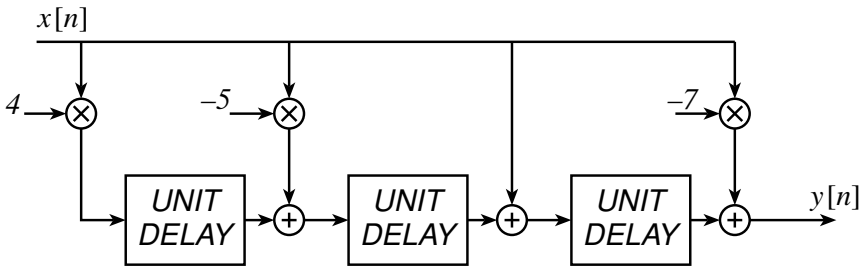
PROBLEM:

The following signal flow graph structure defines a linear time-invariant system:



(a) Write a simple formula for the difference equation defined by the signal flow graph.

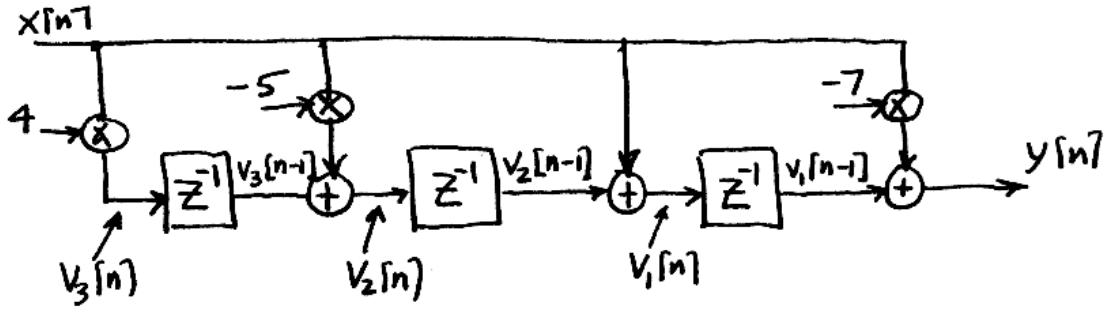
(b) For the following $\mathcal{H}(z)$ determine the difference equation, and draw a representation of this filter in a signal flow graph structure.

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

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

SOLUTION

(a)



EQUATIONS:

$v_3[n] = 4x[n]$

$v_2[n] = v_3[n-1] - 5x[n]$ ← Substitute $v_3[n-1] = 4x[n-1]$ into next eqn

$v_1[n] = v_2[n-1] + x[n]$ Then substitute $v_2[n-1]$ and $v_1[n-1]$.

$y[n] = v_1[n-1] - 7x[n]$

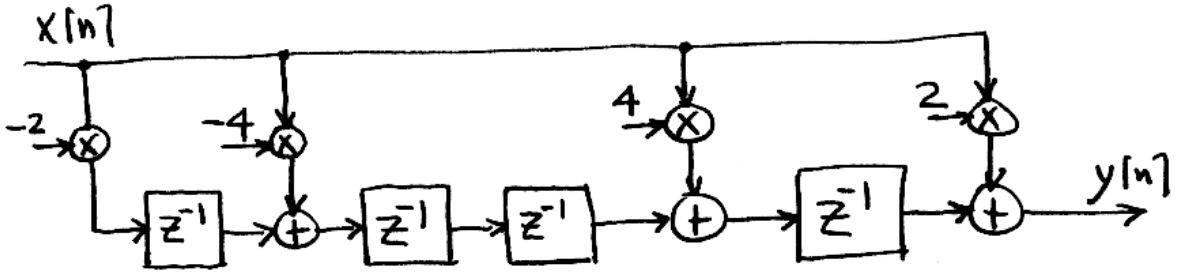
↳ $v_2[n] = 4x[n-1] - 5x[n]$ ← change to $v_2[n-1]$

$v_1[n] = 4x[n-2] - 5x[n-1] + x[n]$ ← Make $v_1[n-1]$

$$y[n] = 4x[n-3] - 5x[n-2] + x[n-1] - 7x[n].$$

Notice that the filter coeffs go from right to left in the structure.

(b) $H(z) = 2 + 4z^{-1} - 4z^{-3} - 2z^{-4} \Rightarrow \{b_k\} = \{2, 4, 0, -4, -2\}$



TRANSPOSED FORM