2)

$$G(z) = \frac{9 + 33z^{-1} + 57z^{-2} + 33z^{-3} + 12z^{-4}}{6 - 12z^{-1} + 11z^{-2} - 5z^{-3} + z^{-4}}$$

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

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

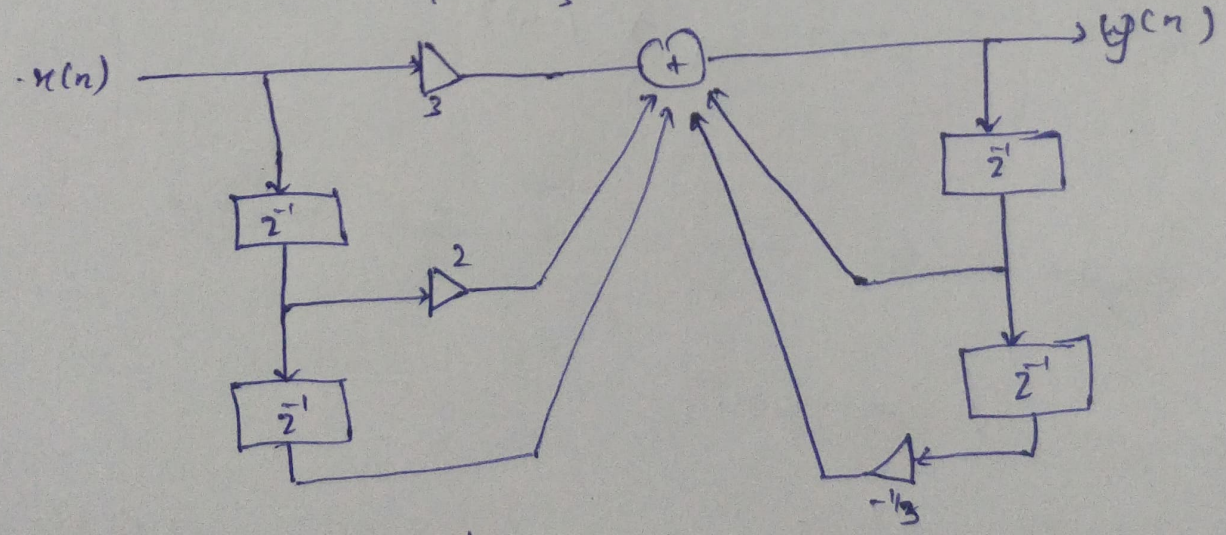
Dircet Form I realization:

$$G(z) = 3\left(\frac{3+2z^{-1}+z^{-2}}{3-3z^{-1}+z^{-2}}\right) * \frac{(1+3z^{-1}+4z^{-2})}{2(1-z^{-1}+\frac{1}{2}z^{-2})}$$

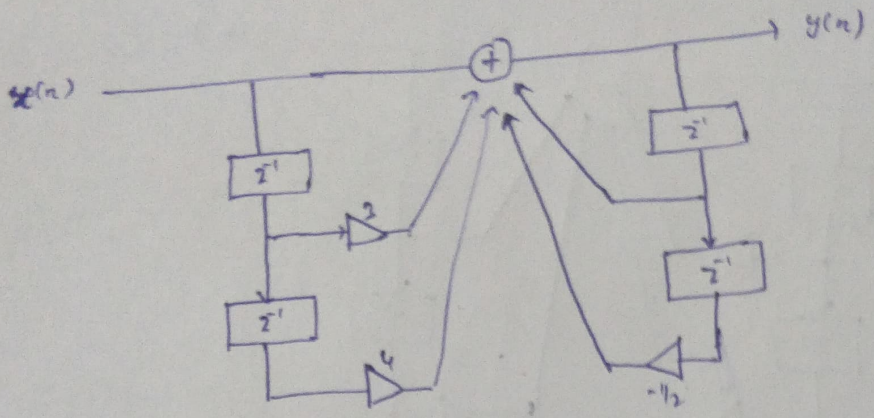
$$= \frac{1}{2}\left(\frac{3+2z^{-1}+z^{-2}}{1-z^{-1}+\frac{1}{3}z^{-2}}\right) * \frac{(1+3z^{-1}+4z^{-2})}{(1-z^{-1}+\frac{1}{2}z^{-2})}$$

