DSP1 ECE-GY 6113 HW3

1.6.1

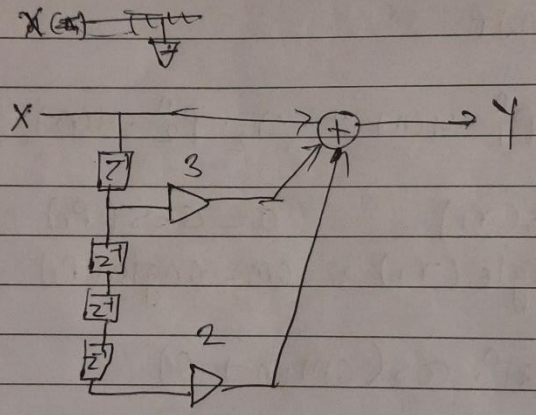
$$y(n) = x(n) + 3 \cdot x(n-1) + 2 \cdot x(n-4)$$

(a)

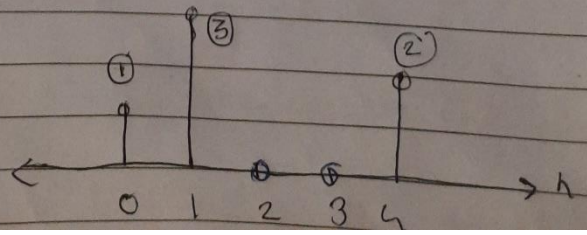
$$Y(z) = X(z) + 3 \cdot X(z) \cdot z^{-1} + 2 \cdot X(z) \cdot z^{-4}$$

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

(b)



n	0	1	2	3	4
X	1	0	0	0	0
					0
X(n-1)	0	1x3			0
X(n-4)	0	0	0	0	1x2
Y	1	3	0	0	2



DSP1 ECE-GY 6113 HW3

1.6.2

$h(n) = \{\boxed{2}, 1, 0, 1, 0\}$

$h(n) = 2\delta(n) + \delta(n-1) + \delta(n-3)$

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

(b) Difference equation

$y(n) = 2 \cdot x(n) + x(n-1) + x(n-3)$

1.6.3

$y(n) = x(n) + x(n-1) + 0.5\, y(n-1)$

Z.T.

$Y(z) = X(z) + z^{-1} \cdot X(z) + (0.5)\, Y(z)\, z^{-1}$

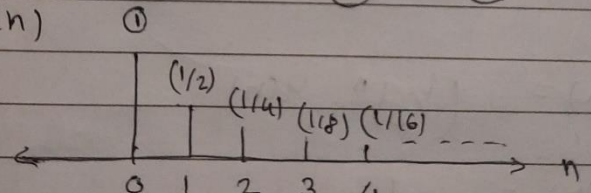
$Y(z)\left[1 - \underset{(0.5)}{z^{-1}}\right] = X(z)(1 + z^{-1})$

$H(z) = \frac{Y(z)}{X(z)} = \frac{(1+z^{-1})}{(1-0.5z^{-1})} = \frac{1}{1-(0.5)z^{-1}} + \frac{z^{-1}}{1-0.5z^{-1}}$

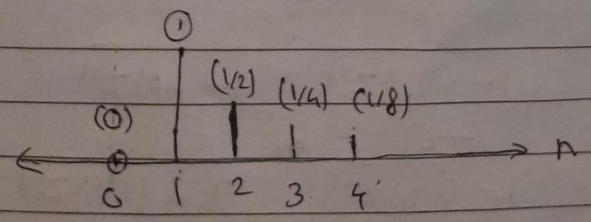
$h(n) = (0.5)^{n} u(n) + (0.5)^{(n-1)} \cdot u(n-1)$

(A) + (B)

(A) $(0.5)^n \cdot u(n)$

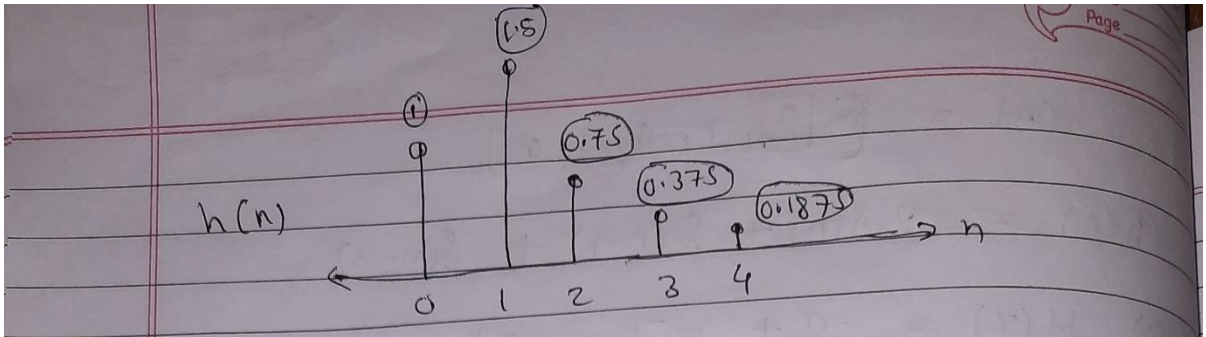


(B) $(0.5)^{n-1} \cdot u(n-1)$



$h(n) = [1, 1.5, 0.75, 0.375, 0.1875]$

DSP1 ECE-GY 6113 HW3



1.6.4

$$h(n) = \left(\frac{1}{3}\right)^n \cdot u(n)$$

(a)

$$H(z) = \frac{z}{z - \left(\frac{1}{3}\right)} = \frac{1}{1 - \left(\frac{1}{3}\right)z^{-1}}$$

$$\frac{Y(z)}{X(z)} = \frac{1}{1 - (1/3)z^{-1}}$$

$$Y(z)\left(1 - (1/3)z^{-1}\right) = X(z)$$

$$Y(z) - \left(\frac{1}{3}\right)Y(z)\cdot z^{-1} = X(z)$$

by observation $y(n) - \left(\frac{1}{3}\right)y(n-1) = x(n)$

$$y(n) = x(n) + (1/3)\,y(n-1)$$

(b) $x(n) = \left(\frac{1}{2}\right)^n \cdot u(n)$

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

$$Y(z) = H(z)\cdot X(z)$$

$$= \frac{1}{1 - (1/3)z^{-1}} \cdot \frac{1}{1 - (1/2)z^{-1}}$$

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

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

DSP1 ECE-GY 6113 HW3

$$y(n) = (-2)\left(\frac{1}{3}\right)^n u(n) + (3)\left(\frac{-1}{2}\right)^n u(n)$$

