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ENEE 610

Problems to consider, Set 1

Richards' Function Use and Some Theory

1. Read Chapter 8 on synthesis of the textbook, concentrating on sections 8.3, reactance functions, 8.4, RC functions, and the Richards' function, equation (8.6-1)

2. Denote the Richards' function of equation (8.6-1) as

$$R_{ich}(s,k,z)=\frac{kz(s)-sz(k)}{kz(k)-sz(s)}$$

Note that there are three other similar functions of use $1/R_{ich}(s,k,z)$, $R_{ich}(s,k,1/z)$, $1/R_{ich}(s,k,1/z)$.

a) Evaluate all four of these at k=2 on

$$z(s)=\frac{5(s+1)(s+4)}{(s+3)(s+6)}$$

b) Find the zeros of the even part of the z(s) of a); show that there is at least one which is real and positive.

c) For k one of the real positive zeros of the even part of z(s) of a) evaluate the Richards' function and show that the degree goes down.

b) (harder but useful) Find a coupling 2-port which goes with each of these four Richards' type functions.

3. Show that any real positive k can be used for synthesizing a reactance function in cascade form using the Richards' function. Does it matter which of the four Richards' type functions you use? What is the difference in structure if you are able to use two of the different types of Richards' functions listed above.

Carry out an example using the reactance function which is 3 times that given in Example 8.3-1, page 344 of the text. Do this for several k and discuss the differences.

4. Consider using the Richards' function for RC synthesis. Prove or disprove the statement: For a (positive real) RC driving point impedance there is always at least one real and positive zero of the even part.

From this conclude that a cascade synthesis of a degree n RC driving point impedance can result using only n capacitors. Test this out on the driving point admittance of Example 8.4-1, page 348.