z_2 = 150 - j240\Omega}$.
a) Using a Smith chart, determine the input impedance for a line of length 0.3λ.
b) Determine the VSWR and the reflection coefficient at the load.

a)

$$z_2 = \frac{Z_2}{R_o} = \frac{150 - j240}{300} = 0.5 - j0.8$$

$$z_{in} = 1.18 + j1.41$$

$$Z_{in} = R_o z_{in} = 300(1.18 + j1.41) = 354 + j423$$

b)

$$VSWR = 3.5$$

$$\Gamma_2 = \frac{S - 1}{S + 1} = \frac{3.5 - 1}{3.5 + 1} = 0.556\angle -94^\circ$$