1.6.5

H_1: $r(n) + \frac{1}{3} r(n-1) = x(n) + 2x(n-1)$

H_2: $y(n) + 1/3\, y(n-1) = r(n) - 2r(n-1)$

H_1:

$r(n) = x(n) + 2x(n-1) - \left(\frac{1}{3}\right) r(n-1)$

$R^n = x^n + 2x^{(n-1)} - (1/3) R^{(n-1)}$

H_2: $y(n) = r(n) - 2r(n-1) - (1/3)\, y(n-1)$

$Y^n =$

1.6.6

H_1: $f(n) = x(n) + x(n-2) + 0.1\, f(n-1)$

H_2: $g(n) = x(n) + x(n-1) + 0.1\, g(n-1)$

Equivalent system $= H_1 + H_2$

$= 2x(n) + x(n-1) + x(n-2) + 0.1\, f(n-1) + 0.1\, g(n-1)$

1.6.7

(a)

$$Y(z)\left[1 - (5/6)\cdot z^{-1} + (1/6)\cdot z^{-2}\right] = X(z)\left[2 + (2/3)\, z^{-1}\right]$$

$$\frac{Y(z)}{X(z)} = \frac{2 + (2/3)\, z^{-1}}{1 - (5/6)\, z^{-1} + (1/6)\, z^{-2}}$$

(b) $H(z) = \frac{10}{1 - (\frac{1}{2})^n z^{-1}} - \frac{8}{1 - (1/3) z^{-1}}$

DSP1 ECE-GY 6113 HW3

1.6.7

(b) $h(n) = 10 \cdot (1/2)^n \cdot u(n) - (8)\ (1/3)^n\ u(n)$

1.6.8

$$y(n) = \sum_{k=0}^{\infty} 2^{-k} \cdot x(n-10k)$$

$$Y(z) = \sum_{n=0}^{\infty} \left(\sum_{k=0}^{\infty} 2^{-k} \cdot x(n-10k) \right) \cdot z^{-n}$$

$$= \sum_{k=0}^{\infty} 2^{-k} \left(\sum_{n=0}^{\infty} x(n-10k) \cdot z^{-n} \right)$$

$$= \sum_{k=0}^{\infty} 2^{-k} \cdot X(z) \cdot (z^{-10k})$$

$$= X(z) \cdot \sum_{k=0}^{\infty} 2^{k} \cdot z^{-10k}$$

$$= X(z) \sum_{k=0}^{\infty} (2^{-1} \cdot z^{-10})^k = X(z) \cdot \frac{1}{1-(2^{-1} \cdot z^{-10})}$$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{1}{1-(2^{-1} \cdot z^{-10})} = \frac{z^{10}}{z^{10} - (1/2)}$$

(b) Transfer function $H(z) = \dfrac{1}{1-(1/2)z^{-10}}$

(a) Impulse Response

DSP1 ECE-GY 6113 HW3

Complex Poles

(1.7.1) $y(n) = x(n) - y(n-2)$, $y(n) + y(n-2) = x(n)$

Z.T. $Y(z)[1 + z^{-2}] = X(z)$

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

$\frac{H(z)}{z} = \frac{z}{(z+j)(z-j)}$, $\frac{H(z)}{z} = \frac{(1/2)}{(z+j)} + \frac{(1/2)}{(z-j)}$

$H(z) = (1/2)\frac{z}{(z+j)} + (1/2)\frac{z}{(z-j)}$

$h(n) = (1/2)(+j)^n + (1/2)(-j)^n$

$R = abs(1/2) = 1/2$ $\quad a = abs(+j) = 1$

$\theta = angle(1/2) =$ $\quad w = angle(j) = 90$

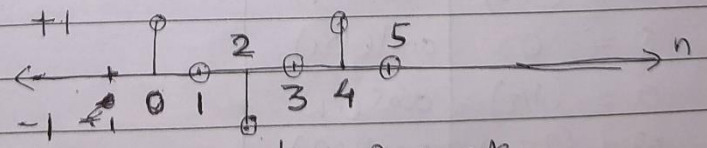
$h = 2 \cdot R \cdot (a)^n \cdot \cos(w \cdot n + \theta) \cdot u(n)$

$= 2 \cdot (\frac{1}{2}) \cdot (1)^n \cdot \cos(0 + 90n) \cdot u(n)$

$= (1)^n \cdot \cos(90n)$

$n=0$	$h=1$	$\cos(0)$	$n=3$ $\cos(270)=0$
$n=1$	$h=0$	$\cos(90)$	$n=4$ $\cos(360)=1$
$n=2$	$h=-1$	$\cos(180)$	$n=5$ $\cos(450)=0$

$h(n) \rightarrow$



(b) Impulse Response

$= [1, 0, -1, 0, +1, 0, \ldots]$

(c) For stable input output is stable.

Therefore system is stable.

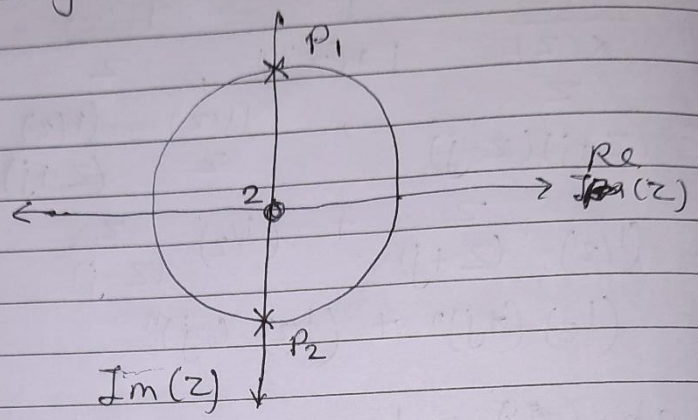
DSP1 ECE-GY 6113 HW3

(a) $H(z) = \dfrac{z^2}{(z+j)(z-j)}$

7.2

$p_1 = +j \qquad z_1 = 0$

$p_2 = -j \qquad z_2 = 0$



1.7.2 $h(n) = \left(\frac{1}{2}\right)^n \cdot \cos\left(\frac{2\pi}{3} n\right) \cdot u(n)$ — (i)

