File: f:/courses/fall2019/610/610F19finalexm.doc RWN for Tu 12/17/19

EE 610 Final Exam Fall 2019 Take Home due prior to end of scheduled exam

If no one is available to collect the exam please turn it in to the ECE Graduate Office

Open Book Open Notes and calculators; 100 points, 2 hours. Your signature insures that the work is totally your own.

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

1. (10 points, 10 minutes)

   For each of the following three cases give a 2-port linear time-invariant example of

   a) a circuit with an admittance matrix but no scattering matrix
   b) a circuit with a scattering matrix but no admittance matrix
   c) a circuit with no scattering or admittance matrix

   {may be helpful: for Av=Bi, $S=(B+A)^{-1}(B-A)$ and $Y=B^{-1}A$}

2. (15 points, 20 minutes)

   For the 1-port admittance $y(s)=[s^2+4s+3]/[s^2+as+1]$

   a) Find the full range of the real parameter, a, such that all zeroes of the even part of y(s) are real and positive.
   b) Show that it is not PR at a=0 but is at a=3 which is included in the range of part a).
   c) Comment on the meaning for the use of Richards' function.

3. (30 points, 25 minutes)

   For the PR y(s) = [s+a]/[s+b] where a and b are both real positive numbers. Synthesize it

   a) by y(s) = [s/(s+b)] + [a/(s+b)]
   b) by a partial fraction expansion when a<b and again when a>b.
   c) by finding a zero of the even part and using a Richards' gyrator-C section.
   d) Comment upon the advantages/disadvantages of each method.

4. (25 points, 35 minutes)

   For the 1st Cauer ladder synthesis of $y(s)=i/v=(s^2+1)/[s(s^2+2)]$ fed by a grounded voltage source, number branches from left to right with branch number 1 the voltage source; also orient branches to the right or down. Choose a tree from nodes to ground.

   a) Give the cut-set and tie-set matrices.
   b) Give the A(s)v=B(s)i equations.
   c) Choose the tree branch voltages and link currents to form the semistate x. And in terms of it give the output portion of the semistate equations $v_{out}(t)=Cx(t)$

5. (20 points, 25 minutes)

   For the lossless PR admittance $y(s) = [s(s^2+2)]/[(s^2+1)(s^2+9)] =i/v$

   a) Give the 2nd Cauer and 2nd Foster circuits.
   b) Using the companion matrix form give the state variable equations dx/dt=Ax+Bv, i=Cx+Dv