$$= k\, H_1(z)\, H_2(z)$$

for $H_1(z) = \frac{3+2z^{-1}+z^{-2}}{1-z^{-1}+\frac{1}{3}z^{-2}}$

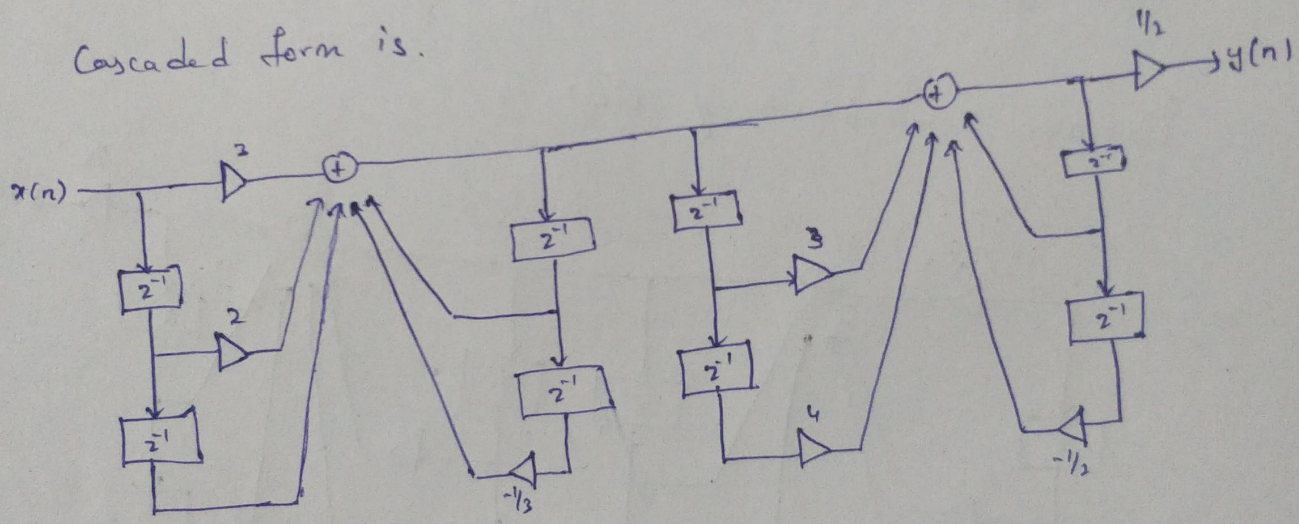


for $H_2(z) = \dfrac{1+3\bar{z}+4\bar{z}^2}{1-\bar{z}+\frac{1}{2}\bar{z}^2}$



for $G(z) = \frac{1}{2} H_1(z) H_2(z)$

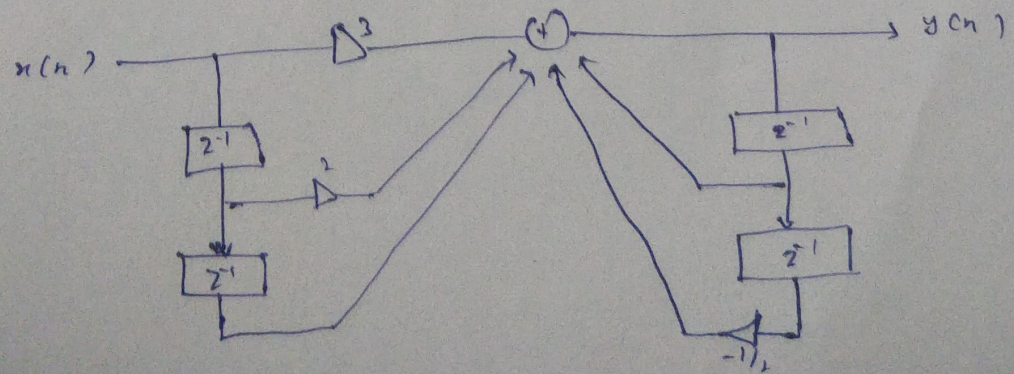
Cascaded form is.



