ECE 464/564: Digital Signal Processing - Winter 2020
Homework 6

Due: Feb 27, 2020 (Thursday)

1. Draw the signal flow graph for the direct form I and direct form II implementation of the LTI system with

$$H(z) = \frac{2z^2 + \frac{1}{4}z}{z^2 + \frac{1}{4}z - \frac{1}{8}}.$$

2. Consider the signal flow graph shown in Fig. 1:

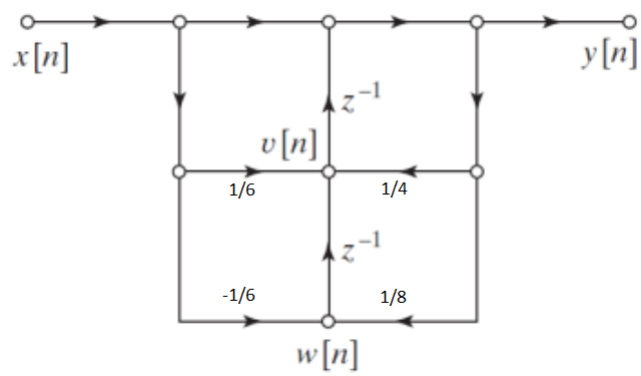

Figure 1: Signal flow graph (for Problem 2).

   (a) Using the node variables indicated, write the set of difference equations represented by this flow graph.

   (b) Draw the flow graph of an equivalent system that is the cascade of two 1st order systems.

   (c) Is the system stable?

3. Consider a causal LTI system whose system function is

$$H(z) = \frac{1}{1 + z^{-1}} + \frac{1 - z^{-1}}{1 - 1.5z^{-1} + 0.9z^{-2}}.$$

   (a) Is this system stable? Explain briefly.

   (b) Draw the signal flow graph of parallel form implementation of this system.

   (c) Draw the signal flow graph of cascade form implementation of this system as a cascade of the 1st order and 2nd order system.

   (d) Repeat part (c) with a transpose direct form II implementation for the 2nd order system.

   (e) Write the difference equation for the system.

4. For the LTI system described by the flow graph in Fig. 2, determine the difference equation relating the input $x[n]$ to the output $y[n]$.

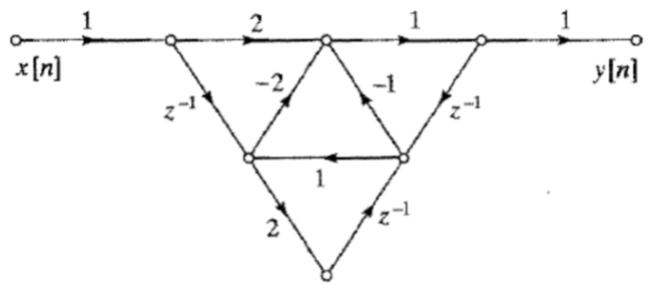

Figure 2: Signal flow graph (for Problem 4).

5. For the LTI system described by the flow graph in Fig. 3, determine the difference equation relating the input $x[n]$ to the output $y[n]$.

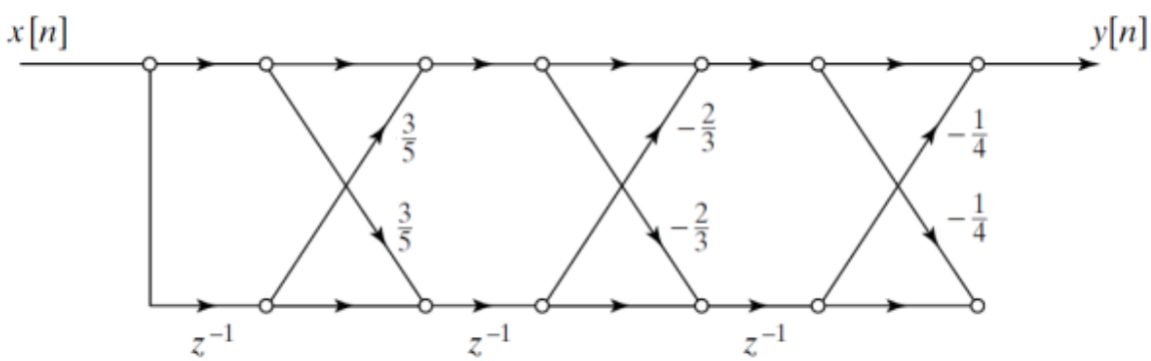

Figure 3: Signal flow graph (for Problem 5).