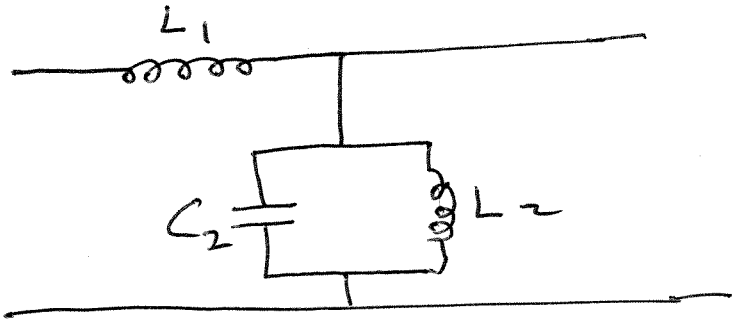
ENEE 381 Problem Set #6

Questions (1),(2),(3),(5),(6),(7),(8),(9),(11),(12), and (14) are very relevant for the final examination

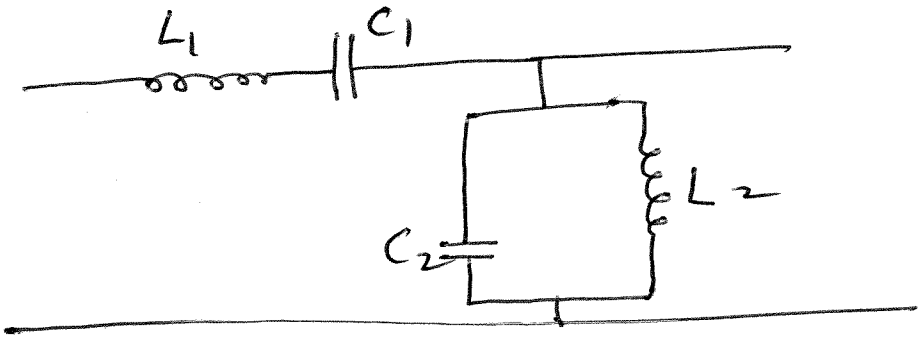
5/6/03 - due 5/16/03

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.

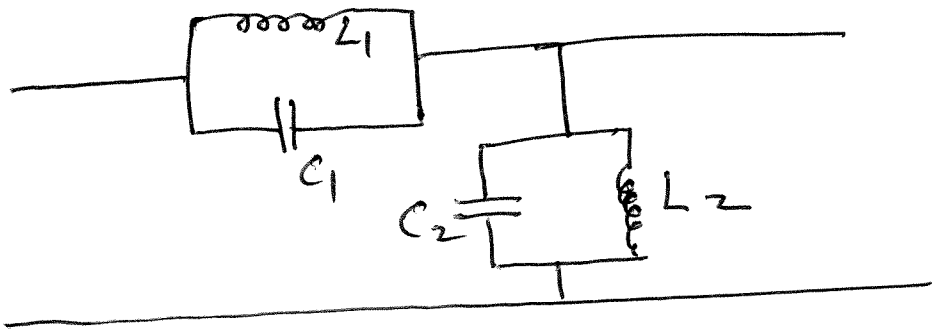
(1)



(2)



(3)



(4) 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.

(5) 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?

(6) 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

(7) 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.

(8) 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.

(9) What refractive index and thickness would you use to make an antireflection coating on silicon (ϵ_r=10) for waves incident at an angle of 45 ° from air?

(10) Cheng (10-8)

(11) Cheng (10-14)

(12) Cheng (10-15)

(13) Cheng (10-17)

(14) Cheng (10-18)