ECE 6342 Fall 2016 HW 07 Due 10/25

Problem 1 Problem 5.36 – Oppenheim, Discrete-time Signal Processing - 2nd edition Chapter 5

5.36. A causal linear time-invariant system has the system function

$$H(z) = \frac{(1 - 1.5z^{-1} - z^{-2})(1 + 0.9z^{-1})}{(1 - z^{-1})(1 + 0.7jz^{-1})(1 - 0.7jz^{-1})}.$$

(a) Write the difference equation that is satisfied by the input and the output of the system.
(b) Plot the pole–zero diagram and indicate the region of convergence for the system function.
(c) Sketch $|H(e^{j\omega})|$.
(d) State whether the following are true or false about the system:
(i) The system is stable.
(ii) The impulse response approaches a constant for large n.
(iii) The magnitude of the frequency response has a peak at approximately $\omega = \pm\pi/4$.
(iv) The system has a stable and causal inverse.

Problem 2. Discrete-time Signal Processing - Oppenheim 2nd ed - Problem 6.5

6.5. A linear time-invariant system is realized by the flow graph shown in Figure P6.5-1.

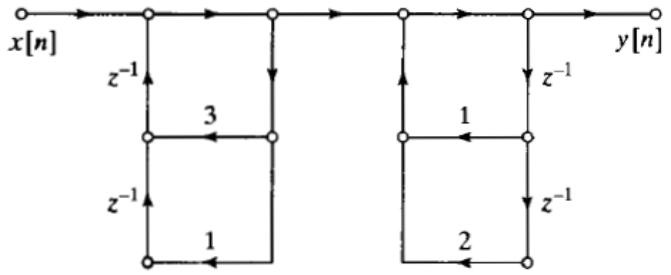
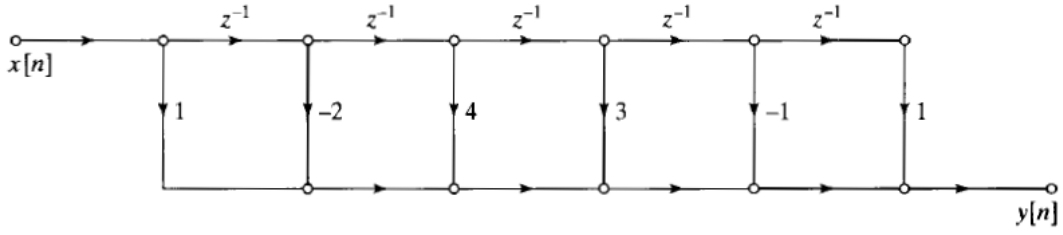


Figure P6.5-1

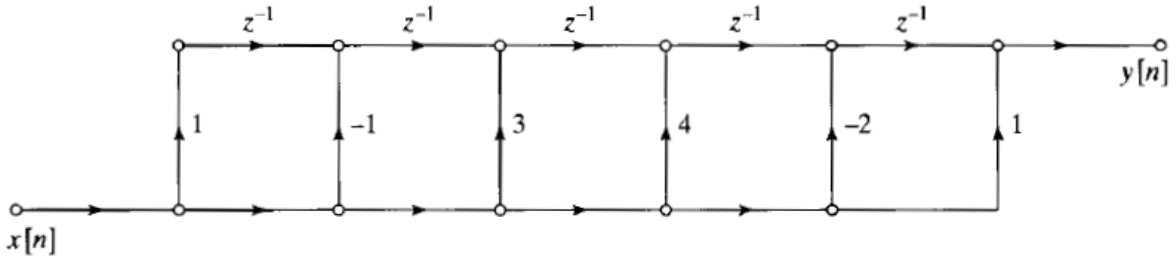
(a) Write the difference equation relating $x[n]$ and $y[n]$ for this flow graph.
(b) What is the system function of the system?
(c) In the realization of Figure P6.5-1, how many real multiplications and real additions are required to compute each sample of the output? (Assume that $x[n]$ is real, and assume that multiplication by 1 does not count in the total.)
(d) The realization of Figure P6.5-1 requires four storage registers (delay elements). Is it possible to reduce the number of storage registers by using a different structure? If so, draw the flow graph; if not, explain why the number of storage registers cannot be reduced.

Problem 3. Discrete-time Signal Processing - Oppenheim 2nd ed - Problem 6.6

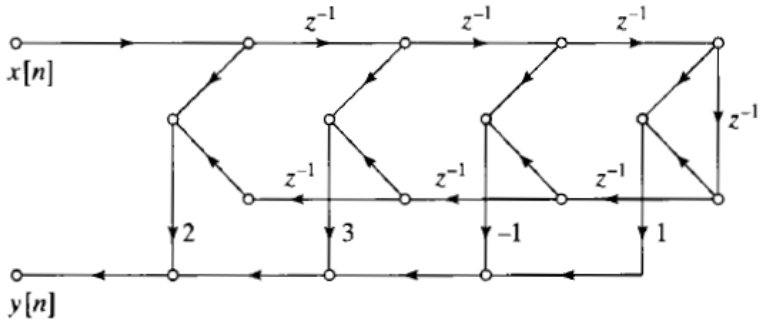
6.6. Determine the impulse response of each of the systems in Figure P6.6-1.



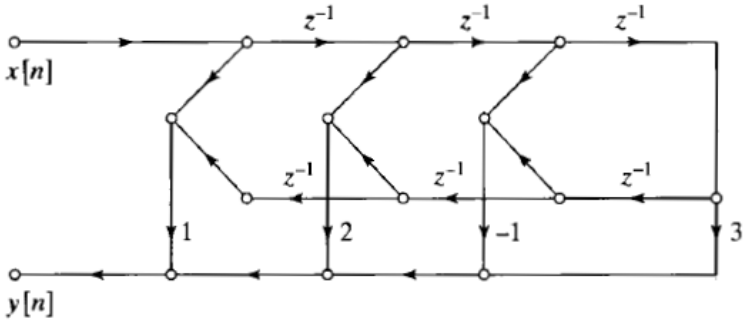
(a)



(b)



(c)



(d)

Figure P6.6-1

Problem 4. Discrete-time Signal Processing - Oppenheim 2nd ed - Problem 6.13

6.13. **Draw the signal flow graph for the direct form I implementation of the LTI system with system function**

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

Problem 5. Discrete-time Signal Processing - Oppenheim 2nd ed - Problem 6.14

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

$$H(z) = \frac{1 + \frac{5}{6}z^{-1} + \frac{1}{6}z^{-2}}{1 - \frac{1}{2}z^{-1} - \frac{1}{2}z^{-2}}.$$