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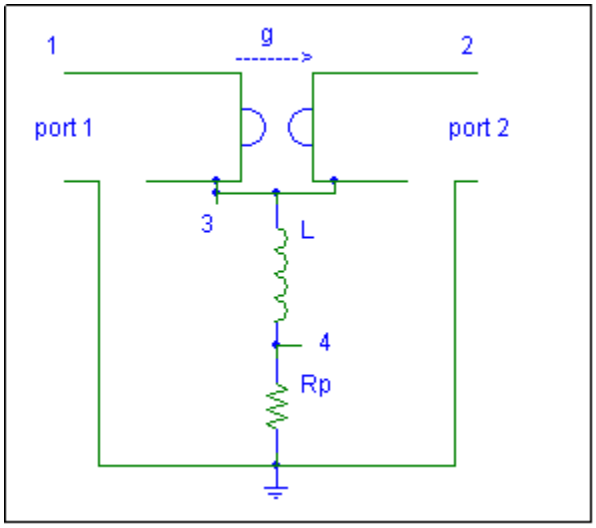
610 Fall 2010 – Problems to consider set 2

1. a) For the following circuit set up the indefinite admittance, ground the bottom node and eliminate the two internal nodes to obtain the 2-port admittance Y(s).
   b) Invert Y to obtain Z(s) and check by adding two impedances, one for the gyrator and one (which has no admittance) for the inductor with its parasitic loss resistance Rp.
   c) Load port 2 with an impedance $z_L(s)$ and find the input admittance $z_{in}(s)$ seen at port 1. From that calculate $z_L(s)$ as a function of zin(s).
   d) In $z_L(s)$ let Rp => 0 and give a means to identify this as zin(k) times a Richards' function, R(s). Here R(s) can probably be [k-sz(s)]/[kz(s)-sz(k)]



2. Find the 2-port scattering matrix for the above circuit assuming unit resistor "terminations." Check that this is lossless when Rp=0.

3. a) For the above circuit consider that current sources are applied to all of the nodes and use the tree as branches of the current sources (direction of branches pointing down). Write the semistate equations assuming inputs are currents into the port nodes, 1 & 2, and that outputs are the voltages at those two nodes with respect to ground.
   b) From the semistate equations find the two port impedance matrix.
   c) Assume Rp=0 and that there are no external inputs but there is an initial current (going down) in the inductor, $i_L(0)$ and solve, versus time t, for the 2-port output voltage vector, $v(t)=[v1(t)\ v2(t)]^T$.