ECE 6342 Fall 2016 HW 8 Due 11/01

Problem 1. Discrete-time Signal Processing - Oppenheim 2nd ed - Problem 6.15

6.15. Draw the signal flow graph for the transposed direct form II implementation of the LTI system with system function

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

Problem 2. Discrete-time Signal Processing - Oppenheim 2nd ed - Problem 6.29

6.29. The impulse response of a linear time-invariant system is

$$h[n] = \begin{cases} a^n, & 0 \le n \le 7, \\ 0, & \text{otherwise.} \end{cases}$$

(a) Draw the flow graph of a direct-form nonrecursive implementation of the system.

(b) Show that the corresponding system function can be expressed as

$$H(z) = \frac{1 - a^8 z^{-8}}{1 - az^{-1}}, \quad |z| > |a|.$$

(c) Draw the flow graph of an implementation of $H(z)$, as expressed in Part (b), corresponding to a cascade of an FIR system (numerator) with an IIR system (denominator).

(d) Is the implementation in Part (c) recursive or nonrecursive? Is the overall system FIR or IIR?

(e) Which implementation of the system requires
   (i) the most storage (delay elements)?
   (ii) the most arithmetic (multiplications and additions per output sample)?

Problem 3. Discrete-time Signal Processing - Oppenheim 2nd edition Problem 6.8

6.8. The signal flow graph in Figure P6.8-1 represents an LTI system. Determine a difference equation that gives a relationship between the input $x[n]$ and the output $y[n]$ of this system. As usual, all branches of the signal flow graph have unity gain unless specifically indicated otherwise.
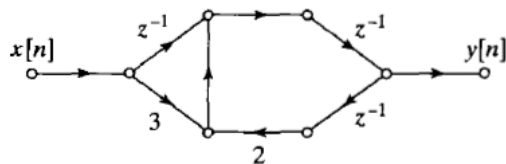

Figure P6.8-1

Problem 4 Discrete-time Signal Processing - Oppenheim 2nd edition Problem 6.10

6.10. Consider the signal flow graph shown in Figure P6.10-1.

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

(b) Draw the flow graph of an equivalent system that is the cascade of two first-order systems.
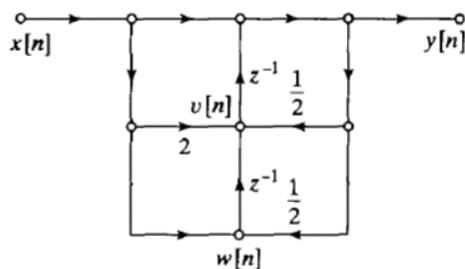
(c) Is the system stable? Explain.

Figure P6.10-1