

610 Fall 2016 – Homework 2 Due Tu 09/20/16

1. (60 points; Transfer Function from State Equation)

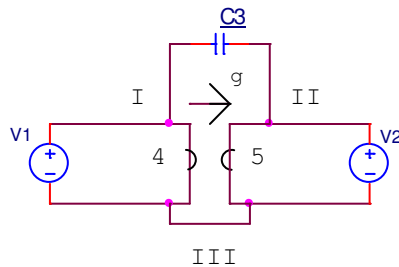
Consider the state variable equations where g is a constant parameter; all entities are scalars:

$$\begin{aligned} dx_1/dt &= 3x_1 - 5x_2 + gu \\ dx_2/dt &= 2\tanh(3x_1 - 3x_2) + 12x_2 \\ y &= 2x_1 - 3x_2 + 8u \end{aligned}$$

- Linearize about the operating point $x_1=x_2=0$ and write the equations in matrix form.
- Give the transfer function for the linearized system.
- If $u=v_{in}$ and $y=v_{out}$ give a circuit using capacitors, resistors and G components.
- By modifying the circuit of c) give a circuit for the full nonlinear equations.

2. (40 points, dual circuits and Indefinite Y)

For the following 2-port circuit.



- Draw a directed graph by numbering the branches as per the subscripts and gyrator branch numbers. Choose the voltage sources for the tree and branches 1,2,4,5 pointed down with 3 to the right. Use the I, II, III node numbering. Give the cut set and tie set matrices.
- As this is a planar graph draw the dual graph with branches numbered as those cut in forming the dual. Give the cut set and tie set matrices of the dual graph and compare with those of the original.
- Draw the dual circuit (with each branch being dual of the original).
- For the dual circuit move the ground off of the graph and give the indefinite admittance matrix of the dual (for the 2-port at the source terminals).

