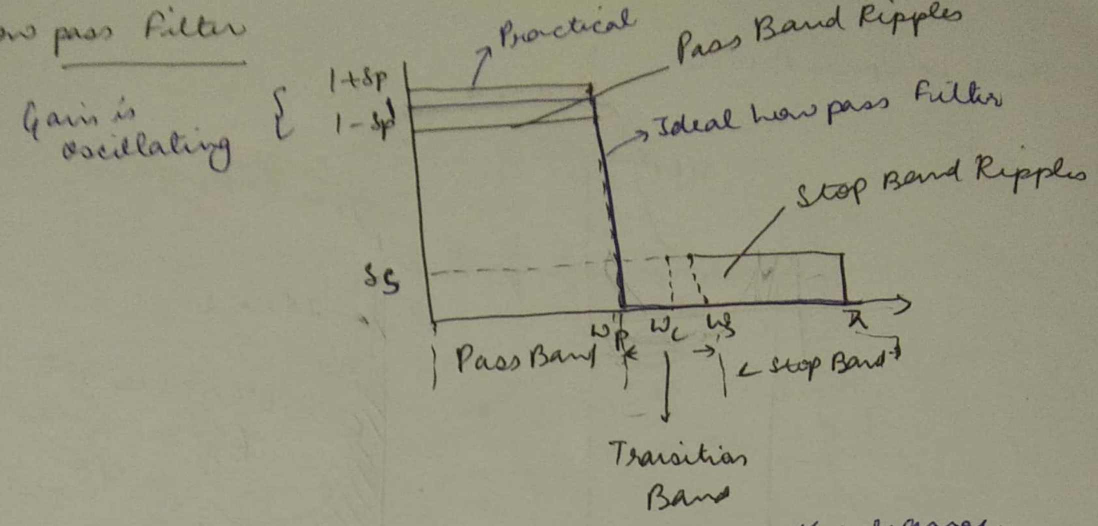
21/11/18

FIR Low pass Filter



If input signal has Frequencies in the range

$w_p \leq w \leq w_s$

then 1. For ideal filter

the signal will pass from w_p to w_c (w_c included)
and will be blocked from w_c to w_s (w_c not included)

uncertainty at w_c due to discontinuity

2. For practical filter

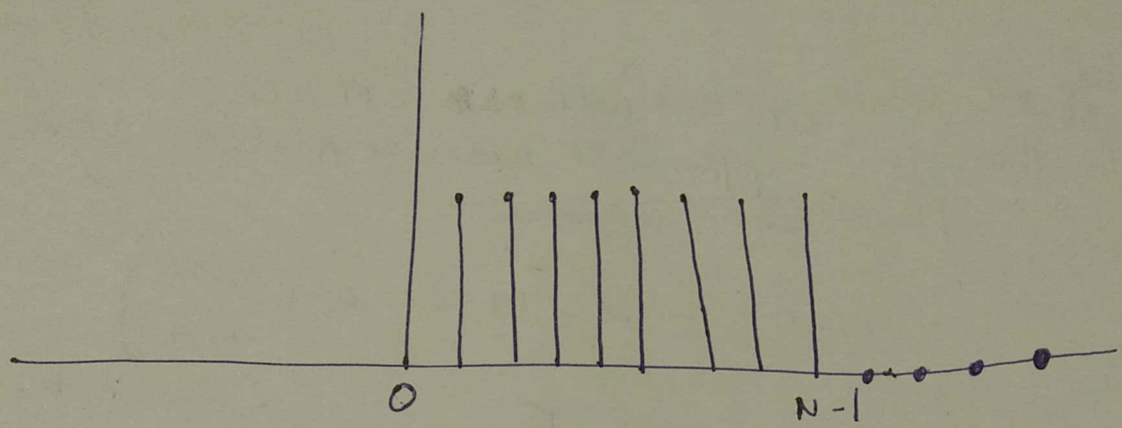
We can not define the value of input signal
For $\{w_p \leq w \leq w_s\}$ range

Now we want $\delta p \to 0$, $\delta s \to 0$
and $[w_p, w_s]$ to be just a single point.
or w_p, w_s as close as possible

If we increase the length / order of the systems,
then the amplitude of oscillations due to δp will decrease
For large N, $\delta p \neq 0$ except δp at discontinuity
Even if we make $\delta p = 0$, $\delta s = 0$ there will be oscillation at discontinuity

But as $N \to \infty$ the transition region will be reduced to W_c

Fourier transform ~~would~~ is not ~~be~~ able to define the system at discontinuity. This is the limitation of Fourier Transform



Two conditions → Decrease Ripple at cost of Transition period

(Keeping N constant)

Decreasing Transition period with increasing ripples

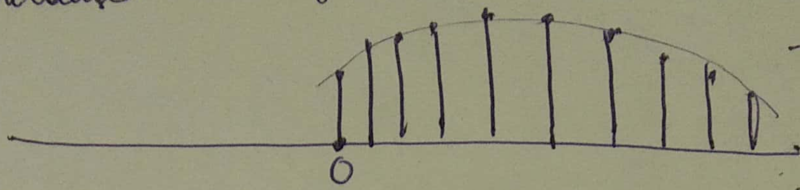
Two Possibilities → Fixed window

→ Variable (adjustable) window

These two conditions belong to this

Hamming

Generalised Hamming window



→ Smooth Function

→ no discontinuity

→ Sinc function

If we multiply this with our LPFilter then the ripples will reduce and transition period will increase

$$w(n) = \alpha - (1-\alpha)\cos\left(\frac{2\pi n}{N+1}\right)$$

$$= 0 \qquad n > N$$

When we say design a Filter for $w_c = 4KHz$ we should take $w_p = 4KHz$ not $w_c = 4KHz$