ENEE 381 Problem Set #6

Due April 26, 2004

Questions (1),(4),(5),(6),(8),and (9) are very relevant for the second examination

(1) Cheng 8.26

(2) Cheng 8.28

(3) A transmission line of characteristic impedance 75ohm is terminated with an inductor of 0.1μH and 50ohm in series. The frequency of operation is 100MHz. Calculate without using the Smith Chart:

(a) $|\rho|$

(b) ϕ

(c) The standing wave ratio

(d) Where on the line closest to the load can the line be matched with the shortest possible shorted stub connected in parallel to the line?

(e) What is the length of this stub?

(4) Repeat (5) with the Smith Chart

(5) A plane wave is incident on the boundary between air and a plastic (ϵ_4=10) at an angle of incidence of 45°. The wave is incident from the air side. Use the Smith chart to find:

(a) $|\rho|$

(b) ϕ

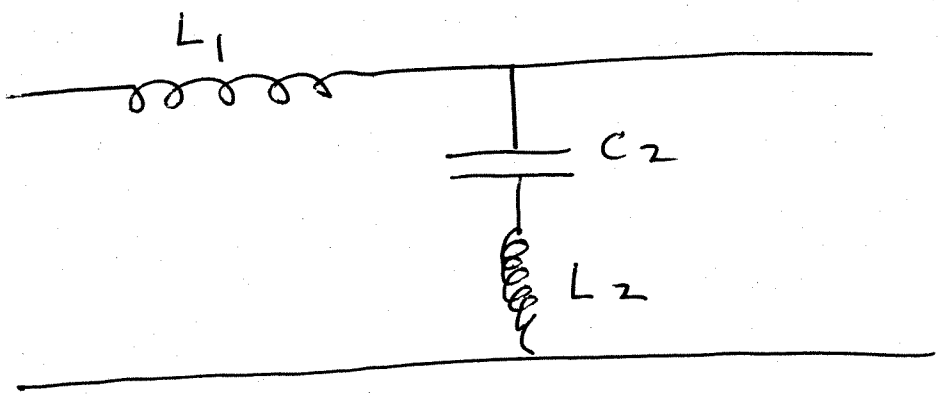
(c) The standing wave ratio

(d) The location of the nearest magnetic field maximum to the boundary

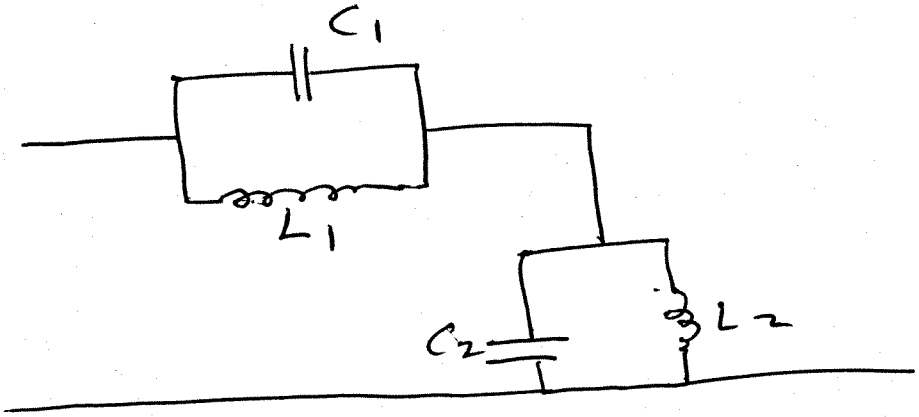
(6)

Calculate and plot the propagation constant (k or β) in the pass band(s), the attenuation constant (α) in the stop band(s), and the cutoff frequency or frequencies for the following generalized transmission lines. Use the values: L_1=10μH/m; C_1=100pF/m; L_2=15μH/m; C_2=75pF/m.

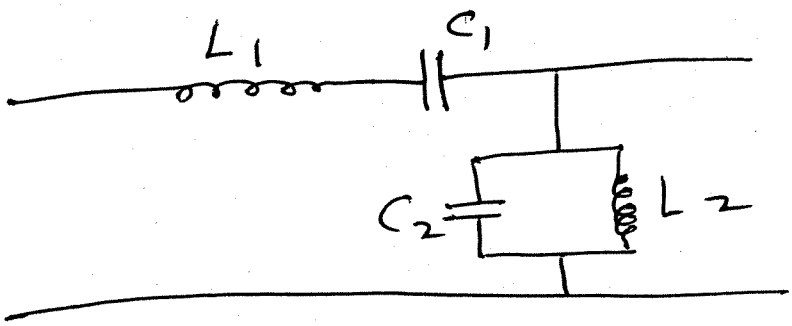
(a)



(b)



(c)



(7) For a sandwich-type radome consisting of two identical thin sheets (thickness 1.5mm, dielectric constant ϵ_r=4) on either side of a thicker foam-type dielectric (thickness 18.1mm, dielectric constant ϵ_r=1.1) calculate the reflection coefficient (amplitude and phase) for normal incidence. Solve for frequencies of 3GHz and 6GHz. Hint: Use Smith chart or the equations for the transformed impedance concept.

(8)For a certain lossless dielectric material of effectively infinite depth, reflections of a plane wave incident normally from free space produce a standing wave ratio of 2.7 in the free space. The boundary is an electric field minimum. What is the dielectric constant?

(9) A plane wave strikes the planar boundary between two lossless semi-infinite dielectrics of dielectric constants 4 and 8 at an angle of 30°. The wave is incident through the lower dielectric constant medium. Calculate

(a) the magnitude and phase of the reflection coefficient

(b) the fraction of energy transmitted into the second medium

(c) the standing wave ratio

(d) the nearest electric field maximum to the boundary

(10) Prove that when a plane wave strikes the planar boundary between two lossless dielectrics at Brewster's angle that the reflected and transmitted waves are at 90° to each other.

(11) A microwave transmitter is placed below the surface of a freshwater lake. Neglecting absorption, find the cone over which you would expect radiation to escape to the air. Use ϵ_r=70.