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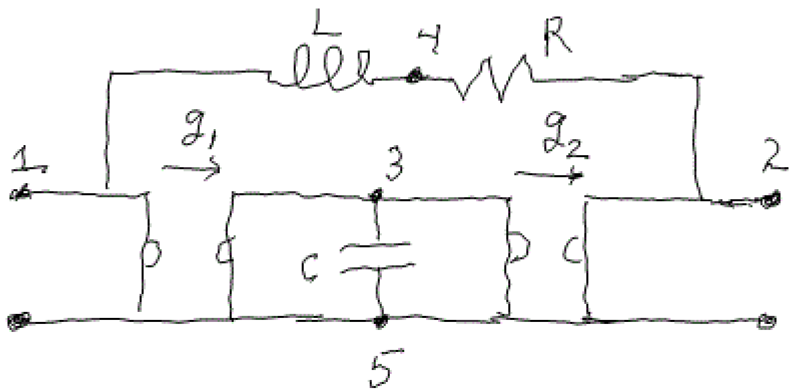
610 Fall 2018 – Homework 3 Due Th 09/27/18

1. (50 points, Indefinite admittance & admittance matrix)



For the above circuit:

a) Using the node numbers and a ground off of the circuit, give the 5x5 indefinite admittance matrix, Y_{ind}.

b) Assume the ground is moved to node 5, find the 2-port admittance matrix Y(s), having port 1 between nodes 1 & 5 and port 2 between nodes 2 & 5, by
b1) eliminating the internal nodes 3 & 4 one at a time (that is, using two different 1x1 matrices$Y_{nodal22}$).
b2) eliminating the two internal nodes together (that is, using $Y_{nodal22}$ as a 2x2 matrix once).
[give the results such that all four entries have the same polynomial denominator]

c) Compare the two procedures.

2. (50 points, state variable for continued fraction)

[this problem uses ideas from Chyi Hwang, Tong-Yi Guo and Leang-San Shieh, "A Canonical State-space Representation for SISO Systems Using Multipoint Jordan CFE," Journal of the Franklin Institute, Vol. 328, No. 2/3, 1991, pp. 207-216.]

For the continued fraction form of the state variable equations Esx=Ax+Bu, y=Cx [the above paper gives these as Ksz=Hz+du, $y=d^Tz$, so here K=E, H=A, d=B, z=x] where [see equations (7) of the above paper]

$$E := \begin{pmatrix} k1 & 1 \\ 1 & -k2 \end{pmatrix}$$

$$A := \begin{pmatrix} -h1 & b1 \\ -a1 & -h2 \end{pmatrix}$$

$$B := \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

a) Show that this form allows the transfer function $T(s)=B^T(sE-A)^{-1}B$ to be written as the continued fraction

$$T(s) := \frac{1}{a \cdot s + b + \frac{(s - e)(s - f)}{c \cdot s + d}}$$

Give a, b, c, d, e, f in terms of the entries in E, A, B.

b) Compare with equation (2) of the above paper.

c) Use this to give a state space realization for the continued fraction form of the previous impedance.

$z(s) = (2s+6)/[(s+2)(s+6)]$