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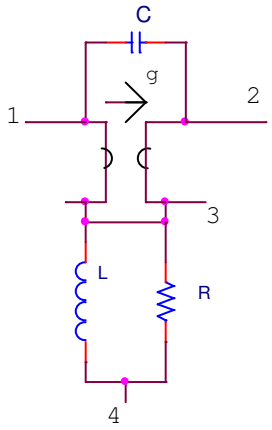
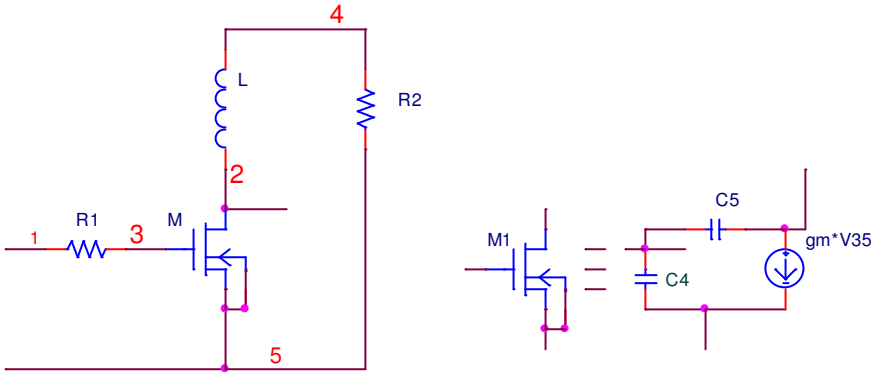
610 Fall 2013 – Homework 4 due Th 10/10/13

1. (25 points) (indefinite Y to 2-port Z) For the following circuit
   a) Give the indefinite admittance matrix Yind(s).
   b) Ground node 4 and eliminate node 3 to give the 2-port Y(s); obtain $Z(s)=Y(s)^{-1}$



2. (10 points) (Even part zeroes) For the result of Problem 1, give the even part of Y(s) and the even part of Z(s), compare, and discuss the even part zeros in terms of G=1/R
3. (15 points) (load z in terms of input z) Using the 2-port Y(s) of problem 1, set C=G=0
   a. Find the load impedance $z_L(s)$ in terms of the input impedance z(s).
   b. Relate to the Richards function of the text and discuss the possibility for lossless synthesis.
4. (50 points) (step response of amplifier) The following 2-port circuit has the input port at nodes 1-5 and the output at nodes 2-5. Assume that C5 can be ignored (C5=0)
   a. Give the transfer function $T(s)=V_{2\text{-}5}(s)/V_{1\text{-}5}(s)$ when fed by a voltage source and having an open-circuit load.
   b. Assume C4=C and R1=R2=R, and normalize C = R = 1. Give the normalized T(s) and find the poles and zeros (in terms of gm and L).
   c. Give the unit step response of this normalized circuit. From it give the impulse response by taking the derivative.



[Optional, not for grading: repeat Problem 4 for C5=C4. Discuss why we know there is at least one real pole or zero]