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EE 610 Final Exam Fall 2013

Open Book Open Notes 150 points, 2 hours.

Notebooks are due at the end of the exam. Good luck and have a good semester break.

1. (50 points, 30 minutes)

Consider a passive RC admittance y(s) of degree n with a pole at infinity

a) Give y(s) in partial fraction form.

b) Sketch y(σ) for all real σ for n=1, for n=2 and for n=3.

c) Form Even(y(σ)) for general n and sketch for the three cases of part b). Comment on the special cases of y(0)=0.

d) Determine when a synthesis can be based upon Richards' functions with extractions at real positive k.

2. (50 points, 30 minutes)

For the following circuit, number the non-ground nodes 1, 3, 2 from left to right.

a) Insert current sources from ground to nodes 1 & 2..

Draw the graph for the resulting circuit numbering branches 1 to 7 from left to right (the gyrators being represented each by two branches, one at each of its ports) orienting branches 1 & 7 up and the others down.

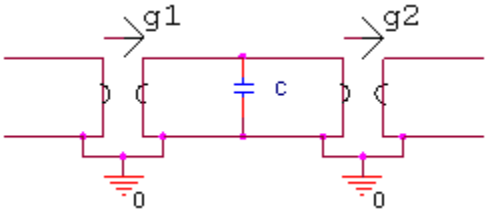
b) Use branches 1, 4 and 7 as the tree and give the cut-set and tie-set matrices. .

c) Remove the ground and call the remaining node 4. Then find the 4x4 indefinite admittance Yind(s) of the given circuit.

d) Ground node 4 and eliminate node 3 to obtain the 2-port admittance matrix.

e) Load port two (the right side) by a capacitor, C_2, and find the input admittance, $y_{in}(s)$ (seen looking into left port).

f) Determine when $y_{in}(s)$ is an RC driving point admittance.



3. (50 points, 30 minutes)

Consider two state variable described systems, one described by

$$dx_1/dt=-3x_1+3u_1,\ y_1=x_1$$

and the other by

$$dx_2/dt=-6x_2+2u_2,\ y_2=5x_2.$$

These are connected in cascade ($y_1=u_2$, $u_1=u$, $y_2=y$, $x=[x_1\ x_2]^T$)

a) Give the state variable equations for the cascade.

b) Give the transfer function T(s) of the cascade.

c) For u=v=input voltage and y=i=input current, give a constant 3x3 coupling admittance matrix, Y_c, which when loaded in unit capacitors yields the input admittance $T(s)=y_{in}(s)=i/v$