

①  
a)

$$H(z) = (1-z^{-1}) \underbrace{(1-(1+j)z^{-1})(1-(1-j)z^{-1})(1-(\frac{1+j}{2})z^{-1})(1-(\frac{1-j}{2})z^{-1}))}_{\text{due to complex zero in GR type IIV}}$$

↑  
type IIV

\*  $(1+j)$  -zero  $\rightarrow (1-j)$  zero (complex conj.)

$\rightarrow \frac{1}{1+j} = \frac{1}{2}(1-j)$  ~~real part~~ real part

$\rightarrow \frac{1}{2}(1+j)$   $\uparrow$  complex conj.

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

② LRF: check  $h(t=1)$  since  $z=e^{j\omega}|_{\omega=0}$  yields  $h(e^{j0})$

$h(1)=0 \Rightarrow$  cannot be LRF

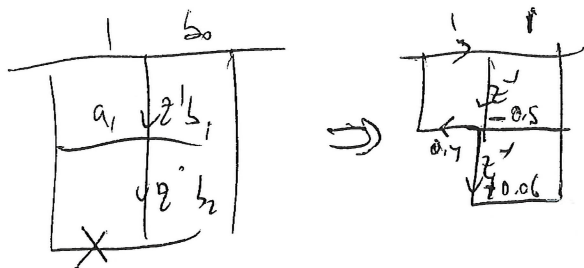
HPR: check  $h(-1)$  ( $z=-1 \Rightarrow e^{j\omega}|_{\omega=\pi}$ )

$\downarrow$   $h(-1) = 2 \cdot 5 \cdot 25 = 25 \neq 0 \Rightarrow$  could be HPR

high freq.

important to check

2) a)

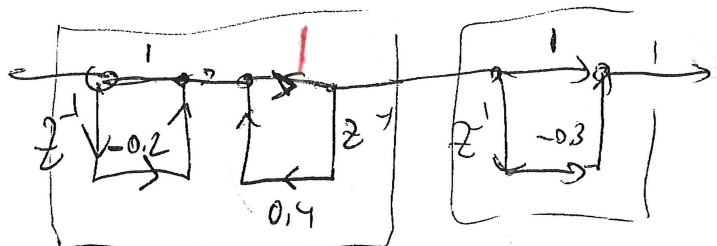


$$H(z) = \frac{1 - 0.5z^{-1} + 0.06z^{-2}}{1 - 0.4z^{-1}}$$

x Addition mit

b)

$$H(z) = \underbrace{\left( \frac{1 - 0.2z^{-1}}{1 - 0.4z^{-1}} \right)}_{H_1} \cdot \underbrace{(1 - 0.3z^{-1})}_{H_2}$$



product

c)

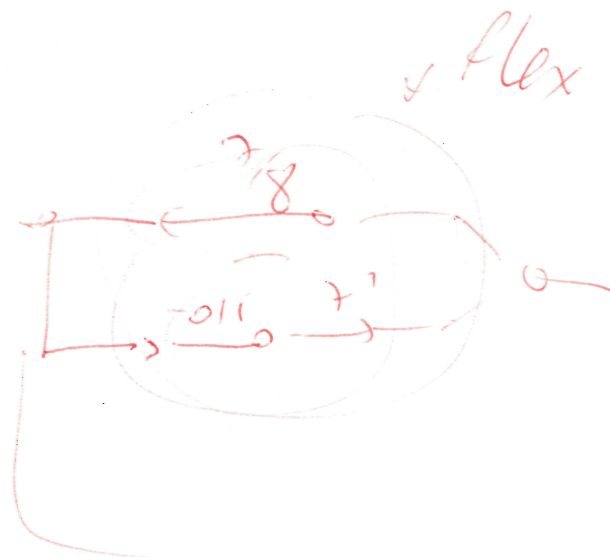
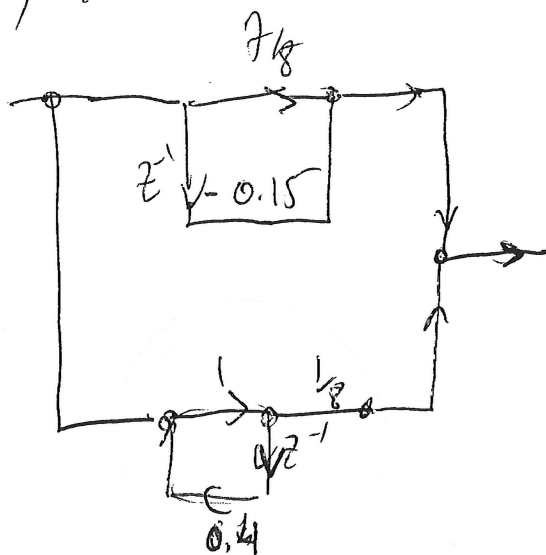
$$H = \frac{1 - 0.5z^{-1} + 0.06z^{-2}}{1 - 0.4z^{-1}} =$$

$$\begin{aligned} & \frac{1 - 0.4z^{-1}}{1 - 0.4z^{-1}} \cdot \frac{-0.15z^{-1} + \frac{7}{8}}{1 - 0.35z^{-1} + 0} \\ & = \frac{7}{8} - 0.35z^{-1} \\ & \Rightarrow \frac{7}{8} + 0 \end{aligned}$$

