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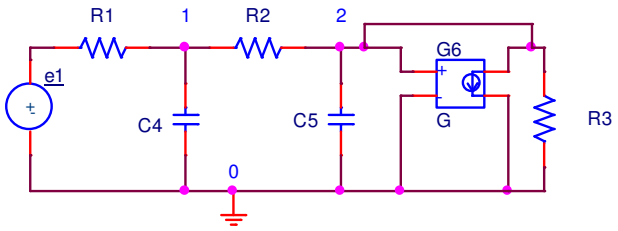
610 Fall 2017 – Homework 1 Due Tu 09/12/17

1. (40 points,)
   For the following circuit

a) Set up the graph, number the nodes as shown and the branches by the element value subscripts. Choose the lowest numbered branches for the tree and orient branches down or from left to right [represent the G component by two branches (these being the input voltage sensor and the output current source)]. Give the cut-set and tie-set matrices.
b) Give the branch by branch A(s)v=B(s)i equation .
c) Set up semi-state equations with $u=e_1$, $y=v_3$ and $x^T=[v_t, i_l]$



2. (60 points, Van der Pol Oscillator)

The Van der Pol oscillator is described by the state equations:

$$dx/dt = y$$
$$dy/dt = - \omega_o^2 x + \varepsilon(r^2 - x^2)y$$

a) Set this up in Spice using two capacitors and G and/or GVALUE (in the ABM library) components. Normalize to r=1 and ω_o=1 but with ε as a parameter. Run transient analysis for ε = 0.02, 2 and 20 and for each of these plot the phase plane trajectory of y(t) versus x(t) (with x on the horizontal axis and y on the vertical; this can be set via the PLOT menu in PSpice). First use initial conditions x(0)=y(0)=0 and then investigate others including x(0)=y(0)=3.