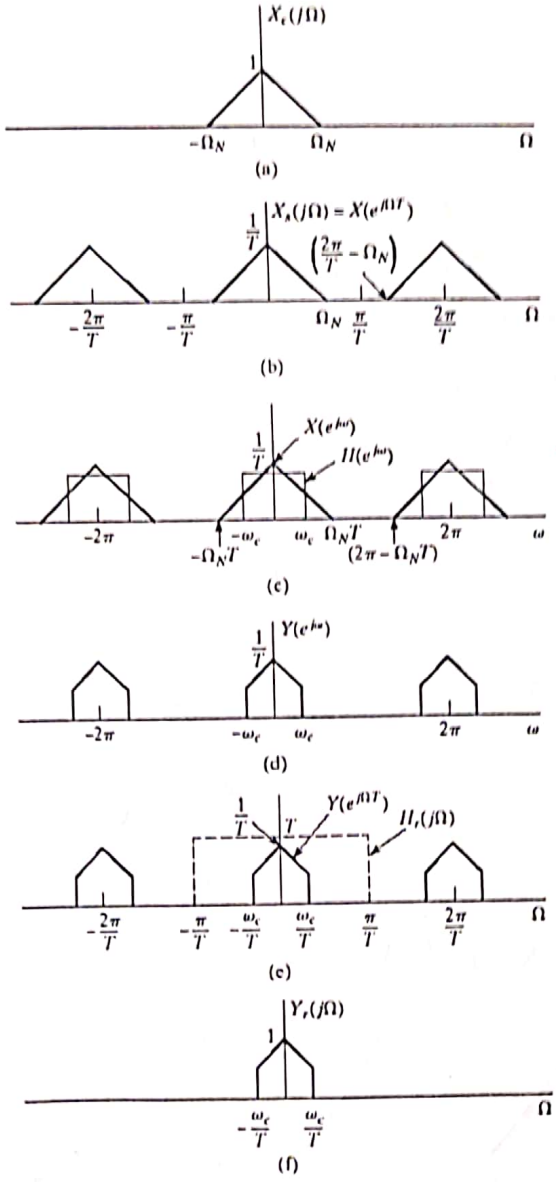
Quiz-2 (CLO1)
BEE-12 (C)
DSP

Name: Solution

Complete the derivations

1. Construct the equations of $Y_r(j\Omega)$ starting from $X_c(j\Omega)$ in the form of equations.



$$X_s(j\Omega) = \frac{1}{T}\sum_{k=-\infty}^{\infty} X_c\left(j\left(\Omega - \frac{2\pi k}{T}\right)\right)$$

$$X(e^{j\omega}) = \frac{1}{T}\sum_{k=-\infty}^{\infty} X_c\left(j\left(\omega/T - 2\pi k/T\right)\right)$$

$$Y(e^{j\omega}) = \frac{1}{T} H(e^{j\omega}) \sum_{k=-\infty}^{\infty} X_c\left(j\left(\frac{\omega}{T} - \frac{2\pi k}{T}\right)\right)$$

