Problem Set #8

EEEC20034 - Introduction to Digital Signal Processing

NYCU

Problem 1

Consider a causal linear time-invariant system whose system function is

$$H(z) = \frac{1 - \frac{1}{5}z^{-1}}{(1 - \frac{1}{2}z^{-1} + \frac{1}{3}z^{-2})(1 + \frac{1}{4}z^{-1})}.$$

(a) Draw the signal flow graphs for implementations of the system, in each of the following forms:

- (i) Direct form I
- (ii) Direct form II
- (iii) Cascade form using first- and second-order direct form II sections
- (iv) Parallel form using first- and second-order direct form II sections
- (v) Transposed direct form II

(b) Write the difference equations for the flow graph of (v) in Part (a), and show that this system has the correct system function.

Problem 2

A linear time-invariant system with system function

$$H(z) = \frac{0.2(1+z^{-1})^6}{(1-2z^{-1}+\frac{7}{8}z^{-2})(1+z^{-1}+\frac{1}{2}z^{-2})(1-\frac{1}{2}z^{-1}+z^{-2})}$$

is to be implemented using a flow graph of the form shown in Fig. 1.

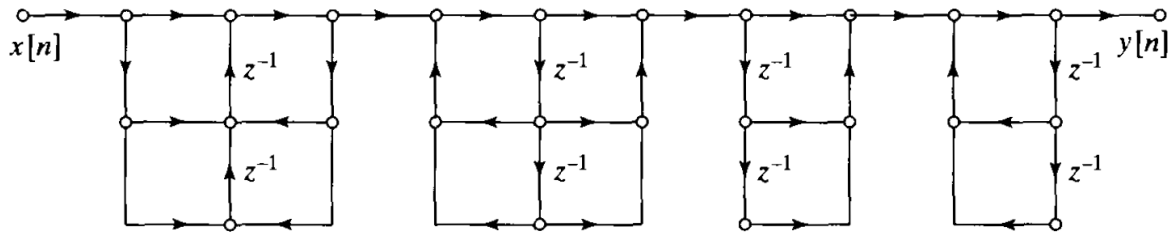

Figure 1

(a) Fill in all the coefficients in the diagram of Fig. 1. Is your solution unique?

(b) Define appropriate node variables in Fig. 1, and write the set of difference equations that is represented by the flow graph.

Problem 3

The flow graph shown in Fig. 2 is noncomputable; i.e., it is not possible to compute the output using the difference equations represented by the flow graph because it contains a closed loop having no delay elements.

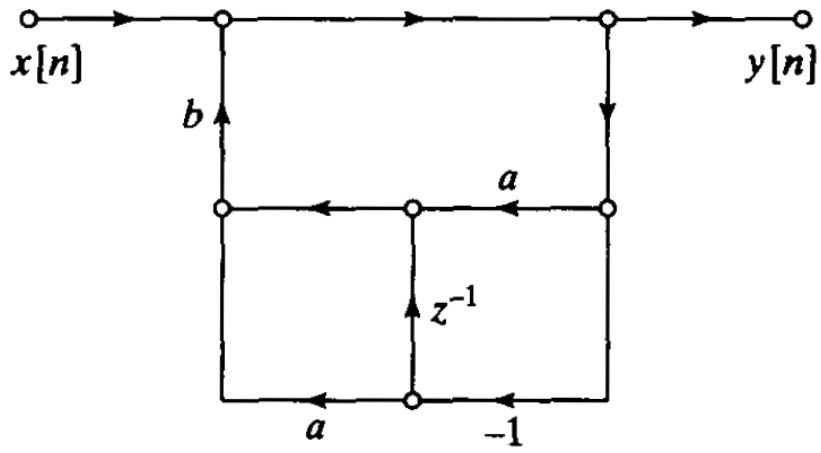

Figure 2

(a) Write the difference equations for the system of Fig. 2, and from them, find the system function of the network.

(b) From the system function, obtain a flow graph that is computable.