Revision

$\boxed{1}$ $X_a(t) = \sin 480\pi t + 3\sin 720\pi t$

$F_s = 600$

1) folding freq. $= \frac{600}{2} = 300$

2) $X(n) = \sin \frac{48\cancel{0}}{60\cancel{0}} \pi n + 3\sin \frac{72\cancel{0}}{60\cancel{0}} \pi n$

$= \sin(\frac{4}{5}\pi n) + 3\sin(\frac{6}{5}\pi n)$

$= \sin(\frac{4}{5}\pi n) + 3\sin[(2\pi - \frac{4}{5}\pi)n]$

$= \sin(\frac{4}{5}\pi n) - 3\sin \frac{4}{5}\pi n$

$= -2\sin(\frac{4}{5}\pi n)$

3) no because alaising happen in second component

new analog signal $X_a(t) = -2\sin 480\pi t$

$\boxed{2}$

i) to remove high frequencies (noise frequencies) in order to avoid alaising

ii) because it destroys frequency relations

iii) because ideal filter needs infinite h(n) which is impractical

iiii) beause it concentrates all signal information in few coefficients

$\boxed{3}$

i) sharpening the signal

ii) Smoothing the signal

iii) noise frequencies will be aliazed with signal band

$\boxed{4}$ first order

$$H(s) = \frac{1}{s+1}$$

low to high $\quad s = \frac{\omega_p'}{s}$

$$\omega_p' = \tan\left(\frac{2\pi f_c}{2 f_s}\right) = 1.7320$$

$$H(s) = \frac{1}{\frac{1.732}{s}+1} = \frac{s}{1.732+s}$$

$$H(z) = \frac{\frac{z-1}{z+1}}{\frac{z-1}{z+1}+1.732} = \frac{z-1}{z-1+1.732(z+1)}$$

$$\frac{y(z)}{x(z)} = H(z) = \frac{z-1}{2.732z+0.732}$$

$$2.732\,z\,y(z) + 0.732\,y(z) = (z-1)\,x(z)$$

$$2.732\,z\,y(z) + 0.732\,y(z) = z\,x(z) - x(z)$$

$$y(z) + \frac{0.732}{2.732}\,y(z)\,z^{-1} = 0.366\,x(z) - 0.366\,z^{-1}x(z)$$

$$y(n) + 0.268\,y(n-1) = 0.366\,x(n) - 0.366\,x(n-1)$$

$\boxed{5}$ $$H(z) = \frac{z+1}{(z-0.5)(z-2)}$$

i) poles $= 0.5$ & 2

zeros $\Rightarrow -1$

system is not stable because there is a pole outside unit circle

ii) $h(n)$ will diverge

$\boxed{6}$ $$y(n) = y(n-1) + x(n)$$

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

$$y(n-K) = y(n-1-K) + x(n-K) \quad (2)$$

$(1) \neq (2)$ time variant

$\boxed{7}$ $y(n) = x(n^2)$

$x(n) = a_1 x_1(n) + a_2 x_2(n)$

$y(n) = a_1 x_1(n^2) + a_2 x_2(n^2)$ ①

$y_1(n) = x_1(n^2)$ $y_2(n) = x_2(n^2)$

$y(n) = a_1 y_1(n) + a_2 y_2(n)$

$= a_1 x_1(n^2) + a_2 x_2(n^2)$ ②

① = ② Linear

$\boxed{8}$

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

$\boxed{9}$ $X(z) = 2z^{-1} - 3z + z^2$

$\boxed{10}$ $x(n) = \{1, 0, \underline{4}, 2, 0, 3\}$

$\boxed{11}$ # of levels $2^4 \Rightarrow 16$

quantization error $= \Delta/2$

$$\Delta = \frac{26-10}{16} = \frac{16}{16} = 1$$

$$\frac{\Delta}{2} = 0.5$$

$\boxed{12}$

$f_c = f_c - \Delta f/2 = 1.25 - 0.25 = 1$

$F_s = 9$

norm. $W_c = \dfrac{2\pi(1)}{9} = 0.6981$

norm. transistion $= \dfrac{0.5}{9} = 1/18$

$\delta_s = 40$ DB

highpass FIR

$$h_D(n) = \frac{-2f_c \sin(n\omega_c)}{n\omega_c} \quad n \neq 0$$

$$1 - 2f_c \quad n = 0$$

Suitable window for 40 DB

$$0.5 + 0.5 \cos\left(\frac{2\pi n}{N}\right)$$

$\dfrac{1}{18} = \dfrac{3.1}{N} \quad \therefore N = 3.1 \times 18 = 55.8$

$= 57$

Coefficients $= -28$ to 28

$h_D(0) = 1 - 2(0.1111) = 0.7778$

$w(0) = \underline{1}$

$h(0) = h_D(0)\,w(0) = 0.7778$

$h(1) = h(-1) = h_D(1)\,w(1) =$

$-0.20461\,(0.99) = -0.204$

$h(2) = h(-2) = -0.1567\,(0.98) = -0.1548$

$\boxed{13}$ $X(k) = \{1, 1+J, 0, 1-J\}$

$X^*(k) = \{1, 1-J, 0, 1+J\}$

$X(k) \times X^*(k) = \{1, 2, 0, 2\}$

$F^{-1}\{1, 2, 0, 2\}$

$$x(n) = \frac{1}{N} \sum_{k=0}^{N-1} X(k)\, e^{Jk\frac{2\pi n}{N}}$$

$x(0) = 1/4\,\{1+2+0+2\} = 5/4$

$$X(1) = \frac{1}{4}\left\{1 + 2e^{J\frac{2\pi}{4}} + 0 + 2e^{J\frac{6\pi}{4}}\right\}$$

