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ENEE 610 Fall 2002
Problems to consider #6

1. Consider a rational driving-point admittance y(s) which has real coefficients.

a) If y(s) comes from a passive RL circuit show that its poles and zeros are on the non-positive real axis and alternate. Since the poles and zeros for an RC circuit have the same property, what is it that distinguishes y(s) to be RL rather than RC?

b) Give necessary and sufficient conditions that y(s) is the driving-point admittance of a passive RL circuit. Repeat in the case that y(s) is for an RC circuit.

2. Using the Richards' function to obtain a cascade, correct errors, if any, and then complete the synthesis started in class of

$$y(s)=\frac{s(s^2+3)}{3(s^2+\frac{1}{3})}$$

3. For the following function plot the poles and zeros and the zeros of the even part and of the odd part. Show that this is the driving point admittance of a two element kind circuit (that is, one of LC, RL, or RC).

$$y(s)=\frac{s(s+3)}{3(s+\frac{1}{3})}$$

Synthesize using the Richards' function this driving point admittance.

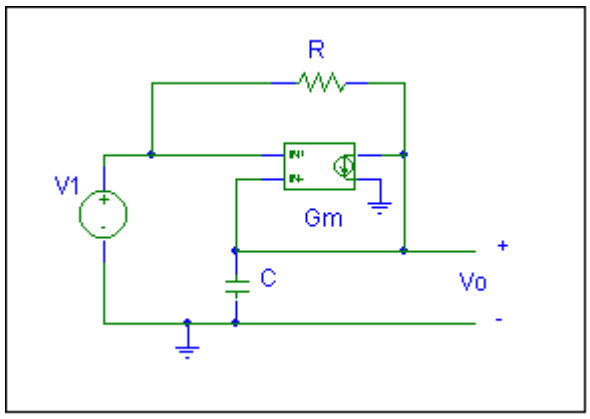
Give a synthesis using the 1st and 2nd Cauer and the 1st an 2nd Foster forms and compare these and with the result of the Richards' function synthesis.

4. Find all values of the triple of complex numbers a, b and c such that

$$y(s)=\frac{(s+a)(s+c)}{3(s+b)}$$

is the driving-point admittance of a passive circuit.
For those values find the zeros of the even part and use a Richards' function to give a synthesis.

5. For the following circuit find the sensitivity of Vo/V1 to Gm, to C, and to R. Do this in two ways, by direct calculation and by the use of the adjoint circuit.



6. Given a circuit with a graph G show how to draw the graph for the adjoint. Carry out your construction on the circuit of 5. above.

7. Find the adjoint circuit for an ideal current mirror and then for a transistor realization as a simple current mirror acting linearly. Repeat for the differential pair acting linearly and for the op-amp.

8. If the circuit is nonlinear discuss how you would define the adjoint circuit. Consider your definition in the case of the differential pair.

9. Discuss the uniqueness or non-uniqueness of the adjoint circuit (for this also consider the nullator, the norator, the op-amp, the transformer, and the circulator).