$h_2(n) = 2R \cdot (a)^n \cdot \cos(\omega \cdot n + \theta) \cdot u(n)$ — (ii)

compare (i) & (ii)

$2R = 1 \qquad \omega = (2\pi/3)$

$a = (1/2) \qquad \theta = 0$

$R = (1/2)$	abs(r_1)
$\theta = 0$	angle(r_1)
$a = (1/2)$	abs(p_1)
$\omega = (2\pi/3)$	angle(p_1)

$a^n \cdot \cos(\omega \cdot n) \cdot u(n) \xrightarrow{Z.T.} \dfrac{z^2 - z\cos(\omega) \cdot a}{z^2 - 2a\cos(\omega) \cdot z + a^2}$

DSP1 ECE-GY 6113 HW3

(1.7.2) $a = (1/2) \quad \omega = (2\pi/3)$

$$H(z) = \frac{z^2 - z\cdot\cos(2\pi/3)\cdot(1/2)}{z^2 - 2(1/2)\cdot z\cdot\cos(2\pi/3) + (1/2)^2}$$

$$= \frac{z^2 - z(-1/2)(1/2)}{z^2 + (1/2)z + (1/4)} = \frac{z^2 + z/4}{z^2 + \left(\frac{1}{2}\right) + \left(\frac{1}{4}\right)} = \frac{Y(z)}{X(z)}$$

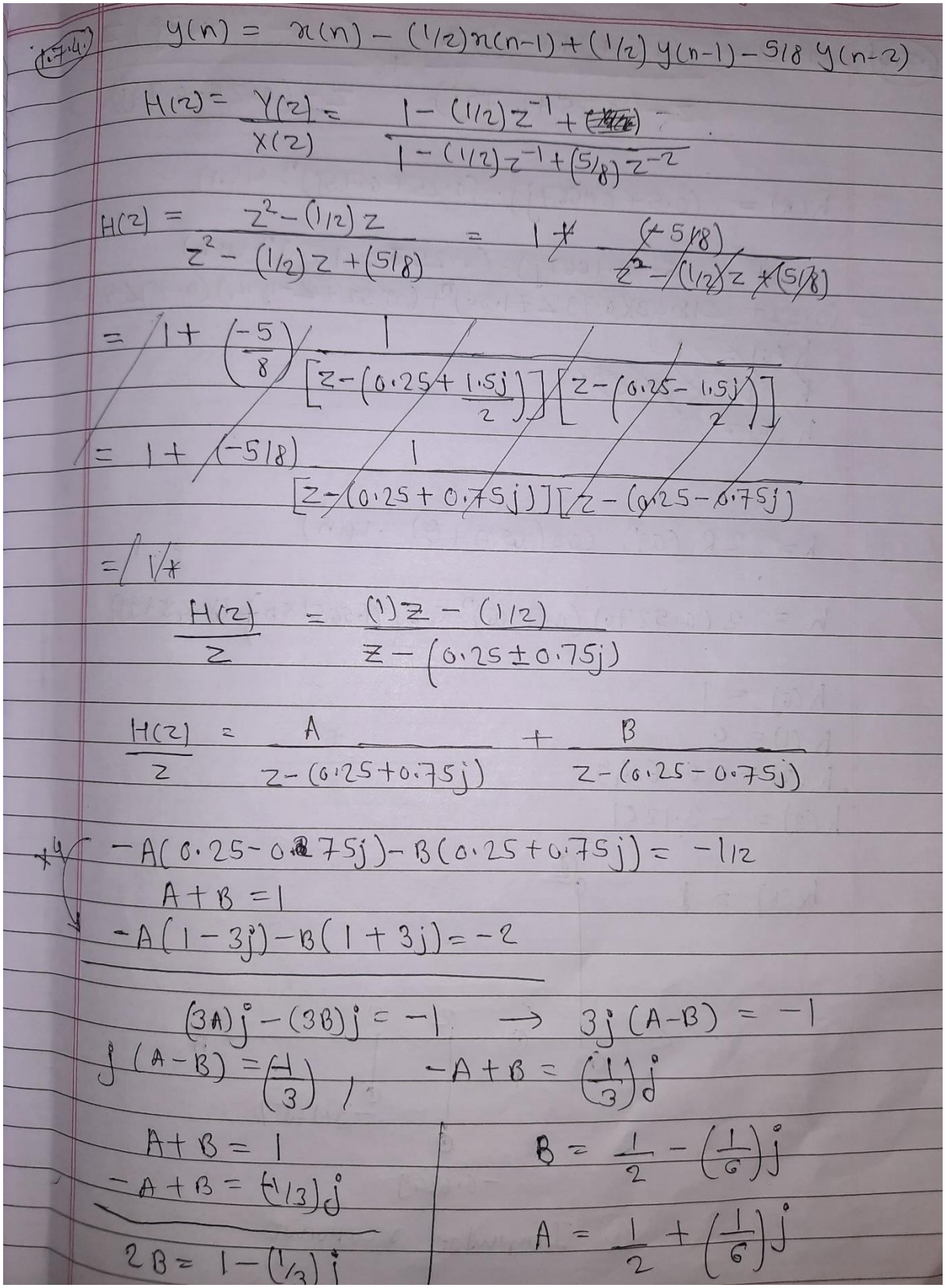
~~$Y(z)\left[z^2 + (0.25)z\right.$~~ $\quad \frac{1 + (0.25)z^{-2}}{1 + (0.5)\cdot z^{-1} + (0.25)z^{-2}} = \frac{Y(z)}{X(z)}$

$$X(z)\left[1 + 0.25\,z^{-2}\right] = Y(z)\left[1 + 0.5\cdot z^{-1} + 0.25\,z^{-2}\right]$$

