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610 Fall 2009 – Homework 6 Due ~~Th~~ ~~Tu~~ Th 10/~~22~~ ~~27~~ 29/09

1. [60 points] [losslessness & synthesis]

   a) Find the conditions on the real constants a, b, c, d such that the following scattering function (=1x1 matrix=reflection coefficient) is (passive and) lossless

$$S(s) = \frac{(s-a)(s-b)}{(s+c)(s+d)}$$

   b) For all these lossless S(s) of a), realize S(s) by connecting two reflection coefficients, S1(s) and S2(s), to a 3-port circulator.

   c) For all the lossless S(s) of a) convert to Y(s) and realize by the two Foster forms and the two Cauer forms.

   d) For all the lossless S(s) of a) realize via the Richards function choosing k=1.

   e) Repeat parts c) and d) in the presence of complex constants under the condition that a=c=b*=d*.

2. [40 points] [Richards' functions]

   If f(s) is PR show that if any one of the following is PR then so are all of the rest:

a)

$$g1(s) = f(k)\frac{kf(k)-sf(s)}{kf(s)-sf(k)}$$

$$g2(s) = f(k)\frac{kf(s)-sf(k)}{kf(k)-sf(s)}$$

$$g3(s) = \frac{1}{f(k)}\frac{[k/f(k)]-[s/f(s)]}{[k/f(s)]-[s/f(k)]}$$

$$g4(s) = \frac{1}{f(k)}\frac{[k/f(s)]-[s/f(k)]}{[k/f(k)]-[s/f(s)]}$$

   b) Assuming k real and f(s)=y(s), an admittance, show which of the gi(s), i=1,…,4, of part a) are admittances and which are impedances and give a circuit to realize each of the gi(s) in part a) as the load on a passive 2-port.