RF & Microwave
Assignment-1

Note:

1. Write the expressions for $\bar{E}$ and $\bar{H}$ fields for a short-circuited $\lambda/2$ coaxial line resonator, and show that the time-average stored electric and magnetic energies are equal.

2. a) Consider the resonator shown below, consisting of a $\lambda/2$ length of lossless transmission line shorted at both ends. At an arbitrary point z on the line, compute the impedances Z_l and Z_R seen looking to the left and to the right, and show that $Z_L = Z_R^*$ Also comment on the generality of this condition.
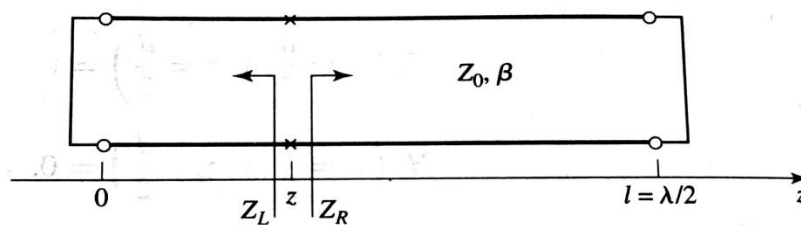
b) A Transmission line resonator is made from a length l of lossless transmission line of characteristic impedance $Z_0 = 100\Omega$. If the line is terminated at both ends as shown, find Q of this resonator.
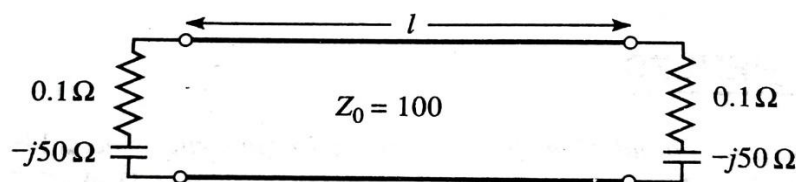
3. A circular cavity resonator is to be designed so that it resonates at 10GHz at its dominant TE Mode. If the cavity of made out of copper and it is filled with the Rogers RT/Duroid 5880 ($\varepsilon_r = 2.2, tan\delta = 0.0009$) .Find the dimensions of the waveguide. (consider d=3*a)

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4. Design an 1:2 Unequal Split Wilkinson Power divider. The power ratio in the two output arms should be $\frac{P_3}{P_2} = 0.25$. Also, give the widths of the microstrip lines for each of the arms if we are designing the P.D using RT/Duroid 5880 substrate.
   (Hint: For design part, give the values of the impedances of the arms and the isolation resistor. For microstrip line widths use ADS Software)

5. Calculate all the impedance values required to design a 1:4 Power divider circuit and draw a neat diagram of the circuit as well as the microstrip line based layout, with all impedance and isolation resistor values. Suppose you have to design this using microstrip lines with RT/Duroid 5880 substrate, determine the microstrip line widths using ADS Software.

6. A 40 dBm power source is connected to the input of a directional coupler having a coupling factor of 15 dB, a directivity of 35 dB, and an insertion loss of 1 dB. If all ports are matched, find the output powers (in dBm) at the through, coupled, and isolated ports.

7. Derive the even and odd mode characteristic impedance values for the single section coupled line coupler.

8. Explain about the unequal phase velocities in the even mode and odd mode of a single section coupled line coupler. Also explain any one method used to make these phase velocities equal.

9. A microwave resonator is connected as a one-port circuit, and its return loss is measured versus frequency. At resonance the return loss is 14 dB, while at 2.9985 GHz and at 3.0015 GHz the return loss is 11 dB (the half-power points). Determine the unloaded Q of the resonator. Do this for both series and parallel resonators.