$$x(n) + (0.25)\,x(n-2) = y(n) + (0.5)\cdot y(n-1) + (0.25)\cdot y(n-2)$$

$$y(n) = x(n) + 0.25\cdot x(n-2) - (0.5)\cdot y(n-1) - (0.25)\cdot y(n-2)$$

DSP1 ECE-GY 6113 HW3



1.7.4)

$$y(n) = x(n) - (1/2)x(n-1) + (1/2)y(n-1) - 5/8\, y(n-2)$$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{1 - (1/2)z^{-1} + (\cancel{1/2})}{1 - (1/2)z^{-1} + (5/8)z^{-2}}$$

$$H(z) = \frac{z^2 - (1/2)z}{z^2 - (1/2)z + (5/8)} = 1 + \frac{(+5/8)}{z^2 - (1/2)z + (5/8)}$$

$$= 1 + \left(\frac{-5}{8}\right) \frac{1}{\left[z - \left(0.25 + \frac{1.5j}{2}\right)\right]\left[z - \left(0.25 - \frac{1.5j}{2}\right)\right]}$$

$$= 1 + (-5/8) \frac{1}{[z - (0.25 + 0.75j)][z - (0.25 - 0.75j)]}$$

$$= 1 +$$

$$\frac{H(z)}{z} = \frac{(1)z - (1/2)}{z - (0.25 \pm 0.75j)}$$

$$\frac{H(z)}{z} = \frac{A}{z - (0.25 + 0.75j)} + \frac{B}{z - (0.25 - 0.75j)}$$

$$-A(0.25 - 0.75j) - B(0.25 + 0.75j) = -1/2$$

$$A + B = 1$$

$$-A(1 - 3j) - B(1 + 3j) = -2$$

$$(3A)j - (3B)j = -1 \rightarrow 3j(A - B) = -1$$

$$j(A - B) = \left(\frac{-1}{3}\right), \quad -A + B = \left(\frac{1}{3}\right)j$$

$$A + B = 1$$

$$-A + B = (1/3)j$$

$$2B = 1 - (1/3)j$$

$$B = \frac{1}{2} - \left(\frac{1}{6}\right)j$$

$$A = \frac{1}{2} + \left(\frac{1}{6}\right)j$$

DSP1 ECE-GY 6113 HW3

(1.74) $H(z) = \frac{(0.5+0.1667j)z}{z-(0.25+0.75j)} + \frac{(0.5-0.1667j)z}{z-(0.25-0.75j)}$

$h(n) = (0.5+0.1667j)\cdot(0.25+0.75j)^n \cdot u(n)$

$+ (0.5-0.1667j)\cdot(0.25-0.75j)^n \cdot u(n)$

$= (0.527 \cdot \angle 18.43)(0.79\angle 71.56)^n + (0.527\angle -18.4)(0.79\angle -71.56)^n$

~~$h(0) = 1$~~

~~$h(1) = (-5\times 10^{-5})$~~

~~$h(2) =$~~

$h = 2R\cdot(a)^n \cdot \cos(\omega n+\theta)\cdot u(n)$

$h = 2(0.5270)(0.7906)^n \cdot \cos(71.5651\times n + 18.43499)$

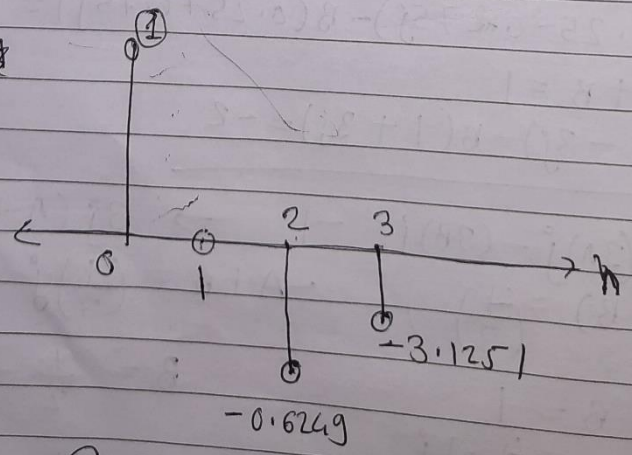
$h(0) = 1$

$h(1) = 0$

$h(2) = -0.6249$

$h(3) = -3.1251$

$h(n) =$



(b) Impulse response

DSP1 ECE-GY 6113 HW3

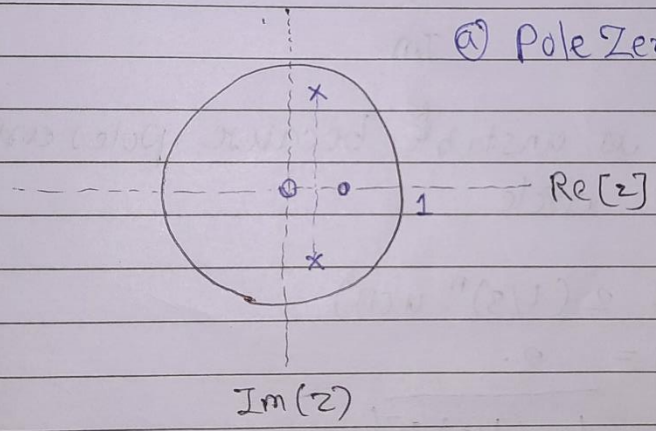
1.7.9

(a) Pole Zero Diagram

$$H(z) = \frac{z^2 - (1/2)z}{[z - (0.25 + 0.75)][z - (0.25 - 0.75)]}$$

$$H(z) = \frac{z(z - 1/2)}{[z - (0.25 + 0.75j)][z - (0.25 - 0.75j)]}$$

(a) Pole Zero Plot



1.13 (a)

DSP1 ECE-GY 6113 HW3

1.7.8

Impulse Response	Pole-Zero diagram.
1	5
2	6
3	7
4	1
5	4
6	3
7	8
8	2

1.7.9

Pole-Zero diagram	Impulse Response
1	6
2	1
3	7
4	5
5	2
6	8
7	3
8	4

1.7.11

$h(n) = A(0.7)^n \cdot u(n)$

$x(n) = B(0.9)^n \cdot u(n)$

$$H(z) = \frac{A}{1-(0.7)z^{-1}} \qquad X(z) = \frac{B}{1-(0.9)z^{-1}}$$

$$Y(z) = \frac{Az}{z-(0.7)} \cdot \frac{Bz}{z-(0.9)} = \frac{(A \cdot B)z^2}{(z-0.7)(z-0.9)}$$

$$\frac{Y(z)}{z} = AB\left[\frac{10.5}{(z-0.7)} + \frac{(-9.5)}{(z-0.9)}\right]$$

