Exercise 4

Draw a cascade realization and a parallel realization with second order sections for the system with the following transfer function:

$$H(z) = \frac{(1 - z^{-1}) \cdot (1 - 2z^{-1}) \cdot (1 + z^{-1}) \cdot (1 + \frac{1}{8}z^{-1})}{(1 - \frac{j}{2}z^{-1}) \cdot (1 - \frac{j}{2}z^{-1}) \cdot (1 + \frac{1+j}{2}z^{-1}) \cdot (1 + \frac{1-j}{2}z^{-1})}$$

Exercise 5

a) Find if the following polynomial has roots inside the unit circle,

$$D_4(z) = 1 - \frac{9}{8}z^{-1} - \frac{21}{32}z^{-2} + \frac{3}{4}z^{-3} - \frac{1}{4}z^{-4}.$$

b) Draw the lattice realization of the system with transfer function $D_4(z)$.

c) Draw the lattice realization of the system with transfer function $H_1(z) = \dfrac{1}{D_4(z)}$ and of the system with all-pass transfer function:

$$H_2(z) = \frac{-\frac{1}{4} + \frac{3}{4}z^{-1} - \frac{21}{32}z^{-2} - \frac{9}{8}z^{-3} + z^{-4}}{1 - \frac{9}{8}z^{-1} - \frac{21}{32}z^{-2} + \frac{3}{4}z^{-3} - \frac{1}{4}z^{-4}}.$$

d) Draw the lattice-ladder realization of the system with transfer function

$$H_3(z) = \frac{-\frac{1}{2} + \frac{1}{4}z^{-1} - \frac{13}{4}z^{-2} - 7z^{-3} + 8z^{-4}}{1 - \frac{9}{8}z^{-1} - \frac{21}{32}z^{-2} + \frac{3}{4}z^{-3} - \frac{1}{4}z^{-4}}.$$

Exercise 6

Given the transfer function

$$H(z) = \frac{2 - \frac{5}{2}z^{-1} + z^{-2} - \frac{3}{32}z^{-3} + \frac{11}{64}z^{-4} - \frac{5}{64}z^{-5}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 + \frac{1}{2}z^{-1}\right)\left(1 - (\frac{1}{2} - \frac{1}{4}i)z^{-1}\right)\left(1 - (\frac{1}{2} + \frac{1}{4}i)z^{-1}\right)},$$

compute the parallel realization with second order sections. Draw the block diagram using direct form type II sections.
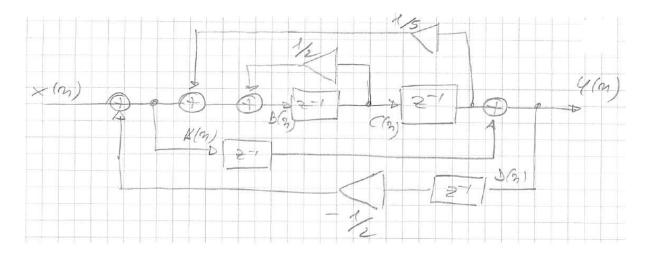
Exercise 7

Draw the lattice-ladder realization of the system with the transfer function

$$H(z) = \frac{-48 + 4z^{-1} + 26z^{-2} - 40z^{-3} + 32z^{-4}}{16 - 4z^{-1} - 3z^{-2} + 8z^{-3} - 8z^{-4}}$$

Determine if the system is stable or instable.

Exercise 8 Find the transfer function of the system represented by the following block diagram: