



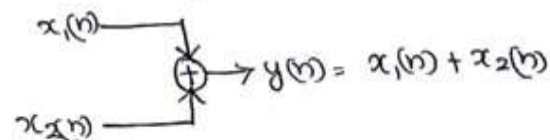
The discrete time systems are represented by block diagram these are also called as DT systems.

Summary of elementary blocks used to represent DT s/ms :-

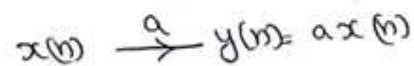
Name of the block

Symbols.

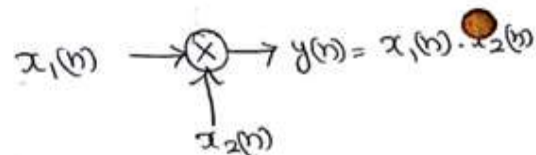
1. Adder



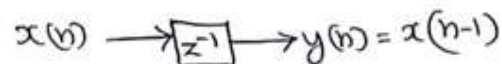
2. constant Multiplier



3. signal Multiplier



4. Delay element



5. Advancing element



1) obtain the DF-I and DF-II realisation of the system described by the differential Equation :-

$$y(n) = \frac{5}{6} y(n-1) + \frac{1}{6} y(n-2) = x(n) + 2x(n-1)$$

Taking z-transform on both sides

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

$$Y(z) \left[1 - \frac{5}{6} z^{-1} + \frac{1}{6} z^{-2} \right] = X(z) \left[1 + 2z^{-1} \right]$$

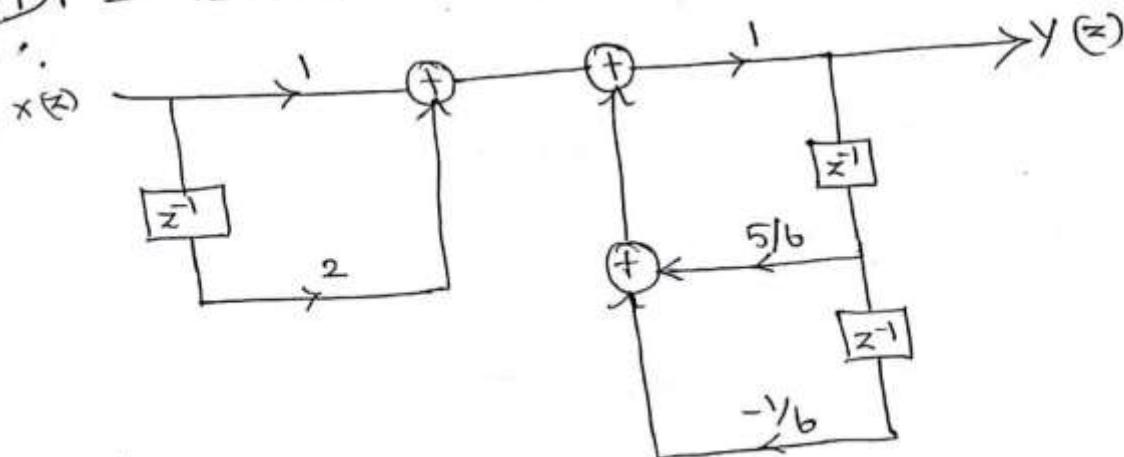
$$X(z) + 2z^{-1} X(z) = W(z) \rightarrow \textcircled{1}$$

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

$$W(z) - \frac{5}{6} z^{-1} Y(z) - \frac{1}{6} z^{-2} Y(z) = Y(z) \rightarrow \textcircled{2}$$



DF-I Realisation :-



Direct Form-II

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

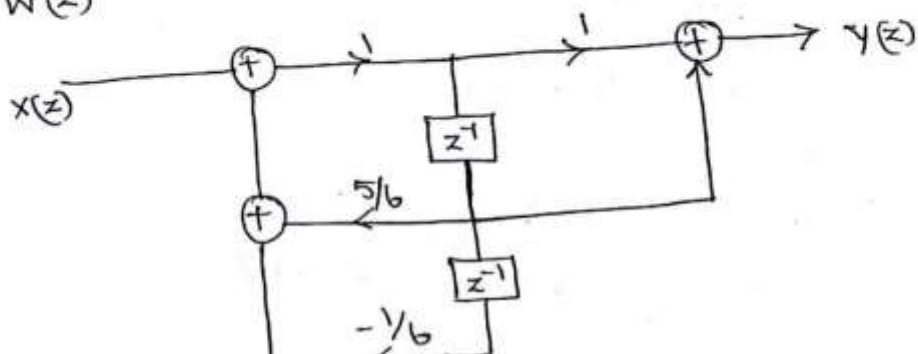
$$\frac{Y(z)}{X(z)} = \frac{Y(z)}{W(z)} \cdot \frac{W(z)}{X(z)}$$

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

$$X(z) = W(z) - \frac{5}{6}z^{-1}W(z) + \frac{1}{6}z^{-2}W(z) \rightarrow (1)$$

$$W(z) = X(z) + \frac{5}{6}z^{-1}W(z) - \frac{1}{6}z^{-2}W(z) \rightarrow (2)$$

$$\frac{Y(z)}{W(z)} = 1 + 2z^{-1} \quad W(z) + 2z^{-1}W(z) = Y(z) \rightarrow (2)$$





Cascade Form :- $y(n) = 0.75y(n-1] - 0.125y(n-2) + bx(n) + 7x(n-1) + x(n-2)$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{b + 7z^{-1} + z^{-2}}{1 - 0.75z^{-1} + 0.125z^{-2}}$$

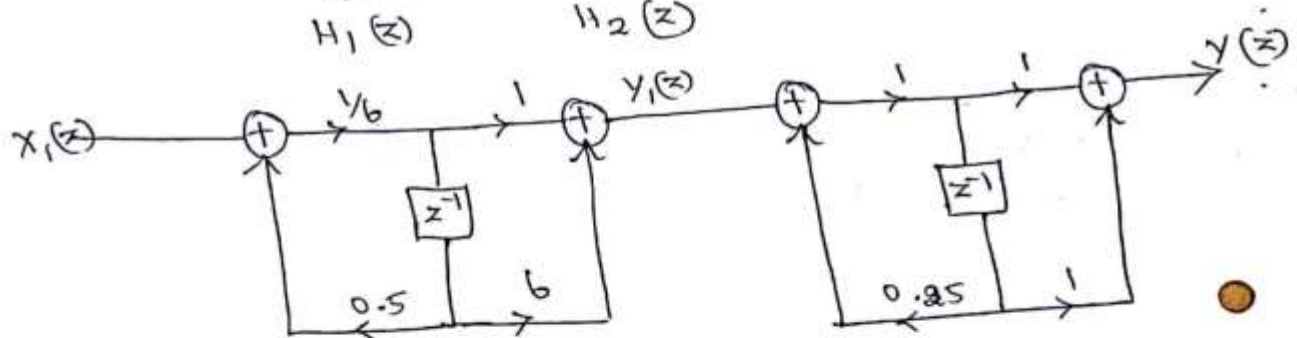
Multiply & divide by z^2

$$= \frac{z^2}{z^2} \cdot \frac{b + 7z^{-1} + z^{-2}}{1 - 0.75z^{-1} + 0.125z^{-2}}$$

$$= \frac{bz^2 + 7z + 1}{z^2 - 0.75z + 0.125}$$

$$H(z) = \left(\frac{bz + 1}{z - 0.5} \right) \left(\frac{z + 1}{z - 0.25} \right)$$

$\downarrow$ $H_1(z)$ $\downarrow$ $H_2(z)$



Parallel Form :-

$$H(z) = \frac{(bz + 1)(z + 1)}{(z - 0.5)(z - 0.25)}$$

$$\frac{(bz + 1)(z + 1)}{(z - 0.5)(z - 0.25)} = \frac{A}{z - 0.5} + \frac{B}{z - 0.25}$$



$$(6z+1)(z+1) = A(z-0.25) + B(z-0.5)$$

$$\text{put } z = 0.25$$

$$3.875 = B(-0.25)$$

$$\boxed{B = -15.5}$$

$$\text{put } z = 0.5$$

$$6 = A(0.25)$$

$$A = \frac{6}{0.25}$$

$$\boxed{A = 24}$$

$$H(z) = \frac{24}{z-0.5} - \frac{15.5}{z-0.25}$$

$$\downarrow$$
$$H_1(z)$$

$$\downarrow$$
$$H_2(z)$$

complete Realization :-

