Microwaves

Series 3

Problem 1

A lossless transmission line is terminated with a 100 Ω load. If the SWR of the line is 1.5, find the two possible values for the characteristic impedance of the line

Solution :

$$|\Gamma| = \frac{swr-1}{swr+1} = \frac{0.5}{2.5} = 0.2$$

$$|\Gamma| = \left|\frac{Z_L - Z_o}{Z_L + Z_o}\right| = \left|\frac{100 - Z_o}{100 + Z_o}\right|$$

Moreover, we know that Zo is real, thus either

$$\frac{100 - Z_o}{100 + Z_o} = 0.2 \quad \Rightarrow \; Z_o = 66.7\Omega$$

or

$$\frac{100 - Z_o}{100 + Z_o} = -0.2 \quad \Rightarrow \; Z_o = 150\Omega$$

Problem 2

A radio transmitter is connected to an antenna having an impedance 80+j40 Ω. with a 50 Ω coaxial cable. If the transmitter can deliver 30W to a 50 Ω load, how much power is delivered to the antenna ?

Solution :

$$\Gamma = \frac{Z_L - Z_o}{Z_L + Z_o} = \frac{30 + j40}{130 + j40} = 0.367 \angle 36°$$

$$P_{Load} = P_{in} - P_{\text{reflected}} = P_{in}\left(1 - |\Gamma|^2\right) = 30\left(1 - (0.367)^2\right) = 25.9$$

Problem 3

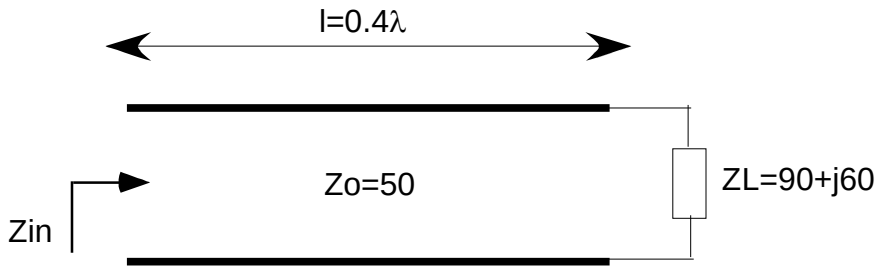
Use the Smith chart to fond the following quantities for the transmission line circuit bellow :

a) the SWR of the line

b) the reflection coefficient at the load

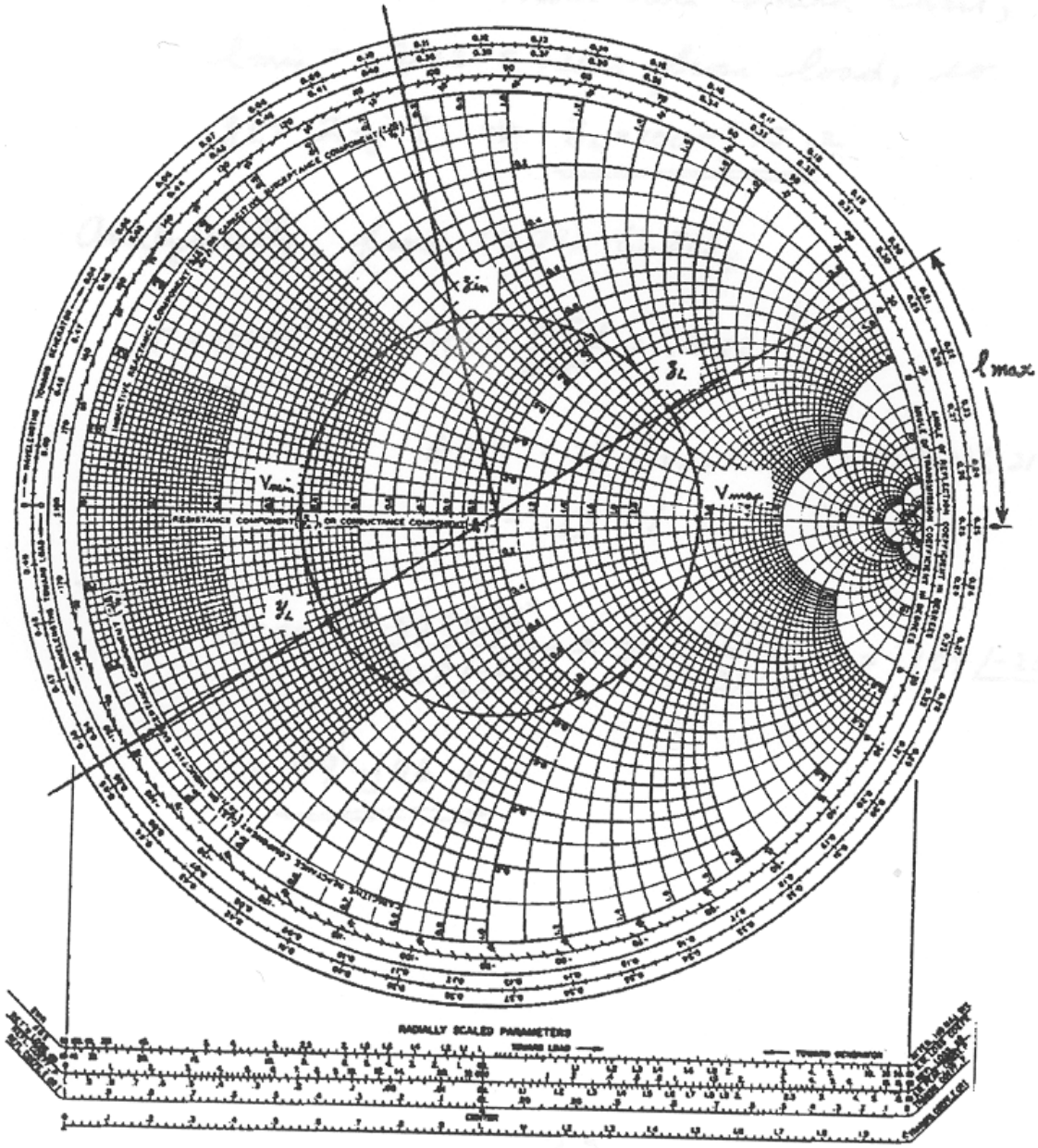
c) the load admittance

d) the input impedance of the line



Solution : see Smith Chart

a) SWR = 2.8
b) $G = 0.45 \angle 33°$
c) $y_L = 0.38 - j0.25 \Rightarrow Y_L = 7.6 - j5$ mS
d) $z_{in} = 0.54 + j0.63 \Rightarrow Z_{in} = 27 + j32\ \Omega$


z_{in}
z_L
y_L
V_{max}
V_{min}
l_{max}
RADIALLY SCALED PARAMETERS