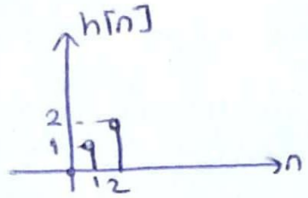
BME 3161

HW2 SOLUTIONS

Q1 –

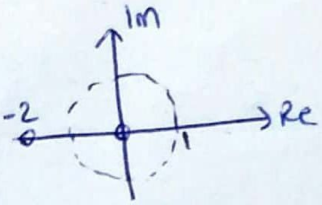


$h[n] = \delta[n-1] + 2\delta[n-2]$

$\delta[n] \xrightarrow{z} \sum_{-\infty}^{\infty} \delta[n] z^{-n} = \delta[0] z^{-0} = 1$

$\left.\begin{array}{l} \delta[n-1] \xrightarrow{z} z^{-1} \cdot 1 \\ 2\delta[n-2] \xrightarrow{z} 2z^{-1} \end{array}\right\} \boxed{H(z) = 2z^{-2} + z^{-1}}$

b)



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

$z=0 \; ; \; z=-2 \Rightarrow$ zeros

No feedback → FIR
in block diagram
No poles (only zeros)

Zeros in −2.
↓
Low-Pass

c) $Y(z) = X(z)H(z) = \dfrac{1}{(1-3z^{-1}+2z^{-2})\cancel{z^{-1}}} \cdot \cancel{z^{-1}}(2z^{-1}+1)$

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

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

$$A = \lim_{z\to 2} \cancel{(1-2z^{-1})} \frac{(2z^{-1}+1)}{\cancel{(1-2z^{-1})}(1-z^{-1})} = \frac{2}{0.5} = 4$$

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

$$Y(z) = \frac{4}{1-2z^{-1}} - \frac{3}{1-z^{-1}} \Rightarrow y[n] = \left(4(2)^n u[n]\right) + \left((-3) \cdot u[n]\right)$$

Q2- $x[n] = \underbrace{(0.2)^n u[n-4]}_{x_1[n]} + \underbrace{(0.4)^{n-1} u[n]}_{x_2[n]} \rightarrow X(e^{jw}) = ?$

$$\sum_{n=0}^{\infty} \alpha^n e^{-jwn} \longrightarrow \frac{1}{1-\alpha e^{-jw}}$$

$$x_1[n] = (0.2)^n u[n-4] = (0.2)^4 (0.2)^{n-4} u[n-4]$$

$$F\{(0.2)^n\} = \frac{1}{1-0.2e^{-jw}}$$

$\downarrow$

$$X_1(e^{jw}) = (0.2)^4 e^{-j4w} \frac{1}{1-0.2e^{-jw}}$$

$$x_2[n] = (0.4)^{n-1} u[n] = (0.4)^{-1} (0.4)^n u[n] \Rightarrow X_2(e^{jw}) = (0.4)^{-1} \frac{1}{1-0.4e^{-jw}}$$

$$\boxed{X(e^{jw}) = \frac{(0.2)^4 e^{-j4w}}{1-0.2e^{-jw}} + \frac{(0.4)^{-1}}{1-0.4e^{-jw}}}$$

Q3-

			$x_1[n]$		
$x_2[\langle n-0\rangle_4]$ =	1 1 0 0	.	1	=	1 1 0 0
$x_2[\langle n-1\rangle_4]$ =	0 1 1 0	.	2	=	0 2 2 0
$x_2[\langle n-2\rangle_4]$ =	0 0 1 1	.	3	=	0 0 3 3
$x_2[\langle n-3\rangle_4]$ =	1 0 0 1	.	4	=	4 0 0 4
				+	5 3 5 7

n: 0 1 2 3

$x_1[n] \, (N) \, x_2[n]$