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ENEE 610

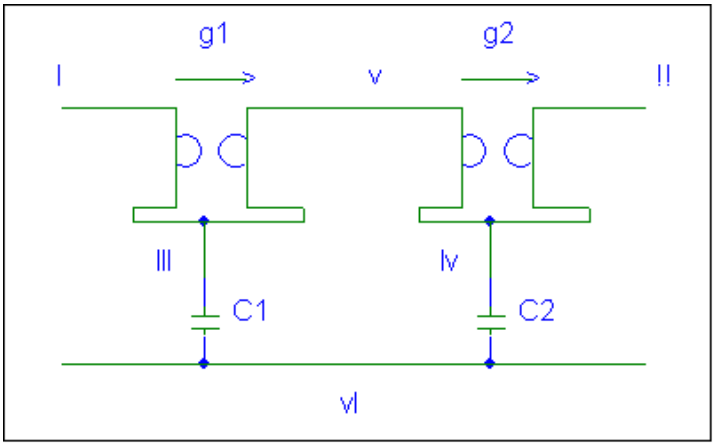
Homework Problems for Grading, Set 4 (100 points)

Due at class ~~W 10/12/05~~ ~~M 10/17/05~~ W 10/19/05

Passivity properties, solving chaotic ODE with Spice

1. (50 points)

For the following circuit assume that the g's and c's can assume any complex values and that as a 2-port the input port uses terminals I and VI while the output port uses terminals II and VI



a) Determine for which values of the g's and c's the 2-port admittance matrix Y(s) satisfies $Y(s) = -Y(-s)^T$

b) Determine for which values of the g's and c's the 2port admittance matrix Y(s) is positive-real.

c) Determine for which values of the g's and c's the 2-port admittance matrix Y(s) is positive-real and lossless.

2. (50 points)

A certain circuit has w as a real parameter and is described by the equations

$$\frac{dx}{dt} = Ax + Wv, \qquad x(0) = [-0.2, -0.5, 0, 0]^T$$

$$v = \tanh(x)$$

where

$$A = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -100 \end{bmatrix}, W = \begin{bmatrix} 1 & 1/2 & -3 & -1 \\ 0 & 2+w & 3 & 0 \\ 3 & -3 & 1 & 0 \\ 100 & 0 & 0 & 170 \end{bmatrix}$$

a) Set up a PSpice schematic and plot x_2 then x_3 then x_4 all versus x_1 (x_1 on the horizontal axis) all for w=-0.4; show that there is a limit cycle.

b) Repeat a) for w=+0.3 which supposedly gives chaos. Discuss the result.

c) Investigate the range of A_{44} over which the chaotic response of b) remains.