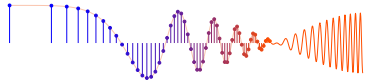


EXERCISE 7.5: Use the z-transform of

$$x[n] = \delta[n-1] - \delta[n-2] + \delta[n-3] - \delta[n-4]$$

and the system function $H(z) = 1 - z^{-1}$ to find the output of a first-difference filter when $x[n]$ is the input. Compute your answer by using polynomial multiplication and also by using the difference equation:

$$y[n] = x[n] - x[n-1]$$

What is the degree of the output z-transform polynomial that represents $y[n]$?

McClellan, Schafer and Yoder, *Signal Processing First,* ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION

$$X(z) = \sum_{n=0}^{4} x[n]\, z^{-n} = 1z^{-1} - 1z^{-2} + z^{-3} - z^{-4}$$

$$Y(z) = H(z)\, X(z)$$

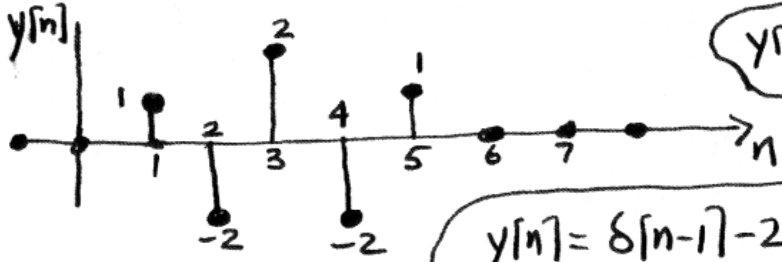
POLYNOMIAL MULTIPLICATION

$$= (1 - z^{-1})(z^{-1} - z^{-2} + z^{-3} - z^{-4})$$

DEGREE IS FIVE

$$Y(z) = z^{-1} - 2z^{-2} + 2z^{-3} - 2z^{-4} + z^{-5}$$

$y[1]$ $y[2]$ $y[3]$ $y[4]$ $y[5]$.



$y[n] = 0$ for $n < 1$ and for $n > 5$

$$y[n] = \delta[n-1] - 2\delta[n-2] + 2\delta[n-3] - 2\delta[n-4] + \delta[n-5]$$