DSP1 ECE-GY 6113 HW3

$$Y(n) = AB\left[10.5\,(0.7)^n u(n) + (-9.5)\,(0.9)^n u(n)\right]$$

(1.8.1)

$$H^f(\omega) = \begin{cases} e^{-j\omega} & -0.4\pi < \omega < 0.4\pi \\ 0 & 0.4\pi < |\omega| < \pi \end{cases}$$

$$x(n) = (1.2)\cos(0.3\pi n) + (1.5)\cos(0.5\pi n)$$

~~$y(n) = (1.2)\cos(0.3\pi n)$~~,

$$\cos(\omega_0 n) \rightarrow \boxed{h} \rightarrow |H^f(\omega_0)|\cos(\omega_0 n + \angle H^f(\omega_0))$$

$$(1.2)\cdot\cos(0.3\pi n) \rightarrow \boxed{h} \rightarrow |e^{-j0.3\pi}| \cdot \cos(0.3\pi n + \angle e^{-j0.3\pi})$$

$$+$$

$$(1.5)\cos(0.5\pi n) \rightarrow \boxed{h} \rightarrow |0|\cdot\cos(0.5\pi n + \angle 0)$$

Output

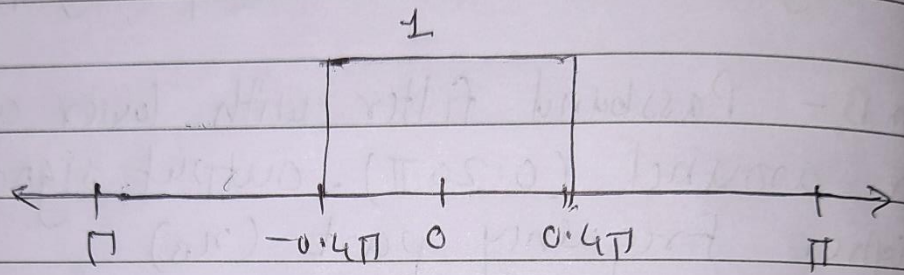
$$= |e^{-j0.3\pi}|\cdot\cos(0.3\pi n + \angle e^{-j0.3\pi}) + 0$$

$$y(n) = 1\cdot\cos(0.3\pi n - 0.3\pi)$$

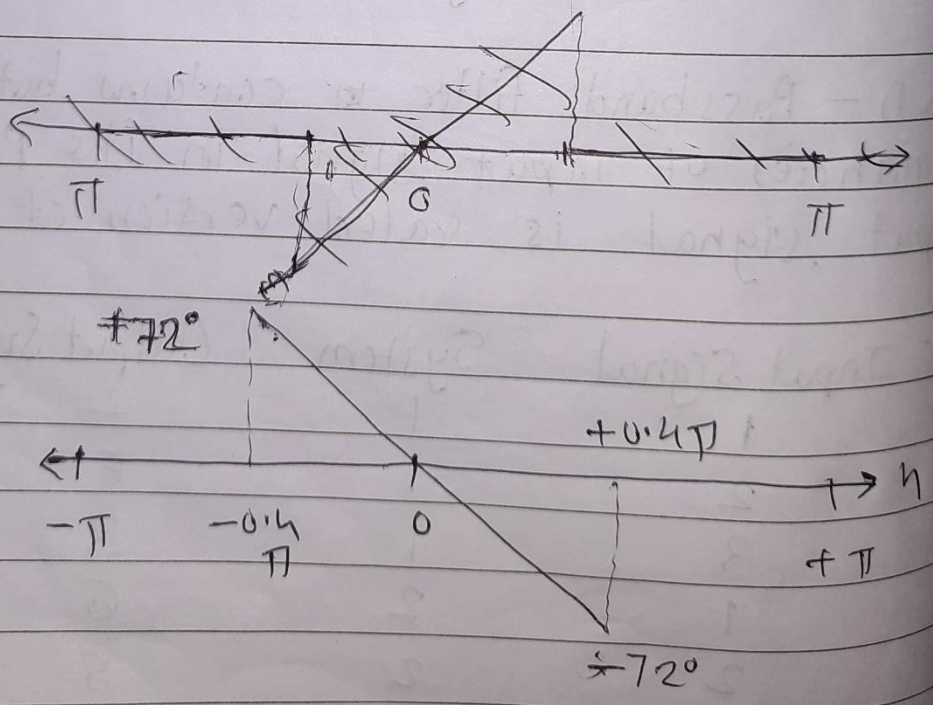
DSP1 ECE-GY 6113 HW3

1.8.1

Frequency Response magnitude



Frequency Response Phase.



DSP1 ECE-GY 6113 HW3

(1.8.2) $x(n) = 1 + \cos(0.3\pi \cdot n)$

$y(n) = |H^f(0)|1 + |H^f(0.3\pi)| \cdot \cos(0.3\pi \cdot n + \angle H^f(0.3\pi))$

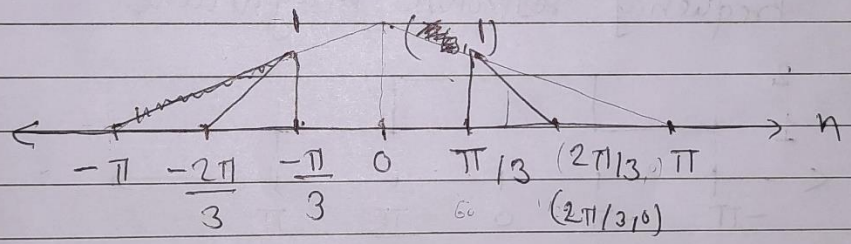
$= 1.1 + (0.7) \cdot \cos(0.3\pi n + 0)$