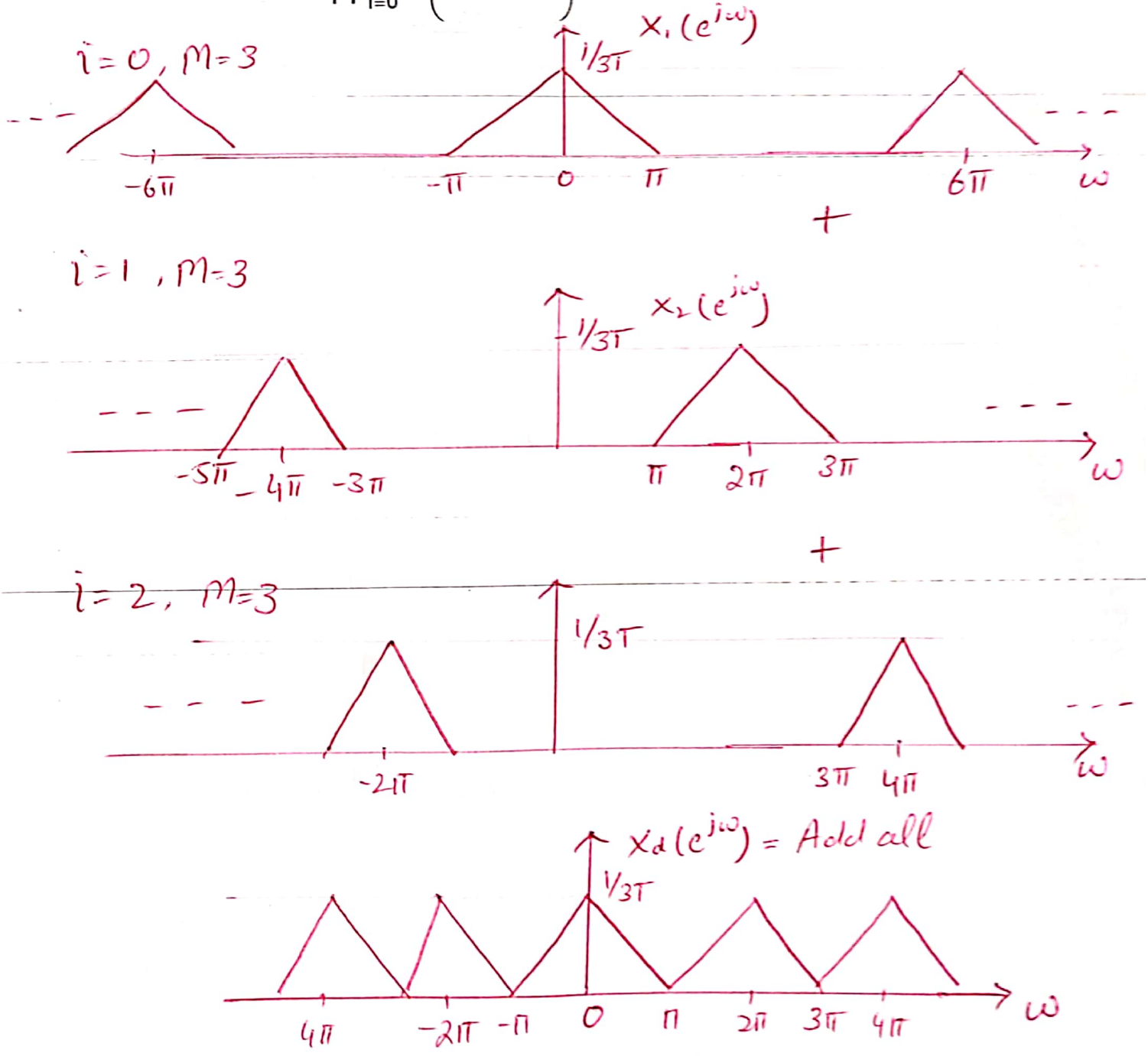
$$Y_r(j\Omega) = Y(e^{j\Omega T})\, H(j\Omega)$$

$$H(j\Omega) = \begin{cases} T & |\Omega| \le \pi/T \\ 0 & \text{else} \end{cases}$$

$$= H(e^{j\Omega T})\, X_c(j\Omega)$$

2. Downsampling: Sketch for M=3 and $\omega_N = \frac{\pi}{3}$, the original bandwidth of signal in radians.

$$X_d(e^{j\omega}) = \frac{1}{M}\sum_{i=0}^{M-1} X\left(e^{j\left(\frac{\omega}{M}-\frac{2\pi i}{M}\right)}\right)$$

