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610 Fall 2011

Homework 4 – due 10/13/11

1. 50 points (Lossless synthesis & PR functions)

a) For the following two (dual) admittances show that they are lossless and give the two Foster and the two Cauer syntheses for each. Comment on how the circuits for $y_2$ can be easily found from those of $y_1$.

$$y_1(s) = \frac{s(s^2+4)}{(s^2+1)(s^2+9)}$$ note correction from s+1 to $s^2+1$

$$y_2(s) = 1/y_1(s)$$

b) Considering the poles & zeroes and the real part for $s=j\omega$, show in two different ways that the following all-pass function is not PR

$$f(s) = \frac{s^2-2s+6}{s^2+2s+6}$$

c) Realize via a lattice circuit the f(s) of part b) as a voltage transfer function, $f(s)=V_2(s)/V_1(s)$

2. 50 points (PR functions)

a. Show that for all positive (>0) constants a, b & c the following admittance function is PR

$$y(s) = \frac{as+1}{bs+c}$$

b. Show that for all such a, b & c there are real zeros of the even part and find them.

c. Make a scale change of s to $s_n$ and one of y to $y_n$ to obtain the normalixed admittance

$$y_n(s_n) = \frac{a_n s_n + 1}{s_n + 1}$$

d. Drop the subscripts n and synthesize the normalized y of part c, that is $y(s)=(as+1)/(s+1)$, by using a Richards' function. Then modify this to give the y of part a.

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3 25 points (input admittance properties)

Dicusss, in regard to the PR test, properties you would expect of the input admittance $y_{in}(s)$ seen by e1 in the following circuit (of previous homework).