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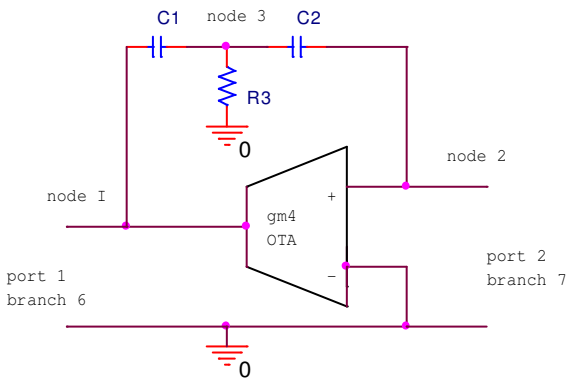
610 Fall 2009 – Homework 4 Due ~~Th~~ Tu 10/~~08~~ 13/09

1. [50 points] [passive 2-port]



For the above circuit assume that all element values, C1, C2, R3, gm4, can take on any real number.

a) Calculate the real power into the 2-port when sinusoidal current sources are applied at the ports assuming that the currents have arbitrary amplitudes |I1| & |I2| at variable frequency ω.

b) Determine the ranges of element values for which $0 \leq \mathrm{Re}(V^{T*}I)$ for any sinusoidal input (port) currents, I1 & I2.

2. [50 points] [semistate/state equations]

In the circuit of problem 1 above replace C2 by a resistor R2. To simplify notation change the name of C1 to C and gm4 to g.

a) Set up the semistate equations taking the port currents as inputs and the port voltages as outputs. Use x as the tree branch voltages [use branches 1, 6, 7 for these] and link currents, $x=[v_t^T \; i_l^T]^T$.

b) Reduce these equations to state variable ones, dv1/dt=Av1+Bu, y=Cv1+Du.

c) Find the transfer function (matrix) $T(s)=D+C(s-A)^{-1}B$.