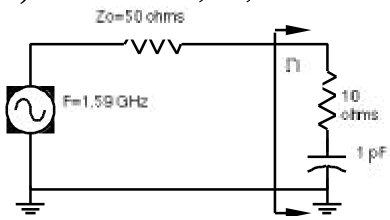
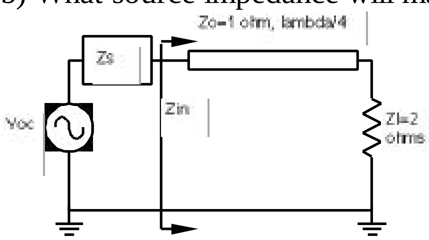
ECE202A first problem set. Due October 18, 1999 (in class)

1) Practice with a Smith Chart:

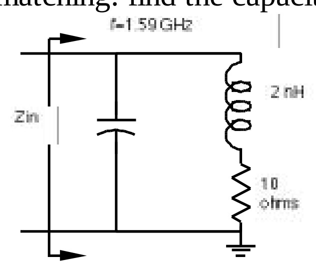
a) What are Zl, Yl, Γl?



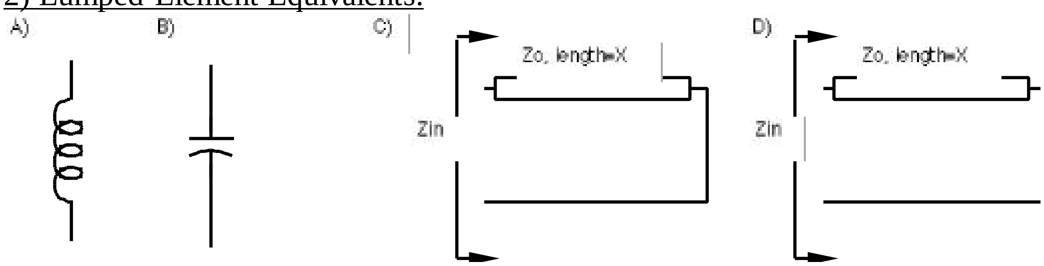
b) What source impedance will match Zin?



c) matching: find the capacitance C required to make Zin=50 ohms.



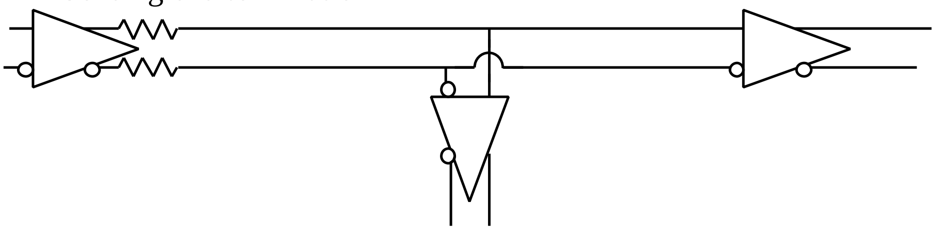
2) Lumped-Element Equivalents:



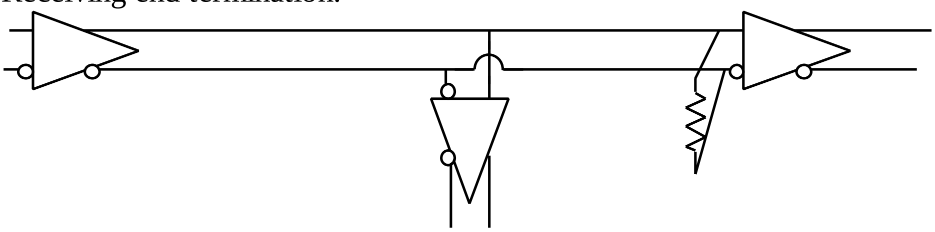
Using the smith chart, determine the reactances for the following elements over the frequency range f=0 to f=2fo, where $L=Z_0\tau$, $C=\tau/Z_o$, $\tau = X/V_p$, and $f_o=1/\tau$ where V_p is the transmission line (phase) velocity, and τ is the line electrical time delay. Plot the trajectories of each on the Smith Chart, and also draw two rectangular plots of reactance-(normalized to Zo) vs.-frequency (normalized to f_0), one with A) and C), the other with B) and D). Over what range of frequencies does which transmission line reactance approximate which lumped element reactance? This should give a very clear picture

3) Lattice Diagrams and Bus Structures

Sending end termination

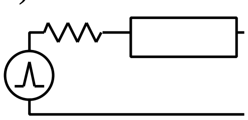


Receiving end termination.

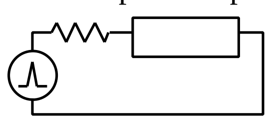


The circuit diagrams above represent logic gates interconnected by a 200? balanced transmission line, typical of ECL. The line is one meter long, with a third gate connected at the middle. The line velocity is 2/3 c. The gates have infinite input impedance and zero output impedance. In the sending-end termination case, the sending end is driven from a total source impedance of 150? , while in the receiving end case the recieving end is terminated in 150? . The output voltage of the driving gate is a 300 mV step-function; use lattice diagrams for the 2 cases to find the input voltages to the two receiving gates; which gates function correctly?

4) More on lattice diagrams and pulse responses:



a



b

In parts a and b the lines are driven by unit voltage impulses. In case a the line is 50? and the generator impedance 5000? , while in case b the line is 50? and the generator impedance 0.5? . In both cases the lines are 1 ps long.

First) Use Lattice diagrams to find the input voltage to the lines

Second) Using either pi- or T-equivalent lumped-element approximations to the circuits, again find the input voltage

Third) explain clearly what you have found.

You have worked through 2 of 4 possible cases-what would the other 2 cases be?