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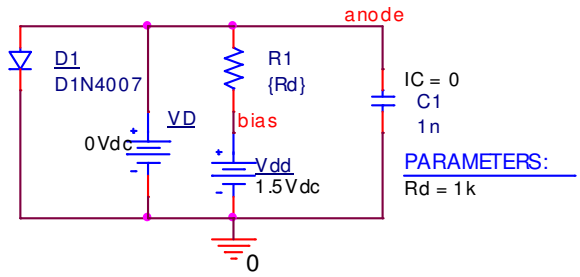
610 Fall 2014 – Homework 1 Due Th 09/11/14

The diode part is in the DIODE library
The PARAM part is in the SPECIAL library.

1. (40 points, Diode bias & Spice transient analysis)
   Set up the following circuit in Spice. Then do a DC run on VD along with a Parametric run to find RD to give a diode current of 1mA.
   a) Record a) the resistance Rd of the resistor R1, b) the diode voltage, Vanode, at the Q point and c) the conductance (slope), gd, of the diode current vs diode voltage at the Q point.



   b) Delete the voltage source VD from the circuit and make Rd the value found for the Q point. From those values set up the small signal differential equation when the initial value of the capacitor is 1mV greater than the Q point voltage. Do a transient analysis for about 50uSec in PSpice with that capacitor IC value. Submit your transient analysis curves of anode voltage and diode current..

2. (40 points, Small Signal Equivalent and ODE solution)
   a) For the above circuit draw the small signal equivalent circuit linearized at the Q point with the capacitor IC considered as input.
   b) Analyze the circuit to get the (first order) ODE describing the circuit.
   c) Obtain the solution of the ODE and implement it in MathCad including obtaining an xy graph for the diode anode voltage. Compare this with that obtained from Spice.
   d) Discuss the reasons for any differences.

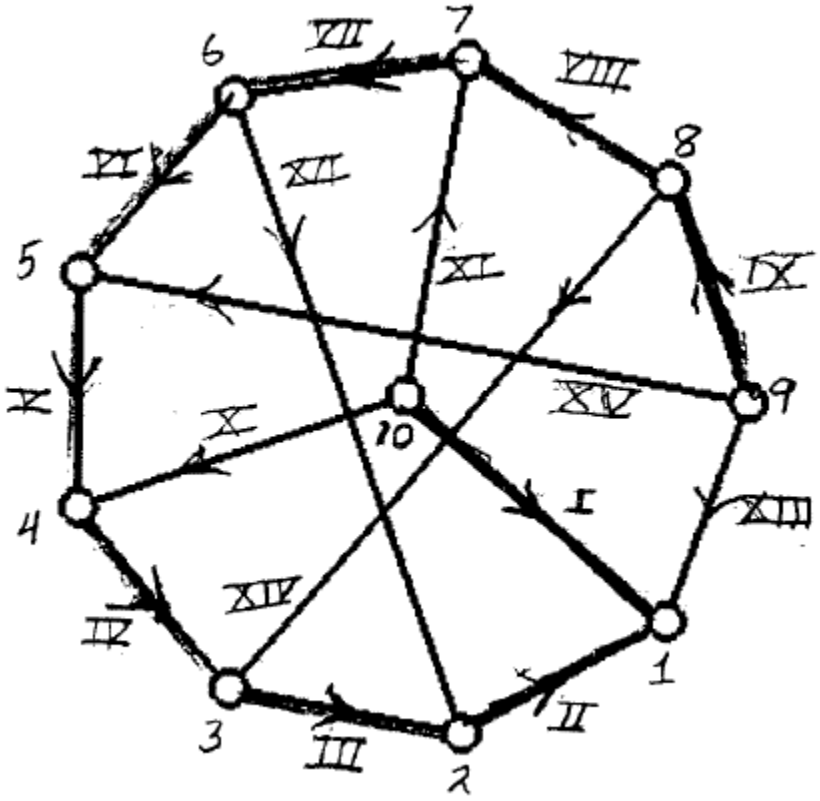
3. (20 points, circuit graph)
   For the circuit of problem 2 above, draw the circuit graph using a branch for each component including the initial condition voltage source as a component. Orient all branches pointing down and number from left to right for the top components and continue such for the bottom components. Choose a tree to be the maximum number of branches tied to ground. Then give the cut-set and tie-set matrices.

Additional problems, not for grading

1. 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.

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



2. For the above graph set up the augmented incidence matrix, Aa. 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 in the literature especially since the result stated in the book [using Aa instead of A] is in error).