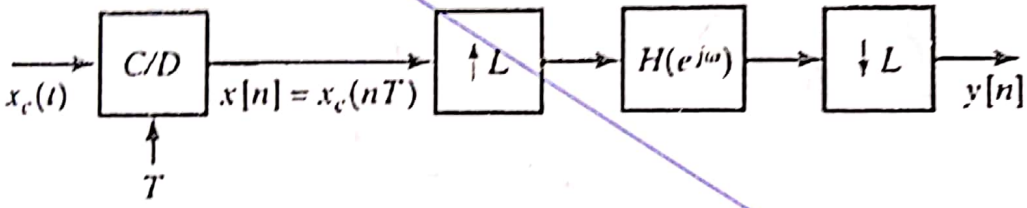


Quiz-2 (CLO1)
BEE-12 (D)
DSP

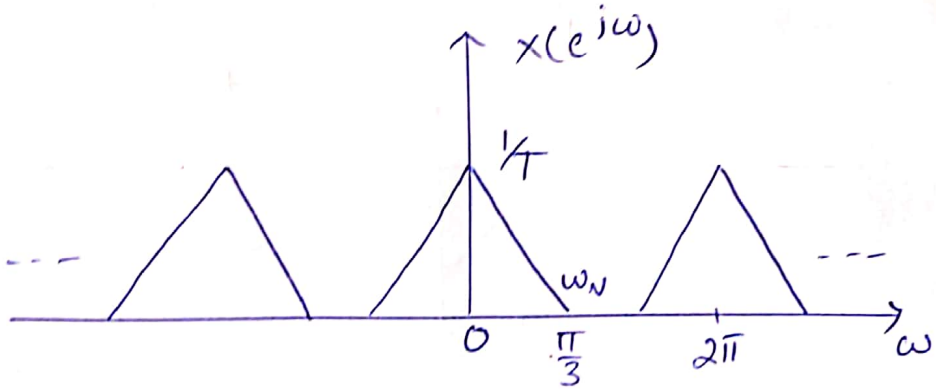
Name: Solution

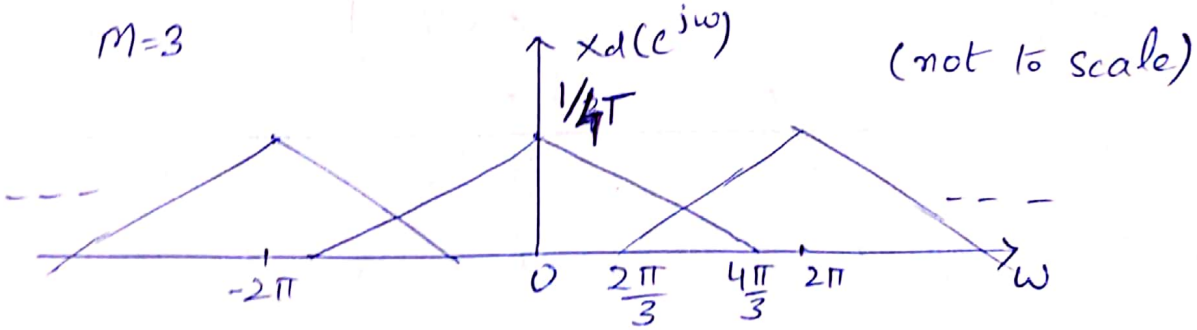
1. Downsampling: Sketch for M=4 and $\omega_H = \frac{\pi}{2}$, the original bandwidth of signal in radians. Label x and y-axis completely. Ignore the anti-aliasing filter in downsampling scheme.

2. Analyze the schematic below



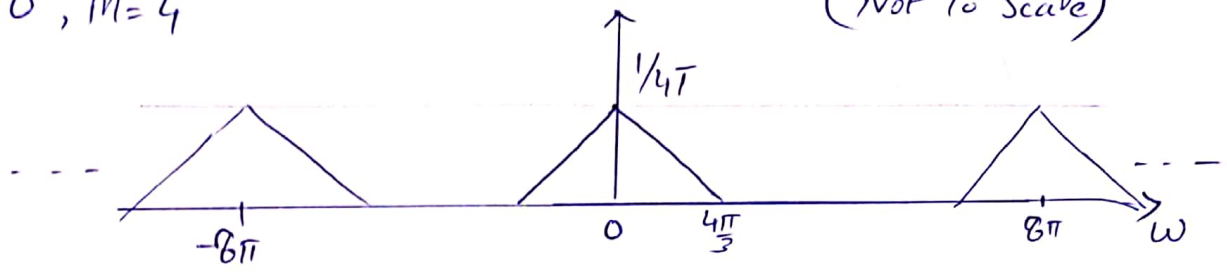
How is $y[n]$ related to $x_c(t)$? Write complete mathematical equations step by step according to the figure. Assume $H(e^{j\omega}) = \begin{cases} e^{-j\omega} & |\omega| < \pi/L \\ 0 & \pi/L < |\omega| \le \pi \end{cases}$ and $x_c(t)$ to be bandlimited with $|\Omega| < \frac{\pi}{T}$. Write only time domain equations.





