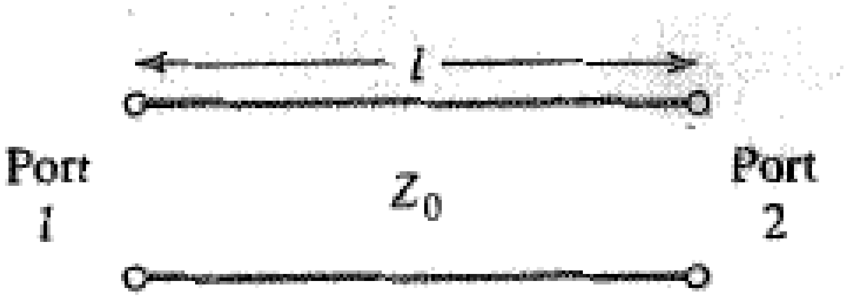
EE6311 Fall 2009, Design Project #1, Impedance Matching

1. Derive the scattering matrix for the lossless transmission line shown below, relative to a system impedance of Z_0. Verify that the matrix satisfies the unitary condition. (Given during streaming lecture on 9/28)



2. (a) Using ideal lumped-element components, design a 2-element matching network to match a 100-Ω source (port 1) to a load impedance, Z_L = 50+j15 Ω at 10 GHz. Obtain two solutions. (Given during streaming lecture on 9/30).

(b) Convert to the appropriate L and C values at 10 GHz **simulate** your results. This will be a 1-port circuit where you change your load impedance from 50 Ω to 50 +j15 Ω and include ideal L and C values for the matching networks. Plot the magnitude of S_{11} (in dB) from 8 to 12 GHz.

3. Design a single-section quarter-wave matching transformer to match a 250 Ω load to a 50 Ω line. What is the percent bandwidth of this transformer, for SWR less than or equal to ≤ 1.5. If the design frequency is 6 GHz, what are the dimensions of the microstrip lines and matching network. Assume the substrate is 0.159 cm thick, with a dielectric constant of 2. No need to simulate, just include dimensions.

4. Design a microstrip impedance matching network using a single shunt-stub tuner with an open- or short-circuited stub to match 75 Ω to a load impedance of 100 + j80 Ω. **Simulate** your results and plot the magnitude of S11 in dB over the frequency range of 8 to 12 GHz.

Use center frequency f_0 = 10 GHz
Port impedances = 50 Ω
Substrate ε_r = 12
Substrate thickness = 0.381 mm
Conductor thickness = Au metal at 10 μm