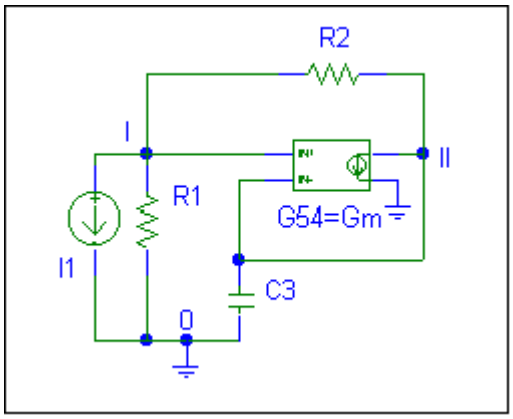
File: c:\temp\courses\fall2002\610\610F02probs1.doc RWN/AD 09/16/02

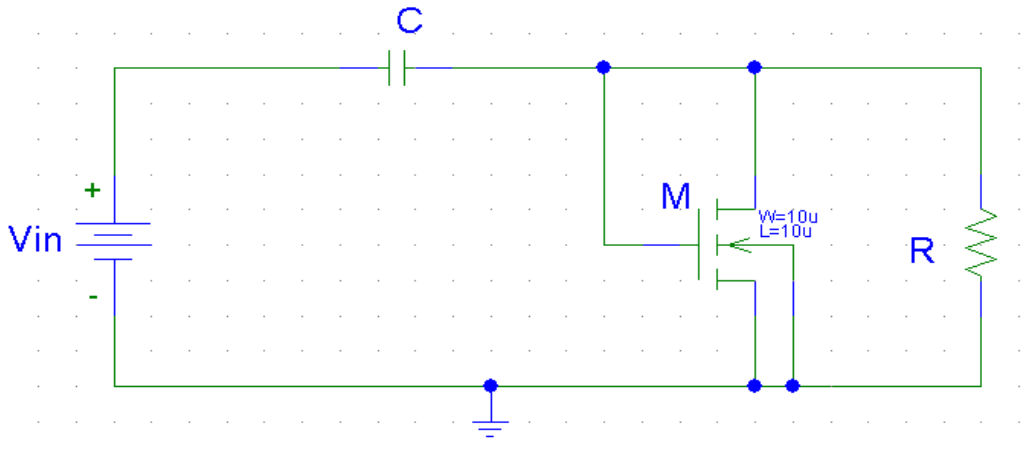
Some Problems to Consider - 1

1. For the following circuit draw a graph with the branches numbered according to the component numbering. Using branches 1 and 2 as the tree find the cutest and tieset matrices; repeat using branches 3 and 4 as the tree. Set up the describing equations twice, once for each tree and compare. Assuming the voltage at node II with respect to ground is the output and I1 is the input, find the transfer function.



2. For the graph of problem 1 draw a dual graph. From the dual graph choose a suitable tree and write the cutest and tieset matrices. Assuming each branch in the dual graph is replaced by the dual circuit element cut in forming the dual, draw the "dual" circuit. Write the describing equations for this dual circuit and compare with those of problem 1.

3. For the following circuit, setup the oriented graph, choose a tree and find the associated cut-set and tie-set matrices. Check that these latter have the desired relationship. Do this in two ways, by once putting the driving source in a separate branch and compare with the case when it is combined with the capacitor.



4. Using the results from 3, give the semi-state variable descriptions and equations of the circuit. Use the capacitor voltage as the state and the voltage-current vector as the semi-state variables. Use the source as the input and the capacitor voltage as the output.

5. For the Kuratowski graph on the left side of Figure 3.3-5, p. 110 of the text,

a. Draw a tree and find the corresponding cutest and tieset matrices.

b. Draw all possible trees.

c. Show that the number of possible trees agrees with the formula of problem 3.12 of the text.

6. If a given graph is not planar one can introduce transformers where branches cross, as shown below, and create a planar graph. Investigate this possibility by looking at some examples and comparing circuit equations for the original and dual graphs.