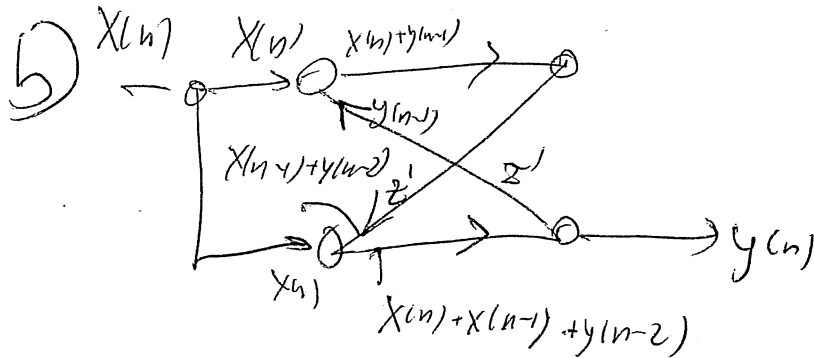
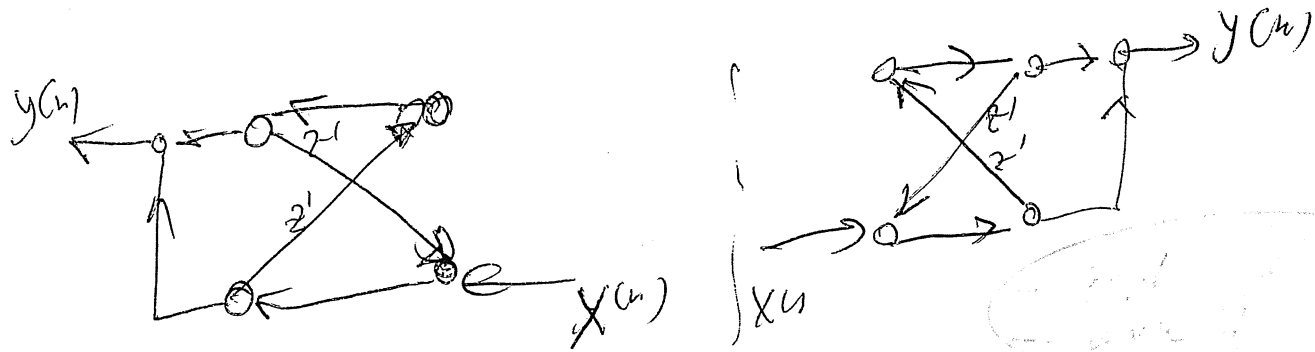
$$H = \frac{7}{8} - 0.15z^{-1} + \frac{\frac{1}{8}}{1 - 0.4z^{-1}}$$

$$\frac{0.06}{0.40} = \frac{6}{40} = \frac{15}{100} = 0.15$$

② c) loud



3) a)



$$y(n) = y(n-2) + x(n) + x(n-1)$$

c)  $Y(z) - (1 - z^{-2}) = X(z) (1 + z^{-1})$

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



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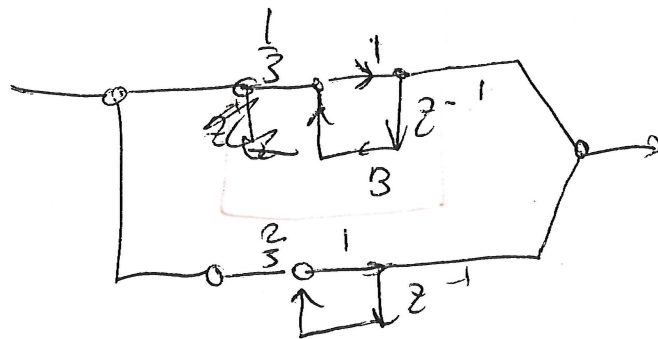
$$H(z) = \frac{A = \frac{1}{3}}{1 - 3z^{-1}} + \frac{B}{1 + 3z^{-1}} = \frac{\frac{1}{3}}{1 - 3z^{-1}} + \frac{\frac{2}{3}}{1 + 3z^{-1}}$$

$$A = \frac{1 - \frac{1}{3}}{1 + 3 \cdot \frac{1}{3}} = \frac{\frac{2}{3}}{2} = \frac{1}{3}$$

$$(A + B = 1) \rightarrow B = \frac{2}{3}$$

$$\text{OR } (B = \frac{1 + \frac{1}{3}}{1 + 1} = \frac{\frac{4}{3}}{2} = \frac{2}{3})$$

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