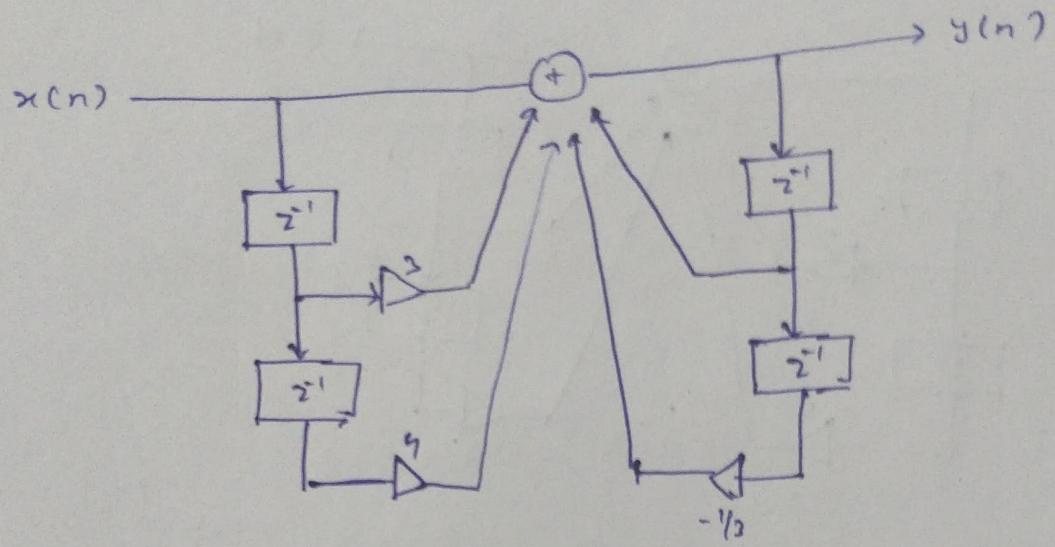
ii) $G(z) = \dfrac{3(3+2\bar{z}^{-1}+\bar{z}^{-2})}{(1-\bar{z}^{-1}+\frac{1}{2}\bar{z}^{-2})} \times \left(\dfrac{1+3\bar{z}^{-1}+4\bar{z}^{-2}}{1-\bar{z}^{-1}+\frac{1}{3}\bar{z}^{-2}}\right)$

$= \frac{1}{2} H_1(z) H_2(z)$

for $H_1(z) = \dfrac{3+2\bar{z}^{-1}+\bar{z}^{-2}}{1-\bar{z}^{-1}+\frac{1}{2}\bar{z}^{-2}}$