$y(n) = 1 + 0.7 \cdot \cos(0.3\pi n)$

(1.8.5) $x(n) \rightarrow [H] \rightarrow [G] \rightarrow y(n)$

(a) Frequency Response of total System

$= |H^f(\omega)| \cdot |G^f(\omega)| \cdot e^{\angle H^f(\omega) + \angle G^f(\omega)}$



(b) input signal $x(n) = 5 + 3 \cdot \cos\left(\frac{\pi}{2}n\right) + 2 \cdot \cos\left(\frac{2\pi}{3}n\right) + 6 \cdot (-1)^n$

$\text{slope} = \frac{0-1}{2\pi/3 - \pi/3} = \frac{-1}{\pi/3} = \frac{-3}{\pi}$

$H^f(\pi/2) = 1 - \left(\frac{-3}{\pi} \times \left(\frac{\pi}{2} - \frac{\pi}{3}\right)\right) = 1 + \left(\frac{-3}{\pi} \times \frac{\pi}{6}\right)$

$n=1 \quad |H^f(\pi/2n)| = (1/2)\{\cos(\pi/2n) \quad n=1$

for $n=0, n>1$ $|H^f(\pi/2*)| = 0$

$|H^f(2\pi/3*)| = 0$

$|H^f(0)| = 0$

DSP1 ECE-GY 6113 HW3

(1.8.5) Output due to $4(-1)^n = 4 \cdot \cos(\pi \cdot n)$

$|Hf(\pi)| = 0$

output

$= 0 + 3 \cdot (1/2) \cdot \cos(\pi/2n) + 0 + 0$

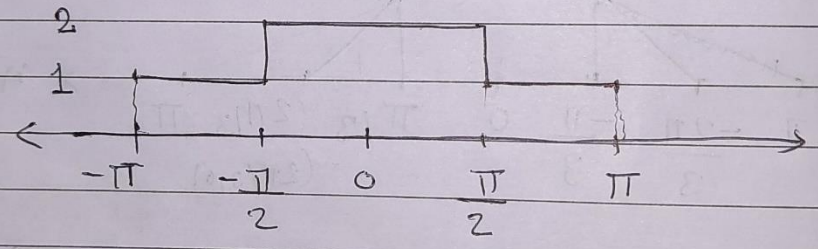
$y(n) = (3/2) \cdot \cos\left(\frac{\pi n}{2}\right)$

(1.8.8)

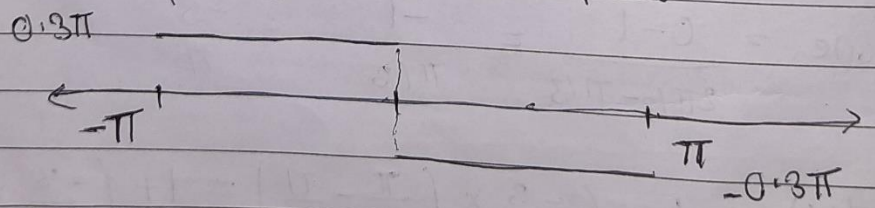
$$|Hf(\omega)| = \begin{cases} 2 & \text{for } |\omega| < 0.5\pi \\ 1 & \text{for } 0.5\pi < |\omega| < \pi \end{cases}$$

$$\angle Hf(\omega) = \begin{cases} 0.3\pi & \text{for } -\pi < \omega < 0 \\ -0.3\pi & \text{for } 0 < \omega < \pi \end{cases}$$

(a) Frequency response magnitude



(b) Frequency Response phase



(c)

Input signal $x(n) = 2\sin(0.2\pi n) + 3\cos(0.6\pi n + 0.2\pi)$

~~$x(n) = 2\cos(\ldots)$~~

$x(n) = 2\cos\left((0.5\pi - 0.2\pi)n\right) + 3\cos(0.6\pi n + 0.2\pi)$

DSP1 ECE-GY 6113 HW3

1.8.8

output signal

(A) $2\cos(0.3\pi n) \rightarrow Hf(0.3\pi) = 2 \quad \angle Hf(0.3\pi) = -0.3\pi$

$\Rightarrow (2)(2)\cos(0.3\pi n - 0.3\pi) = 4\cos(0.3\pi n - 0.3\pi)$

(B) $3\cdot\cos(0.6\pi n + 0.2\pi)$

$|Hf(0.6\pi)| = 1 \quad \angle Hf(0.6\pi) = -0.3\pi$

$\Rightarrow (3)(1)\cos(0.6\pi n + 0.2\pi - 0.3\pi)$

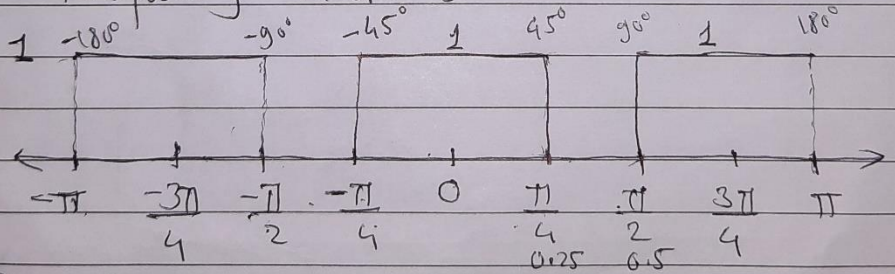
$= 3\cdot\cos(0.6\pi n - 0.1\pi)$

$\Rightarrow 4\cos(0.3\pi n - 0.3\pi) + 3\cos(0.6\pi n - 0.1\pi)$

1.8.9

$Hf(\omega)$	$\lvert Hf(\omega)\rvert$	$\angle Hf(\omega)$	freq Range
1	1	0	$\lvert\omega\rvert \le 0.25\pi$
0	0	0	$0.25\pi < \lvert\omega\rvert \le 0.5\pi$
1	1	0	$0.5\pi < \lvert\omega\rvert \le \pi$

(a) Frequency Response



(c) Band-Stop filter.

