Assignment #3

ENEL 476

Due at 4 pm on March 14th in the dropbox on the 2nd floor of ICT

Question 1:

Mark the following impedances on a Smith chart ($Z_o = 70\ \Omega$):

(1) $350\ \Omega$ (2) $-j35\ \Omega$ (3) $140 - j35\ \Omega$ (4) $70 + j70\ \Omega$

Answer the following questions using a Smith chart:

(a) Which point will provide the smallest reflection ($|\Gamma|$)? What is the value of Γ for this point? Use the Smith chart and mark down all of your work. Check your answer with the appropriate formula. Draw the constant SWR circle for this impedance.

(b) Which point will provide the largest SWR? What is the value of SWR for this point? Use the Smith chart and mark down all of your work.

(c) Which points are capacitive?

(d) Which points are inductive?

Question 2:

A load consists of a resistor and a capacitor connected in series: $R = 10\Omega$ and $C = 8.84$ pF. This load is attached to a transmission line with characteristic impedance $Z_o = 50\ \Omega$. The frequency of operation is 900 MHz and the wavelength on the line (λ) is 28 cm. Use the Smith chart to find the following quantities. Label your work in order to make your solution easy to follow.

(a) Find the reflection coefficient at the load (Γ). Verify by calculating the reflection coefficient with the appropriate formula.

(b) Find the standing wave ratio (SWR). Verify by calculating the standing wave ratio with the appropriate formula.

(c) Find the distance from the load to the first voltage minimum and distance from the load to the first voltage maximum. Express in centimeters as well as wavelengths.

(d) A lossless transmission line of length 19.6 cm is attached to the load.

  (i) Find the input impedance (Z_{in}) when looking into the length of transmission line terminated by the load. Use the Smith chart.

  (ii) A voltage generator is then attached to the lossless transmission line. This generator has a voltage of $V_g = 2\cos\left(2\pi \times 9 \cdot 10^8 t\right) V$ and an impedance of $Z_g = 50\Omega$. What is the power absorbed by the load (P_L)? (You don't need the Smith chart for this.)

(e) Design a single-stub (short circuit) shunt tuner to match this load to the $Z_0 = 50\ \Omega$ characteristic impedance. Choose the distance to the tuner to be $2\text{ cm} \leq d \leq 10\text{ cm}$. Use the Smith chart.

Question 3:
You are given an unknown load on a $Z_0 = 100\ \Omega$ transmission line. Similar to what you did in lab 2, you move a probe down the transmission line and find that the load results in a standing wave ratio of 5 V/V. Assuming that the load is purely resistive, what are the possible values for Z_L? Use a Smith chart to find your solution. (Note that this question is very similar to question #3 from assignment #2. Wasn't this easier with a Smith chart?) Now, if you know that the first voltage minimum is located at a distance of $\lambda/4$ from the load, which impedance value is correct?