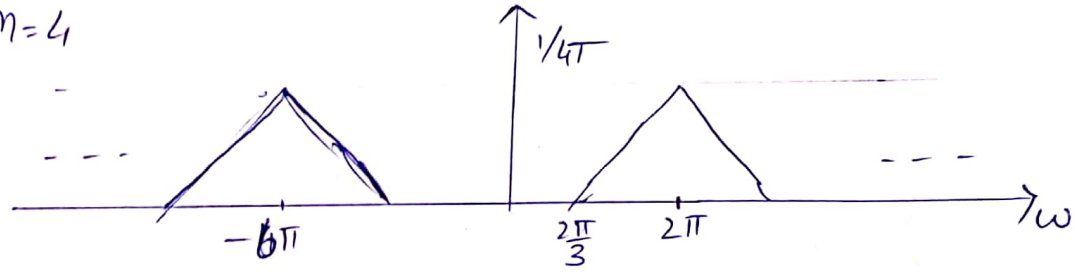
b) $$X_d(e^{j\omega}) = \frac{1}{M}\sum_{i=0}^{M-1} X\left(e^{j(\omega/M - 2\pi i/M)}\right)$$

$i=0$, $M=4$ (Not to Scale)



+

$i=1$, $M=4$



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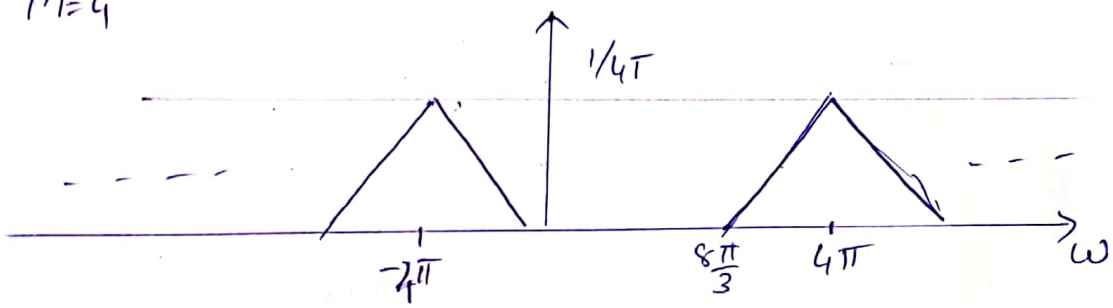
$i=2$, $M=4$



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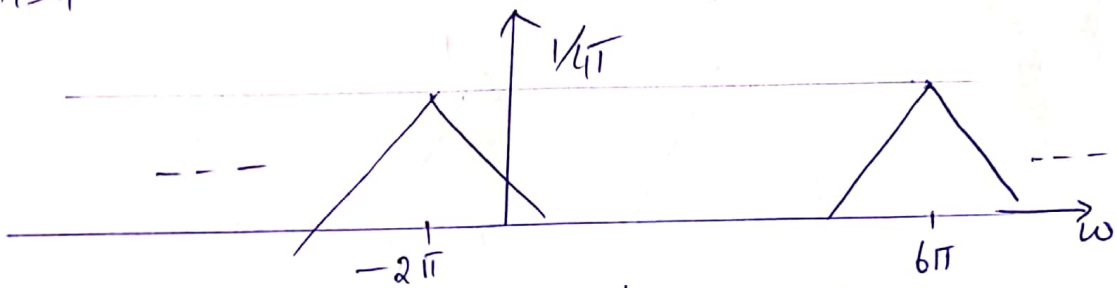
$i=3$, $M=4$



$X_d(e^{j\omega})$ = add all.