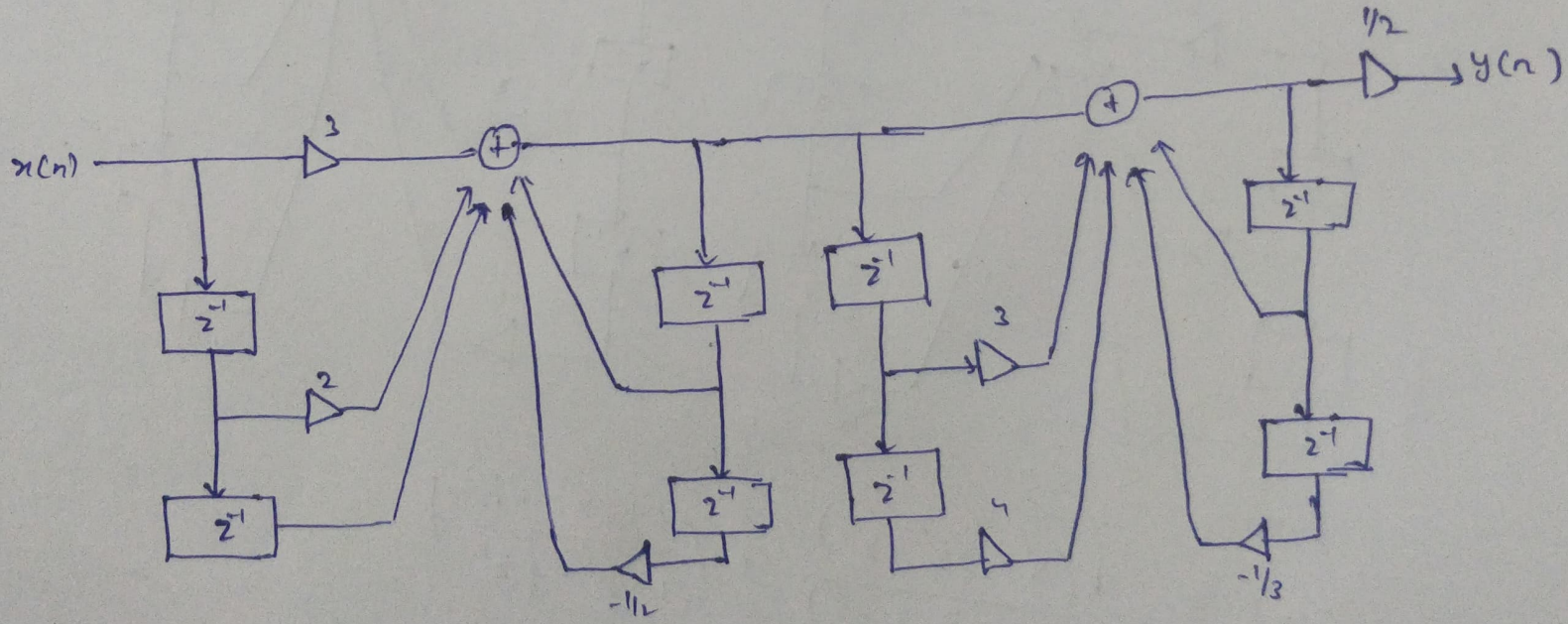


for $H_2(z) = \dfrac{1+3z^{-1}+4z^{-2}}{1-z^{-1}+\frac{1}{3}z^{-2}}$



for $G(z) = \frac{1}{2} H_1(z) H_2(z)$

Cascade realization of $G(z)$ is

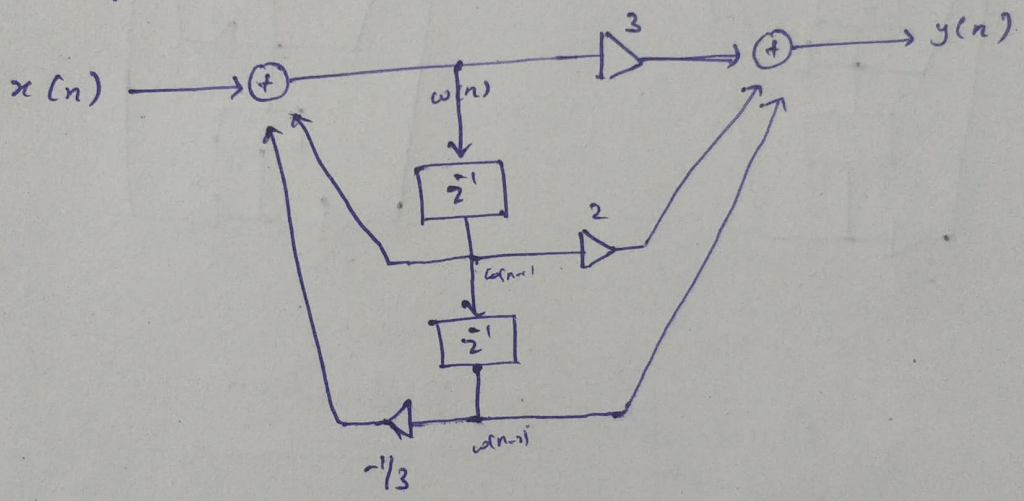


Direct Form II Realization

$$G(z) = \frac{1}{2}\left(\frac{3+2z^{-1}+z^{-2}}{1-z^{-1}+\frac{1}{3}z^{-2}}\right)\left(\frac{1+3z^{-1}+4z^{-2}}{1-z^{-1}+\frac{1}{2}z^{-2}}\right) = \frac{1}{2}H_1(z)\,H_2(z)$$