$$= \frac{1}{4}\left\{1 + 2J - 2J\right\} = \frac{1}{4}$$

$$X(2) = \frac{1}{4}\left\{1 + 2e^{J\frac{4\pi}{4}} + 0 + 2e^{J\frac{12\pi}{4}}\right\}$$

$$= \frac{1}{4}\left\{1 - 2 - 2\right\} = -\frac{3}{4}$$

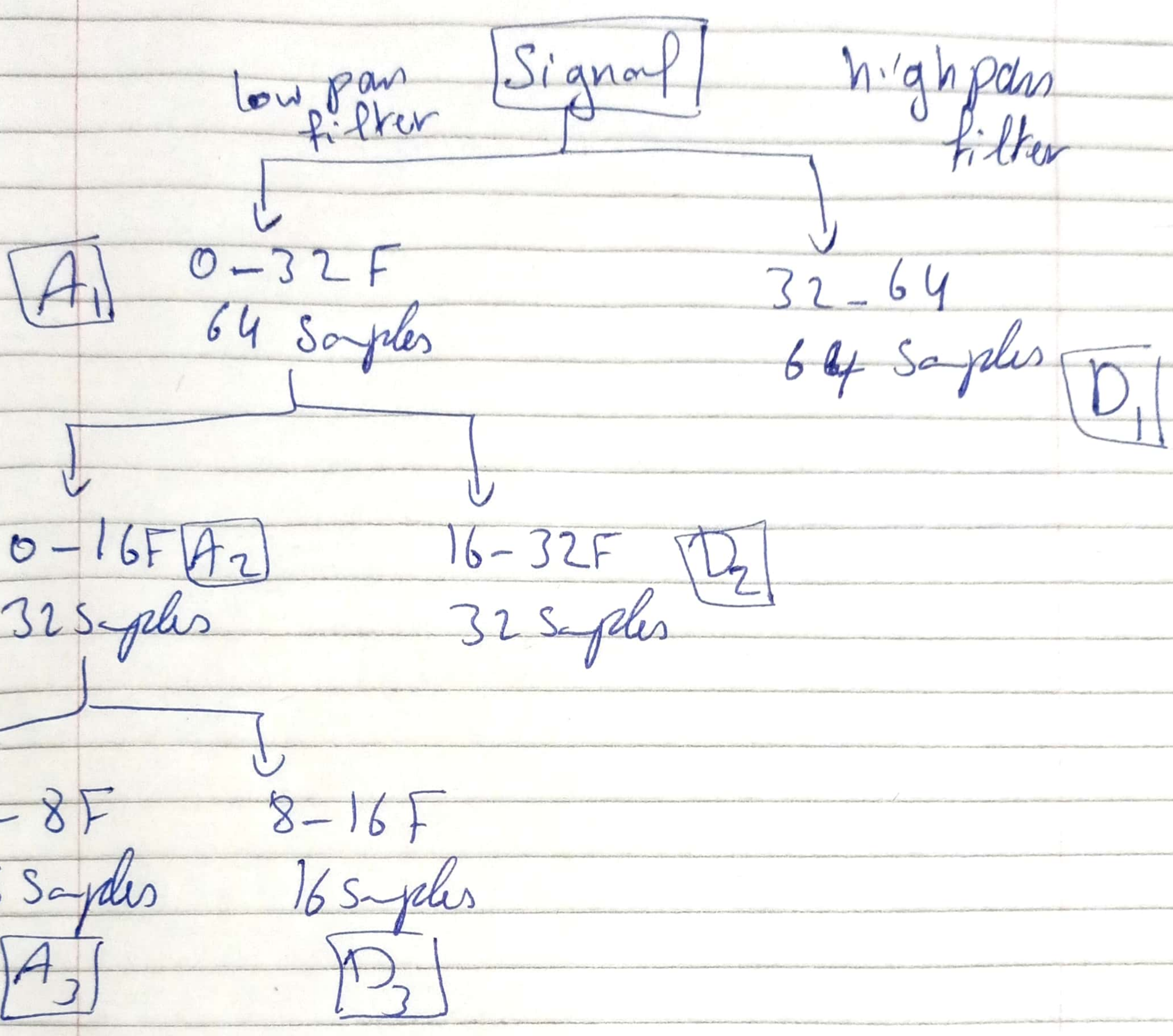
$$X(3) = \frac{1}{4}\left\{1 + 2e^{J\frac{6\pi}{4}} + 0 + 2e^{J\frac{18\pi}{4}}\right\}$$

$$= \frac{1}{4}\left\{1 - 2J + 2J\right\} = \frac{1}{4}$$

$$r_{11}(J) = \left\{\frac{5}{16}, \frac{1}{16}, -\frac{3}{16}, \frac{1}{16}\right\}$$

$\boxed{14}$ $F_s = 128$ $\qquad F_{max} = 64$

$\underline{\underline{1 \text{ sec}}}$



Only D_2 and D_3 are necessary

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