Digital Signal Processing

WS 2017/18 Lab Sheet 8

Due date: 03.01.2018

Exercise 1:

When the input to a causal LTI system is $x[n] = -\frac{1}{3}\left(\frac{1}{2}\right)^n u[n] - \frac{4}{3}2^n u[-n-1]$, the z-transform of the output is $Y(z) = \frac{1+z^{-1}}{(1-z^{-1})\left(1+\frac{1}{2}z^{-1}\right)(1-2z^{-1})}$.

a. Find the z-transform of $x[n]$ (2)

b. What is the region of convergence of $Y(z)$? (1)

c. Find the impulse response of the system. (6)

d. Is the system stable? (1)

Exercise 2:

Use the z-Transform to perform the convolution of the following two sequences: $x[n] = \delta[n] - 2\delta[n-2]$, $h[n] = 2\delta[n] - 2\delta[n-1] + 3\delta[n-2] + \delta[n-3]$.

Exercise 3:

There are two kinds of particles inside a nuclear reactor. Every second, an α particle will split into eight β particles and a β particle will split into an α particle and two β particles. If there is a single α particle in the reactor at time $t = 0$, how may particles are there altogether at time $t = 100$?

(Hint: Find the linear constant-coefficient difference equation and use the z-transform to solve it.)