

610 Fall 2016 – Homework 4 Due Tu 10/11/16

1. (30 points, Positive-Real and Bounded-Real functions)

For each of the following driving point functions, determine the ranges of the real parameters a and b for which they are positive-real and also for which they are bounded-real.

a) $f_a(s) = [s-a]/[s+b]$

b) $f_b(s) = [s^2+s+a]/[s^2+s+b]$

c) $f_c(s) = [s^2+as+1]/[s^2+bs+1]$

d) $f_d(s) = as/(s^2+1)^b$

2. (30 points, Lossless synthesis)

Assume the function below is an admittance. First show that it is lossless positive-real. Then synthesize it by the four canonical forms (the two Foster forms and the two Cauer forms) and compare. Use the synthesized admittance to create the four canonical forms for the function assuming that now it is an impedance [that is create the dual circuits] without further calculations.

$$f(s) = 3[s(s^2+5)(s^2+8)]/[s^2+1)(s^2+6)]$$

3. (20 points; RC results)

Assume the admittance synthesis of problem 2 and replace in each of the canonical circuits the L 's by R ' of the same numerical value. Draw the resulting circuits and give their input admittances.

4. (20 points, lossless reflection coefficient)

Synthesize the lossless bounded-real scattering function

$$S(s)=[3s^2-6s+3]/[3s^2+6s+3]$$

by the use of a circulator and by the two Foster forms and the two Cauer forms and compare.