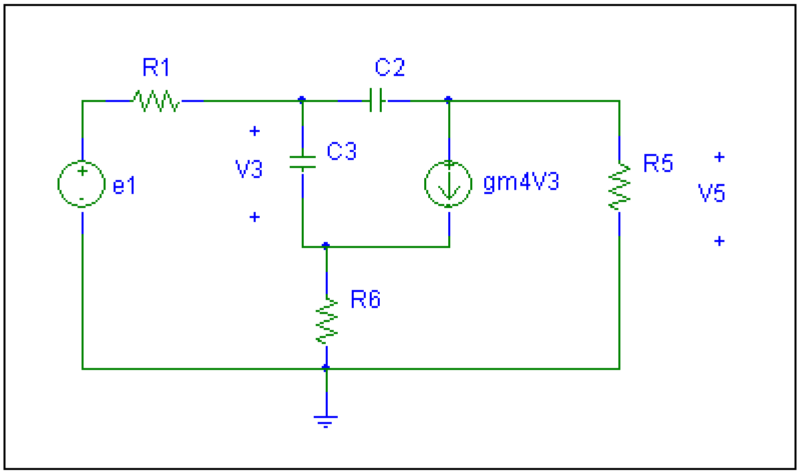
File G/courses/F2011/610/610F11hmrk3.doc RWN 09/26/11

610 Fall 2011

Homework 3 – due 10/06/11

1. 50 points (indefinite equations)

a) For the following circuit from Homework 2, set up the 5x5 indefinite admittance, $Y_{indef}(s)$ (for that replace e1 by a current source and consider it and R1 in two branches; best to number the nodes from left to right and then the top of R6; that is the left of R1 as node 1, the top of R5 as node 3 and the top of R6 as node 4). Use the symbols on the circuit as element values.



b) Ground node 5 and give $Y_{nodal}(s)$.

c) Set R1=R5=R6=1/G=1 and C2=C3=C=1, eliminate internal nodes 2 & 4, and obtain the 2x2 two port Y(s) matrix with port one being node 1 to ground and port 2 being node 3 to ground. Here gm is still a parameter.

d) For the numbers of part c) obtain the transfer function of Homework 2, that is T(s)=V5/E1 with numerical coefficients except gm as a parameter.

e) Give the poles and zeros of T(s) (with numerical coefficients) and comment on their behavior as gm varies.

2. 50 points (nonplanar graphs and trees)

Problem 3.12, p. 124, states that the total number of trees is given by $n_T=\det(A_a A_a^T)$ where A_a is the augmented incidence matrix. Show that this is in error (a misprint ?); A_a should be replaced by A.

a) Find n_T for the circuit of Problem 1 above assuming R1 & e1 are in the same branch. Draw all the possible trees.

b) Find n_T for the two Kuratowski graphs of Figure 3.3-5.

c) Redraw the 5 node Kuratowski graph so that only two branches cross. Then replace the crossing by a transformer and draw the new graph. For it find n_T and compare with the result of b).

d) From c) decide if a formula can be given for the increase in number of trees when a nonplanar graph is converted (by using transformers) to a planar one.