(b)

$$x(n) = \underbrace{3}_{A} + \underbrace{2\cdot\cos(0.3\pi\cdot n)}_{B} + \underbrace{2\cos(0.7\pi\cdot n)}_{C} + \underbrace{(-1)^n}_{D}$$

(A) output $(y_A) = 3\cdot(1)$

(B) $y_B = 2\cdot|Hf(0.3\pi)|\cdot\cos(0.3\pi n) = 2\cdot(0)\cos(0.3\pi n)$

(C) $y_C = 2\,|Hf(0.7\pi)|\cos(0.7\pi n + \angle Hf(0.7\pi)) = 2(1)\cos(0.7\pi n)$

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1.8.9

(1) $y_0 = (-1)^n = \cos(\pi * n)$

$|H^f(\pi)| = 1$

output

$y(n) = 3(1) + 2(0) \cdot \cos(0.3\pi n) + 2(1) \cdot \cos(0.7\pi n) + (1) \cdot (-1)^n$

$y(n) = 3 + 2\cos(0.7\pi n) + (-1)^n \cdot (1)$

$y(n) = 3 + 2 \cdot \cos(0.7\pi n) + \cos(\pi \cdot n)$

DSP1 ECE-GY 6113 HW3

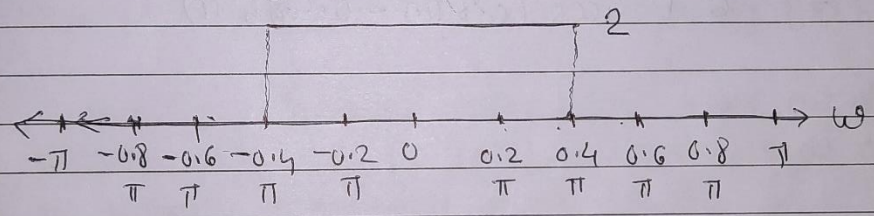
1.8.12

$$Hf(\omega) = \begin{cases} 2e^{-j1.5\omega} & \text{for } |\omega| \le 0.4\pi \\ 0 & \text{for } 0.4\pi < |\omega| \le \pi \end{cases}$$

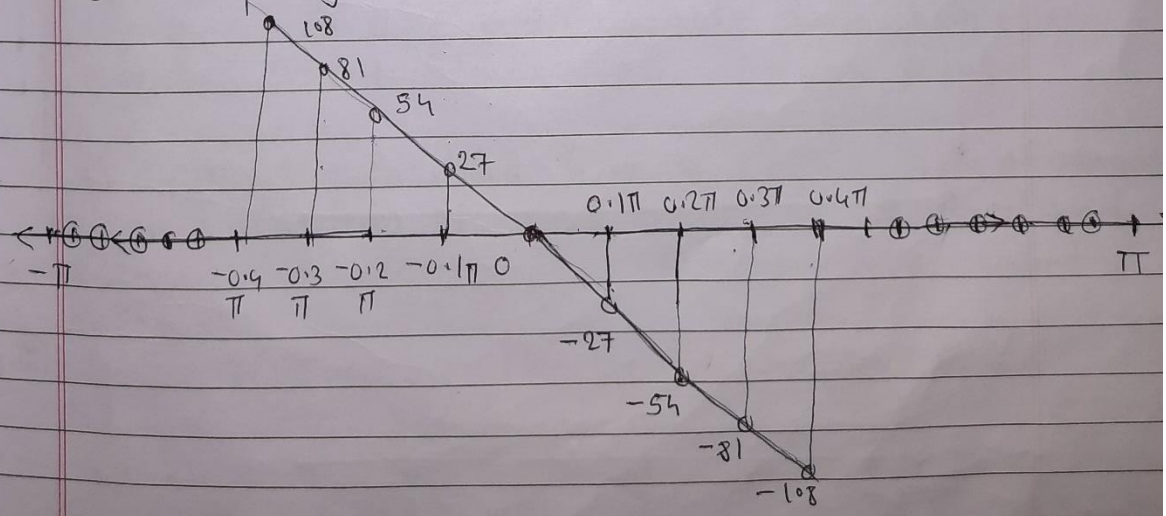
$$|Hf(\omega)| = |2e^{-j1.5\omega}| = 2 \quad \text{for } |\omega| \le 0.4\pi$$

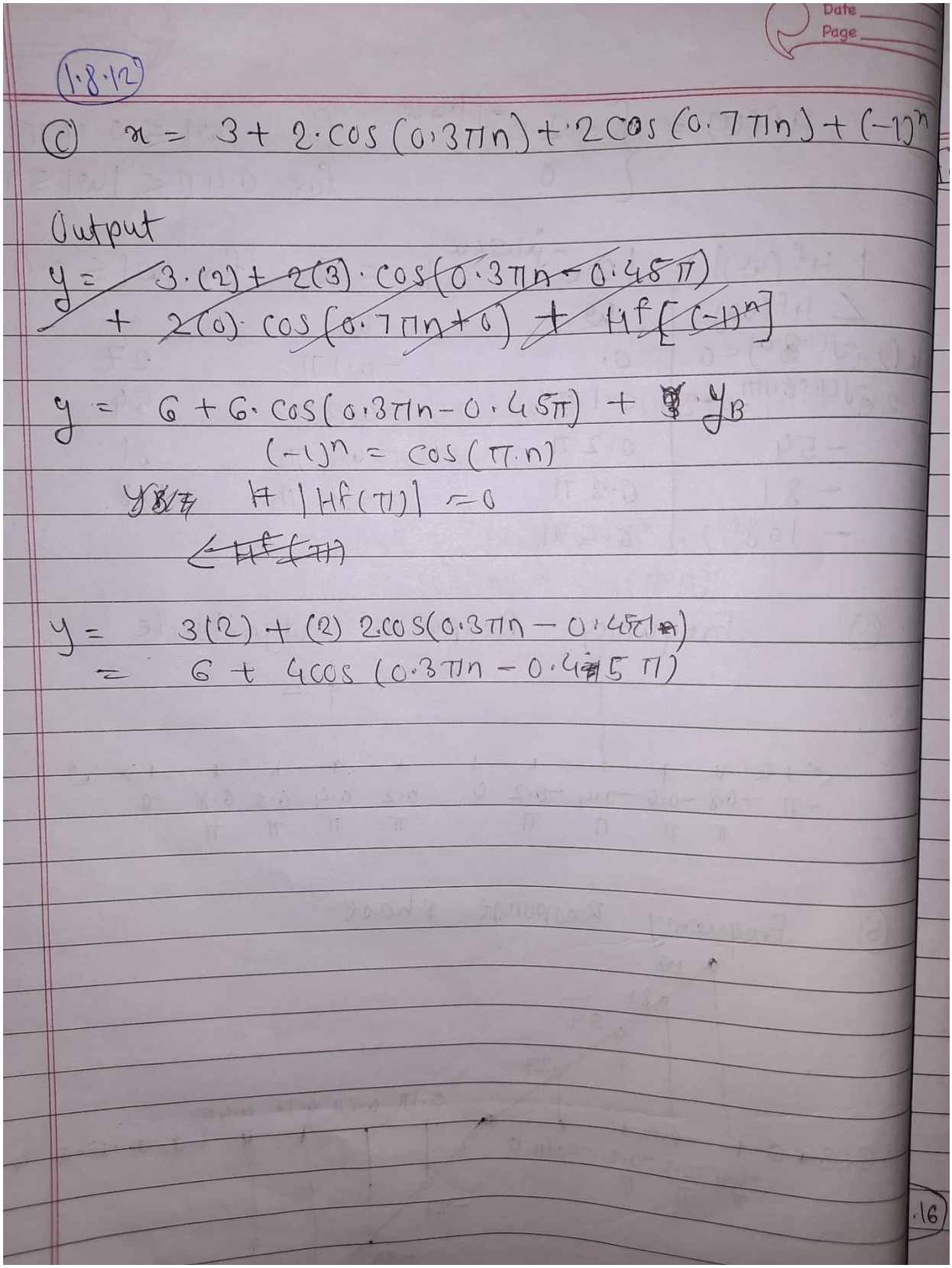
$\angle Hf(\omega)$	ω	ω	
angle $(2e^{-j(1.5\cdot 0)}) = 0$	0	-0.1π	27
$2e^{-j(1.5\cdot 0.1\pi)} = -27$	0.1π	-0.2π	54
-54	0.2π	-0.3π	81
-81	0.3π	-0.4π	108
-108	0.4π		

