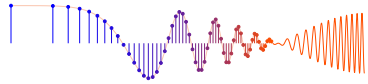


PROBLEM:

The following polynomial is the system function for an FIR filter:

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

(a) Factor the polynomial and plot its roots in the complex plane.

(b) Break $\mathcal{H}(z)$ into the cascade of two "smaller" systems: a first-order FIR and a second-order FIR.

(c) Draw a signal flow graph for each of the "small" FIR systems, using block diagrams consisting of adders, multipliers and unit-delays.

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

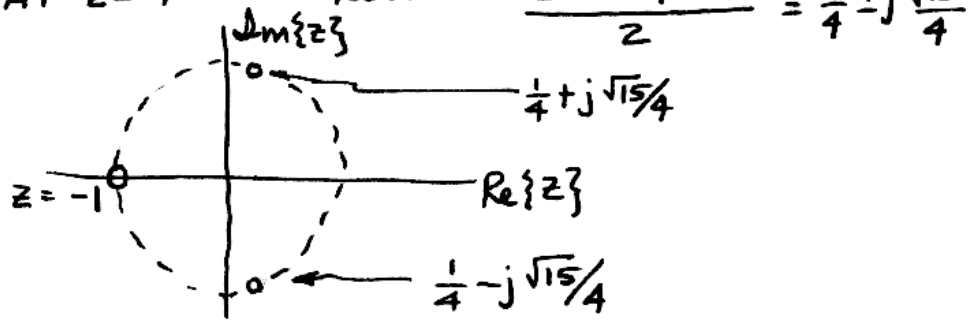
SOLUTION

(a) $H(z) = 1 + \frac{1}{2}z^{-1} + \frac{1}{2}z^{-2} + z^{-3}$

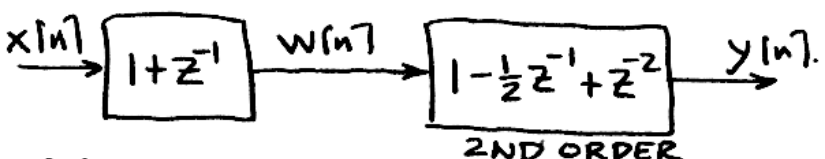
$= (1 + z^{-1})(1 - \frac{1}{2}z^{-1} + z^{-2})$

ROOT AT $z = -1$

ROOTS $= \frac{1/2 \pm \sqrt{1/4 - 4}}{2} = \frac{1}{4} \pm j\frac{\sqrt{15}}{4}$



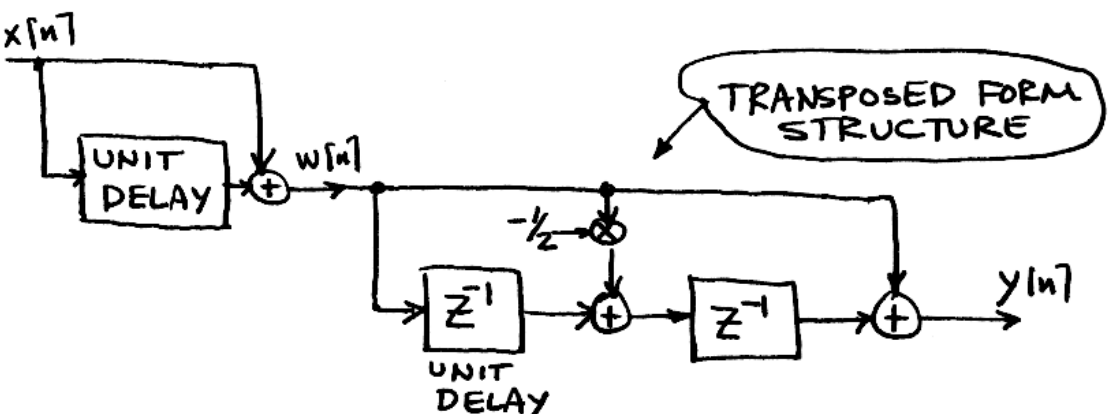
(b)



$w[n] = x[n] + x[n-1]$

$y[n] = w[n] - \frac{1}{2}w[n-1] + w[n-2]$

(c)



OR