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Final Exam ENEE 610 Fall 2007

Open book, open notes (not open computer or open budy!). Due at or before final time, 12/17/07. Insert your answers in a signed exam book (only signed exams will be graded) Check the web for any corrections. Good luck.

#1. 50 points (30 minutes)

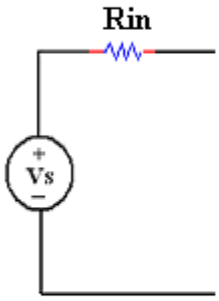


Figure a

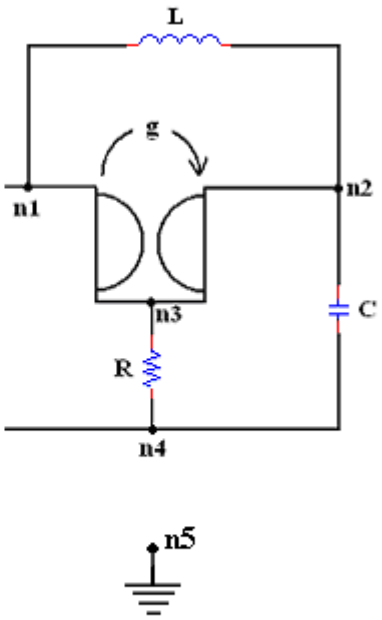


Figure b

a1) Consider first the Figure b circuit and find the indefinite admittance.

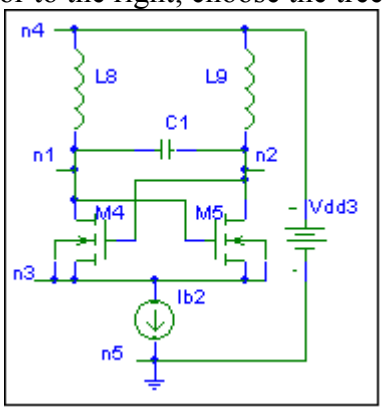
a2) Connect node 4 to ground and eliminate node3 to find the 2-port admittance, Y(s), port one being node n1 to ground and port two being node n2 to ground.

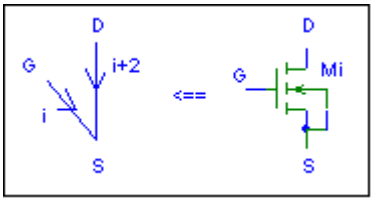
b1) Connect the circuit of Figure a as input to port one of the 2-port of admittance matrix Y(s) and find the voltage transfer function, T(s), this being the voltage of node 2 to voltage of the source of voltage Vs (it may be profitable to use a Norton's equivalent).

b2) Assuming all element values positive except possibly g which is real, determine for what values of the elements T(s) will be positive real and discuss why you expect this result.

#2. 50 points (30 minutes)

Consider the following circuit, which is essentially that studied in the base paper of Mr. McGovern. Here take the graph for transistor Mi to be as shown with its drain current a nonlinear function of only the gate-source voltage, $i_D=f(v_{GS})$; take gate current to be 0. Number the branches by the element numbers and orient them down or for the capacitor to the right; choose the tree to have the smallest numbers.





a) Draw the graph and give the cut-set and tie-set matrices for the circuit.

b) Using the results of a) write the semistate equations [in terms of f(.)] using x to be the vector of tree voltages and link currents.

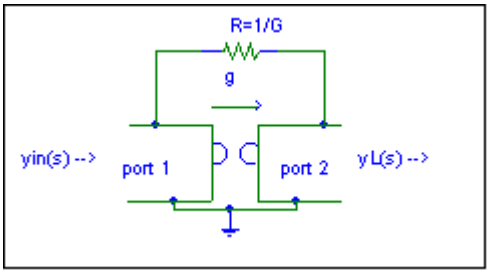
c) Discuss how you would solve these semistate equations and how you would reduce them to the form of the first equation of Mr. McGovern's handout.

#3. 25 points (20 minutes)

For the following 2-port, G is positive and g real.

a) Find the load admittance, $y_L(s)$, in terms of the input admittance, $y_{in}(s)$, and conductances of the 2-port, G and g.

b) If $y_{in}(s)=(a_m s^m+...a_1 s++a_0)/(b_m s^m+...b_1 s+b_0)$,m>1, is positive-real with no pole or zero at both s=0 and s=infinity, and all coefficients different, give the conditions on G and g for $y_L(s)$ to have a zero at s=infinity and a pole at s=0. Determine if the resulting $y_L(s)$ is always positive real and comment upon the results in terms of the concept of passivity.



#4. 25 points (20 minutes)

a) Find the poles and zeros and synthesize the RC admittance

$$y(s)=[4s^2+(27/4)s]/[s^2+3s+2]$$

b) It is conjectured that the zeros of the even part of RC positive real functions all lie on the negative real (=sigma) axis. Prove or disprove this conjecture by showing why it is true or what would need to be changed in the conjecture to make it true.