ECE 391: Transmission Lines

Spring Term 2020

Homework Assignment #5

due Saturday, June 6

1. A lossless transmission line ($Z_0 = 50\Omega$, $\epsilon_r = 2.25$) is terminated in a load impedance consisting of a resistance $R = 25\Omega$ in series with an inductance $L = 60$nH. The transmission line is excited by a sinusoidal voltage of frequency $f = 200$ MHz. Using the Smith chart, determine the distance from the termination (in meters) to the first voltage minimum and the first current minimum on the line. Furthermore, determine (i) the standing-wave ratio on the line and (ii) the input impedance of the line if the line is 1.2 m long.

2. A lossless 75Ω coaxial cable is terminated in an unknown load impedance Z_T. From standing-wave measurements the standing-wave ratio was found as 2.5 and the nearest voltage maximum was 0.35λ from the termination. Determine the unknown load impedance, both analytically and graphically using the Smith Chart.

3. A lossless transmission line section of length $l = 3$m ($Z_0 = 50\Omega, \epsilon_r = 2.25$) is terminated in an unknown impedance Z_T. The input impedance of the line at $f = 40$ MHz has been determined as $Z_{\text{in}} = (20 - j10)\Omega$. Use the Smith chart to answer the following questions: (a) Determine the voltage standing-wave ratio on the line; (b) determine the load impedance and reflection coefficient at the termination; (c) determine the distance (in meters) from the termination to the nearest voltage minimum; (d) determine the distance (in meters) from the termination to the nearest current minimum.

4. A lossless transmission line ($Z_0 = 50\Omega, \epsilon_r = 4$) is terminated in a load impedance consisting of a resistance $R = 25\Omega$ in series with a capacitance $C = 1.59$ nF. If the transmission line is excited by a sinusoidal voltage of frequency $f = 50$ MHz, how far from the termination (in meters) are the first voltage maximum and current maximum on the line? Using the Smith chart, determine the input impedance of the line if the line is 1.8 m long.