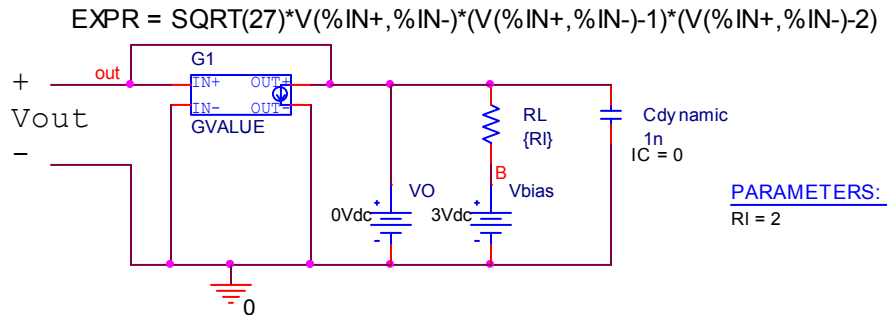


610 Fall 2013 – Homework 1 Due Tu 09/17/13

The Gvalue part is in the abm.olb library  
 The PARAM part is in the SPECIAL library.

1. (50 points, Gvalue and load line)

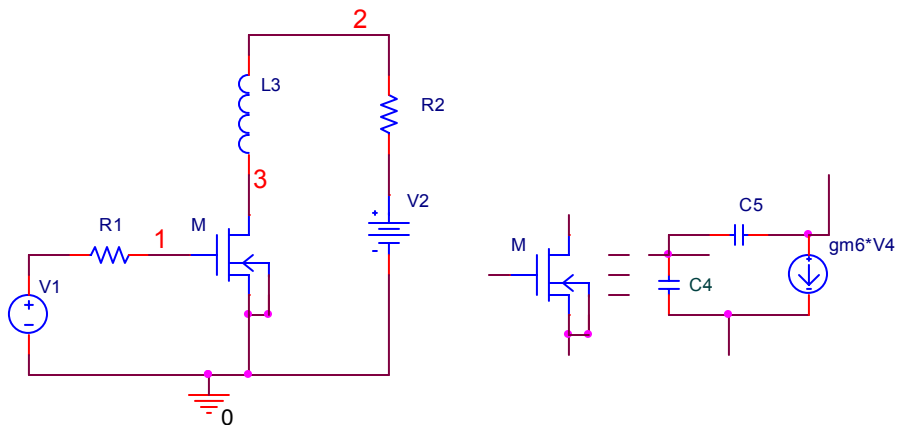
Set up the following circuit in Spice and use that to plot the DC curves of the diode connected Gvalue and its load line over the Gvalue voltage,  $V_0$ , of 0 to 5 V and again, by “zooming” with the x-axis setting, over 0 to 2.2 V. Use the parameter and vary  $R_L$  from 1 Ohm to 7 Ohms in 2 Ohm steps. Change all traces to black and submit your curves along with your circuit diagram. [note that the diode curve is designed to be a cubic with zeroes at  $v=0,1,2$  and a max of 2 between the first two zeroes].



2. (50 points, circuit graph)

For the circuit on the left replace the transistor by the equivalent on the right.

- a. Draw an oriented graph, combining R's with V sources, numbering branches according to the component numbers and orienting from left to right or top to bottom.
- b. Choose branches 1, 2, 3 for the tree and give the cut-set and tie-set matrices. Use the node numbers given on the circuit.
- c. Write the branch-branch admittance matrix, the source vector, and circuit equations from which all the currents and voltages in the circuit can be found.



Additional problems, not for grading

For the following two problems set up the augmented incidence matrix,  $A_a$ . Delete the last row to get  $A$  and calculate  $\det(AA^T)$  to determine how many trees are possible (you may wish to locate a proof of this fact especially since the result stated in the book [using  $A_a$  instead of  $A$ ] is in error).

3. Show that the graph obtained in problem 1 has 13 trees and draw each of them. Discuss if any are advantageous to use in circuit analysis.

4. The following 10 node 15 edge graph, when undirected, is known as the Petersen Graph and, due to each node having three branches, is of interest in the four color problem. Choose the numbering given (1 through 10 for nodes and I through XV for edges)

a. Choose the tree formed by the thicker edges (I through IX) and give the cut-set and tie-set matrices using the orientations given. Discuss the possibility of determining a means to obtain these from  $A_a$ .

b. Determine the number of trees (quite a large number).

