

ECE 604 Electromagnetic Field Theory

Fall 2019

Homework No. 7. Due Date: Oct 25, 2019.

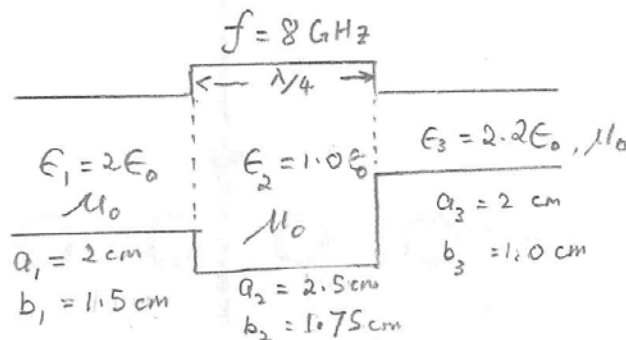
Read lecture notes 1-23.

1. A three section rectangular waveguide is shown and the dimensions and material parameters are also shown.

(i) Ignore junction effects, find the transmission line equivalence model of this waveguide.

(ii) Explain why there are extraneous stored energy at the junction.

(iii) Explain how you would augment the transmission line model in order to account for junction effects.



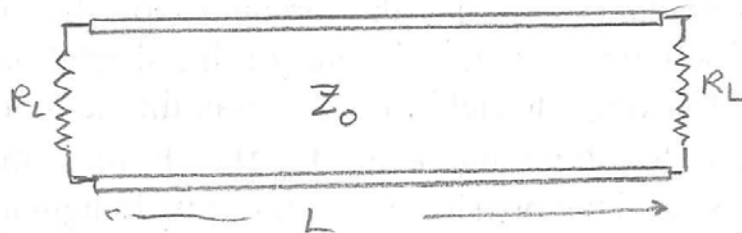
2. The fundamental mode of a circular waveguide cavity is the TM_{010} mode. (Hint: Discussion on this mode can be found in Kong's book.)

(i) Find the formula for the Q of this mode.

(ii) Assume a transmission line resonator is loaded with two resistors at its two ends. Assume that these resistors are much smaller than the characteristic impedance of the line. Find an approximate expression of the Q of this transmission line resonator with the loads at the two ends.

(iii) Now, assume that you can model the wall loss of the waveguide by replacing $j\omega L$ with $j\omega L + R$ where R is small. Find the contribution to the Q from this wall loss alone.

(iv) If you know the Q due to the end walls and the side wall loss, how would you find the total Q of the system.



3. The equations for vector and scalar potentials have been found using the Lorenz gauge in the lecture notes.

(i) Now, find these equations using Coulomb's gauge. (Hint: This is described in J.D. Jackson's book, and many other physics texts.)

(ii) Discuss the pros and cons of Coulomb's gauge versus Lorenz gauge.