(a) Frequency Response Magnitude



(b) Frequency Response phase.





1.8.12

(c) $x = 3 + 2\cdot\cos(0.3\pi n) + 2\cos(0.7\pi n) + (-1)^n$

Output

~~$y = 3\cdot(2) + 2(3)\cdot\cos(0.3\pi n - 0.45\pi) + 2(0)\cdot\cos(0.7\pi n + 0) + Hf[(-1)^n]$~~

$y = 6 + 6\cdot\cos(0.3\pi n - 0.45\pi) + y_B$

$(-1)^n = \cos(\pi\cdot n)$

$H\,|Hf(\pi)| = 0$

~~$Hf(\pi)$~~

$y = 3(2) + (2)\,2\cos(0.3\pi n - 0.45\pi)$

$= 6 + 4\cos(0.3\pi n - 0.45\pi)$

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DSP1 ECE-GY 6113 HW3

1.8.15 Input Signal

$x(n) = 2\cos(0.15\pi n)\cdot u(n-5) + 2\cos(0.24\pi n)\,u(n-5)$

$[x] = [x_A] + [x_B]$

$\omega_A = 0.15\pi \qquad \omega_B = 0.24\pi$

System	Output Signal
A	4
B	1
C	2
D	3

① System A – Low pass filter with cutoff freq. (0.25π) output signal with lower frequency part (x_A)

② System B – Passband filter with lower cut off frequency approx. around (0.20π). output signal contains higher frequency part (x_B)

③ System C – High Pass filter with ~~fast~~ cut off frequency approx. (0.30π) which is higher than both of the signals. Output filtered signals very low value.

④ System D – Passband filter contains both ~~of signals~~ of frequencies of input signal in its Passband. so output signal is scaled version of input signal.

1.8.16

Input Signal	System	Output Signal
1	1	2
2	1	4
3	1	3
1	2	6
2	2	5
3	2	1

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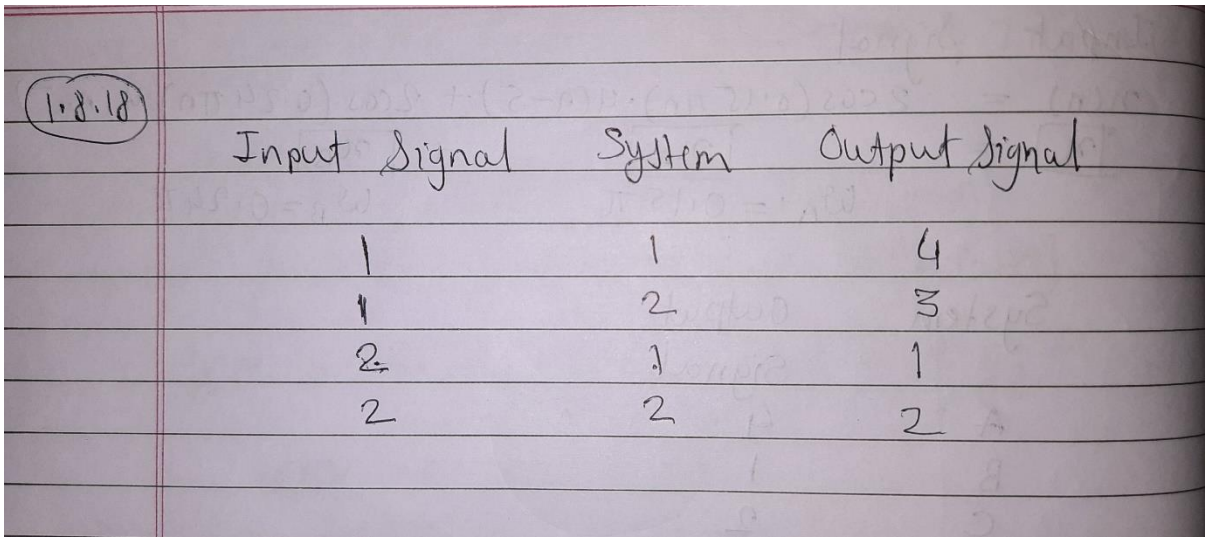

1.8.18

Input Signal	System	Output Signal
1	1	4
1	2	3
2	1	1
2	2	2