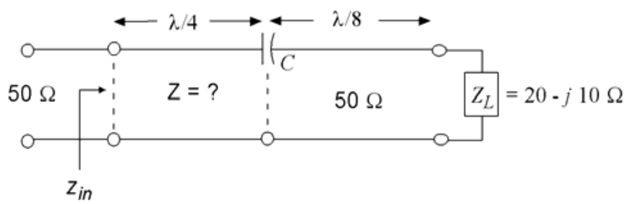
Reading Assignment: Cheng Chapter 10 & Handouts

Homework #6 Due: Friday 3 March 2006

1) Do problem P.9-26 in Cheng

2) A parallel RC load with $R = 100\,\Omega$ and $C = 1.5\,\text{pF}$ is to be matched to a $50\,\Omega$ line over a frequency band from 2 to 10GHz. What is the best return loss over this band that can be obtained with an optimum matching network?

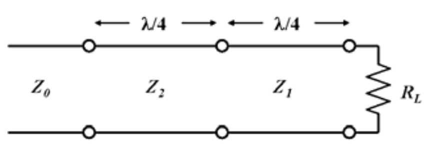
3) Consider the problem below where a load $Z_L = 20 - j10\,\Omega$ at $10\,\text{GHz}$ terminates a $50\,\Omega$ transmission line. You are asked to design a matching network at this frequency, but due to physical constraints you can not use stubs. You have at your disposal only a chip capacitor C, and an ability to adjust the characteristic impedance of the main line if necessary.



   a) Find the required capacitance C such that when inserted in series at a distance $\lambda/8$ from the load, the resulting input impedance is real. You may use a Smith chart but it is not required.
   b) Then determine the necessary characteristic impedance of a quarter-wave transformer to provide a match to a $50\,\Omega$ generator.
   c) Would this procedure work for any arbitrary load impedance?

4) The equivalent circuit for the gate-source junction of a GaAs FET device is usually well modelled by a series RC circuit. Using a Smith chart, design a single-stub input matching network for a FET with $R = 5\,\Omega$ and $C = 0.2\,\text{pF}$, assuming a center frequency of $f = 10\,\text{GHz}$. (Note: I've exaggerated the magnitude of R to make the problem slightly easier; R is more typically 1-2 Ohms or less). Then, using ADS, plot the frequency response of your design over a range of frequencies in the neighborhood of 10 GHz. What is the 3 dB bandwidth of your design?

5) The bandwidth of a quarter-wave matching networks is determined by the load-source impedance transformation ratio, R_L/Z_0. The bandwidth can be improved by using several cascaded quarter-wave sections to gradually transform the impedance, such that each section in the cascade operates at a transformation ratio closer to unity as compared to a single quarter-wave section.



Find the characteristic impedances Z_1 and Z_2 of the 2-section impedance transformer above that will optimize the bandwidth. Simulate this structure on ADS using $R_L = 200\,\Omega$ and $Z_0 = 50\,\Omega$, and compare with the response of a single-section quarter-wave transformer.