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EE 610 Final Exam Fall 2011

Take Home. Open Book Open Notes 100 points total

Due in Room AVW 1364 at the final period along with your notebook. Your signature certifies that the work is your own.

1. (30 points = 6 points per synthesis)

   Synthesize $y(s)=\frac{s(s^2+6)}{s^2+3}$ by 5 methods (1st & 2nd Foster & Cauer & via Richards' function sections with k=3)

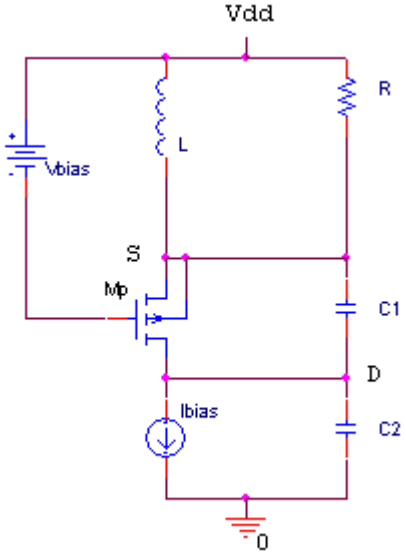
2. (30 points)

   The following circuit is a Colpitts oscillator for which $\omega_0^2=1/(LC)$ where $C=(C1C2)/(C1+C2)$.

   a) Draw the small signal equivalent low-frequency circuit for the oscillator and from it give the circuit graph (ignore M1's output resistance but include its gm). Orient from nodes S and D to ground (use these branches in a tree) and from S to D. Give the cut-set matrix.

   b) Use inductor current and voltages on the capacitors and give state variable equations in matrix form (A is 3x3).. Use $x=[iL, vC1, vC2]^T$ as the state.

   c) From the state variable equations check the oscillation conditions giving the necessary gm if R<0 (hint: equate real and imaginary parts to zero).



3. (40 points; 10 points per part)

   Given two positive-real functions f(s) and g(s), possibly not rational in s, it is known that f(g(s)) is positive-real.

   a) Give those real constants a for which af(g(s)) is positive-real.

   b) Is f(s) + g(s) always positive-real? Is f(s)-g(s) always positive-real?

   c) Is f(s)/g(s) always positive-real?

   d) Exhibit a circuit that has a non-rational in s positive-real input admittance.