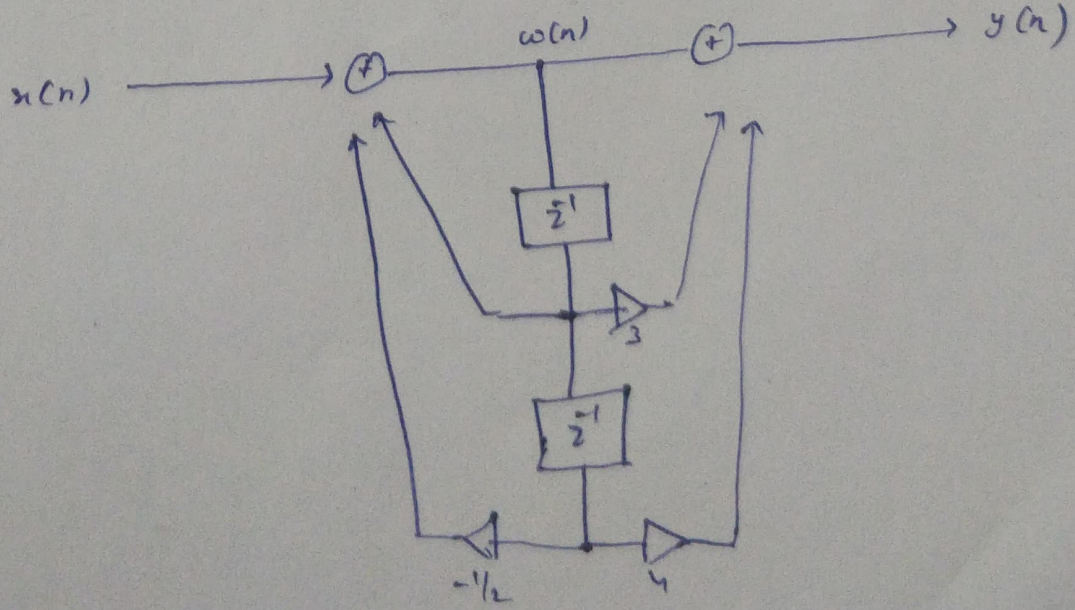
$$H_1(z) = \frac{3+2z^{-1}+z^{-2}}{1-z^{-1}+\frac{1}{3}z^{-2}}$$

Realization of $H_1(z)$ is



$$H_2(z) = \frac{1+3z^{-1}+4z^{-2}}{1-z^{-1}+\frac{1}{2}z^{-2}}$$

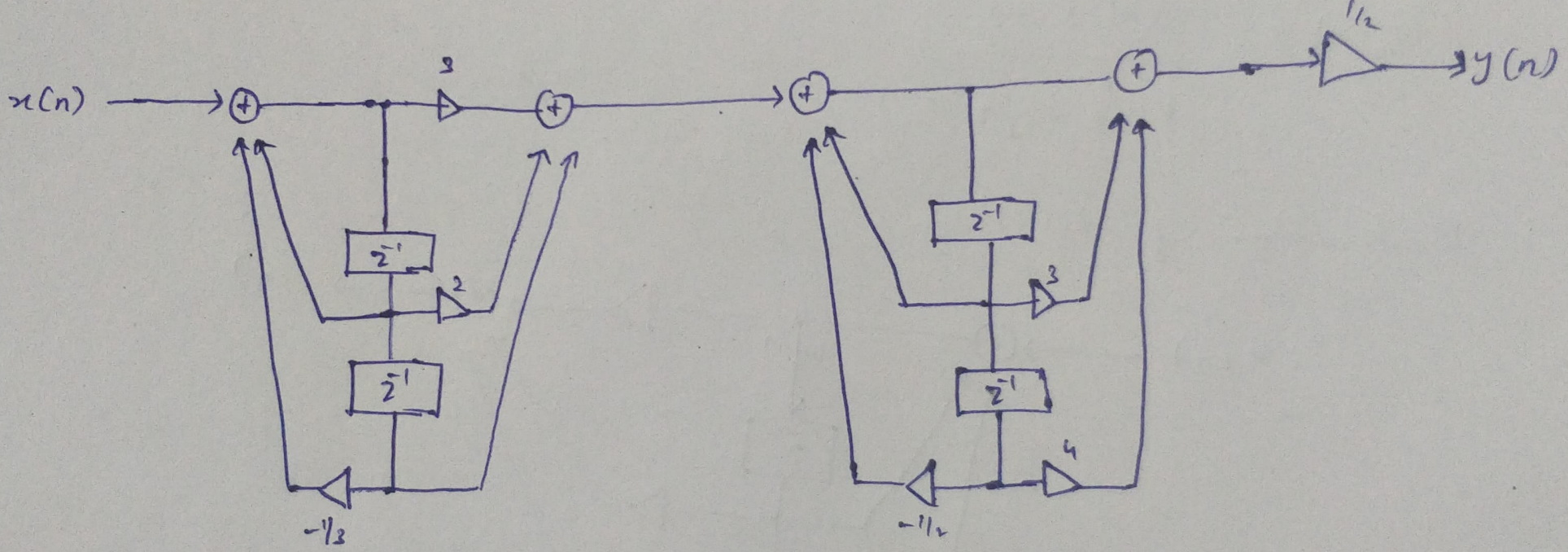
Realization of $H_2(z)$ is



(a)

for $G(z) = \frac{1}{2} H_1(z) H_2(z)$

Cascade Realization of $G(z)$ is



Direct form - II Realization