## Lab 6

## EE 324: Signals and Systems II

We will utilize z transformation to analyze several discrete time dynamical systems.

## 1 Prelab assignment

1. Go over Chapter 7.9. Study how to use delay units  $z^{-1}$  in matlab to realize a discretetime system.

2. Derive the transfer function of the system

$$y[k] - 1.3y[k-1] + 0.4y[k-2] = x[k].$$
(1)

3. The national income is governed by the following set of difference equations:

$$\begin{array}{lll} y[k] &=& c[k] + i[k] + x[k] \\ c[k] &=& \alpha y[k-1] \\ i[k] &=& \beta(c[k] - c[k-1]) \end{array}$$

where  $\alpha$  and  $\beta$  are positive constants, y[k] is the national income, c[k] represents consumer expenditures, i[k] is induced private investment, and x[k] represents government expenditures.

a) Derive the input-output difference equation with input x and output y;

b) Derive the transfer function.

## 2 Lab assignment

- 1. Calculate the analytic impulse response of system (1) (see Lab 3)
- 2. Simulate the impulse response of system (1) using transfer function block in simulink
- 3. Simulate the impulse response of system (1) using delay units  $z^{-1}$
- 4. Compare the results from 1 to 3.
- 5. Repeat 1-4 with input x[k] = 1 and zero initial condition.
- 6. Simulate the impulse response and the step response for three sets of parameters:

i) 
$$\alpha = \beta = 0.5$$

ii) 
$$\alpha = \beta = 1$$

iii) 
$$\alpha = \beta = 2$$

with zero initial conditions.