Digital Signal Processing - EC5011

Lab. - 01

Prelab Preparation

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Part 01:

$x[n] = \cos(2\pi 100t) + \cos(2\pi 500t) + \cos(2\pi 2000t) + \cos(2\pi 2750t)$

Sampling freguency → 4000 Hz

$f_N = \frac{f_s}{2} = \frac{4000Hz}{2} = 2000Hz$.

* only freguencies above 2000Hz will alias.

$f_a = |f - k.f_s|$ where $f_a \leq f_N$

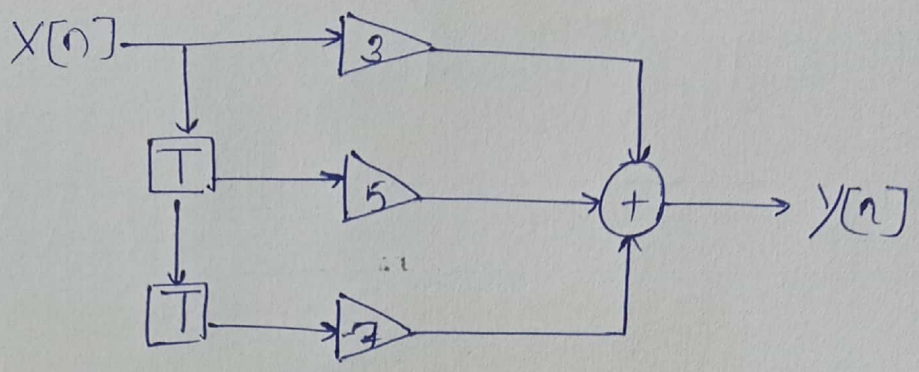
2750 Hz Greater than Nyquist ⇒ will alias.

$f_a = |2750 - 1.4000| = |-1250| = 1250Hz$

So, 2750 Hz alias to 1250 Hz

Part 02:

Q1).



$y[n] = 3x[n] + 5x[n-1] - 2x[n-2]$

$x[n] = \{0, 1, 0, 4, 0, 3, \ldots\}$

$x[n] = 0, \quad n < 0$ (initial condition)

$N=0, \quad y[0] = 3x[0] + 5x[-1] - 2x[-2] = 3$

$N=1, \quad y[1] = 3x[1] + 5x[0] - 2x[-1] = 5$

$N=2, \quad y[2] = 3x[2] + 5x[1] - 2x[0] = 10$

$N=3, \quad y[3] = 3x[3] + 5x[2] - 2x[1] = 20$

$N=4, \quad y[4] = 3x[4] + 5x[3] - 2x[2] = 1$

then $y[n] = \{3, 5, 10, 20, 1, \ldots\}$

Q2). For $n \leq 0, \quad x[n] = 1$

$y[0] = 3 \times 1 + 5 \times 1 - 2 \times 1$
$= 6$

$y[1] = 3 \times 0 + 5 \times 1 - 2 \times 1$
$= 3$

$y[2] = 3 \times 4 + 5 \times 0 - 2 \times 1$
$= 10$

$y[3] = 20$

$y[4] = 1$

then $y[n] = \{6, 3, 10, 20, 1, \ldots\}$

CamScanner

for $n \leq 2$, $x[n] = 2$;

$y[0] = 3\times1 + 5\times2 - 2\times2 = 9$

$y[1] = 3\times0 + 5\times1 - 2\times2 = 1$

$y[2] = 10$

$y[3] = 20$

$y[4] = 1$

then $y[n] = \{9, 1, 10, 20, 1, \ldots\}$

Q3.) $h[n] = y[n]$ $x[n] = \delta[n]$

$h[n] = 3.\delta[n] + 5.\delta[n-1] - 2.\delta[n-2]$

$h[0] = 3$, $h[1] = 5$, $h[2] = -2$.

for $n \geq 3$ & $h[n] = 0$

$h[n] = \{3, 5, -2\}$

Q4.) $x[n] = \{1, 0, 4, 0, 3\}$ $h[n] = \{3, 5, -2\}$

$y[n] = x[n] * h[n]$

$= \sum_{k=0}^{2} x[k].h[n-k]$

$y[0] = 1\times3 = 3$

$y[1] = (1\times5) + (0\times3) = 5$

$y[2] = (1\times(-2)) + (0\times5) + (4\times3) = 10$

~~$y[3] = (4\times(-2)) + (3\times$~~

$y[3] = (4\times5) + (0\times(-2)) = 20$

$y[4] = (4\times(-2)) + 3\times3 = 1$

$y[5] = 3\times5 = 15$

$y[6] = 3\times(-2) = -6$

$y[n] = \{3, 5, 10, 20, 1, 15, -6\}$

05).

```
function y = convolve(x,h)
    N = length(x)
    M = length(h)
    total_length = M+M-1
    y = zeros(total_length)
    for n=0 to total_length-1
        Sum = 0
        for k=0 to M-1
            if (n-k >=0) and (n-k < N)
                Sum += x[n-k] * h[k]
            end if
        end for
        y[n] = Sum.
    end for.
end function
```