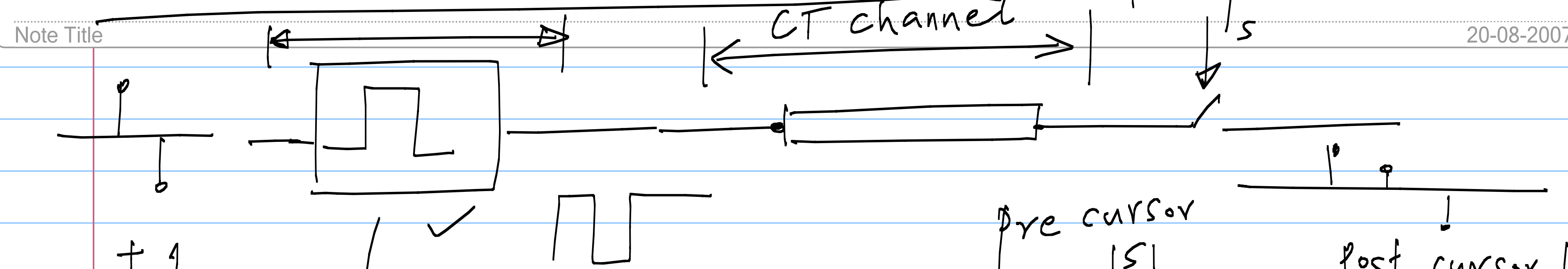
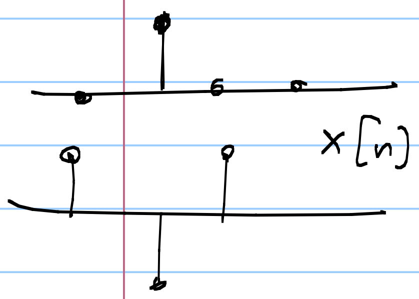
Data transmission over a channel

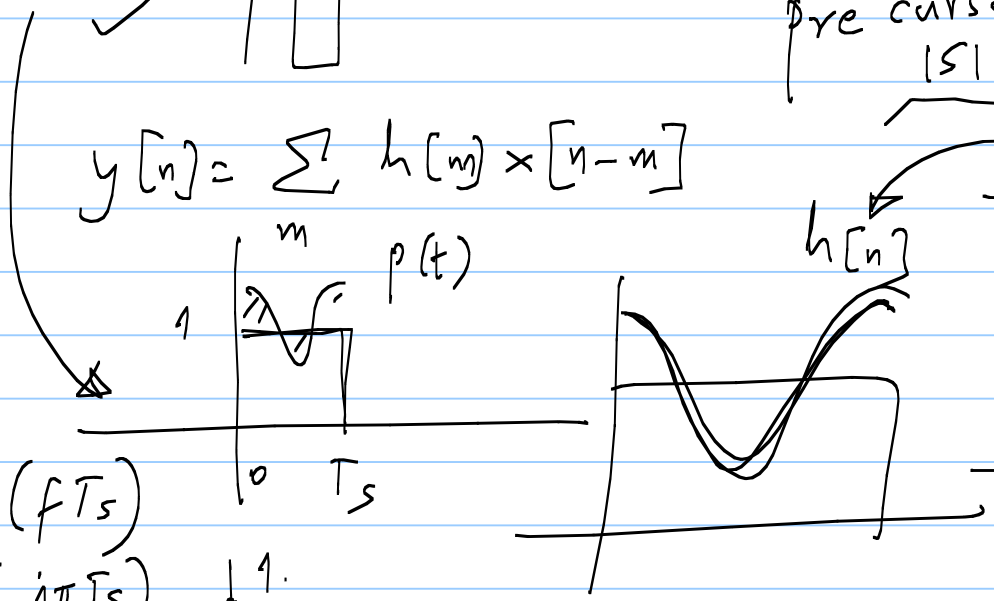
Note Title — 20-08-2007

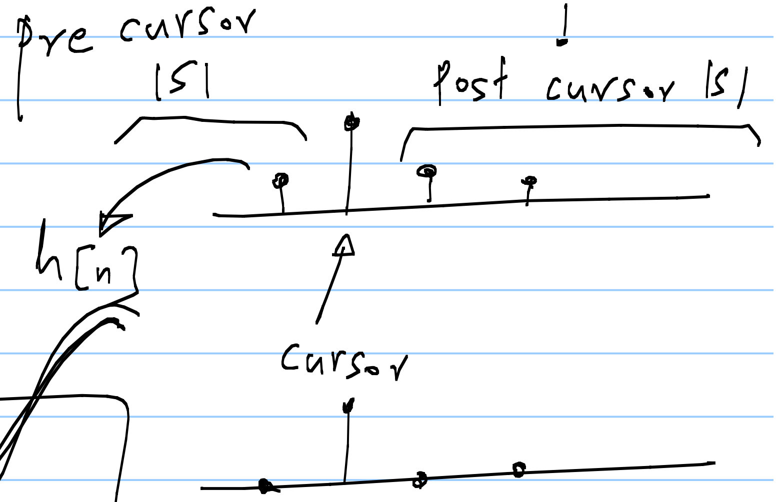


± 1

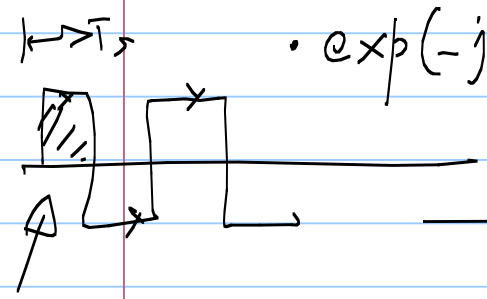


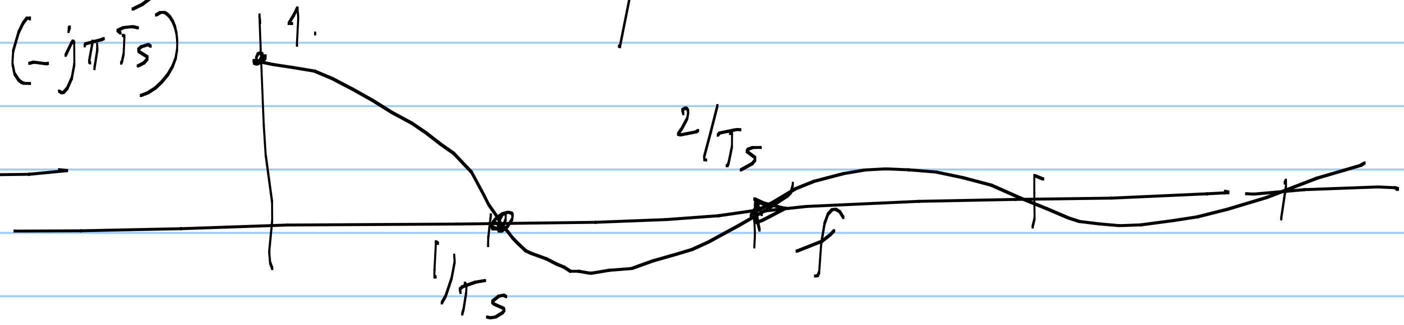
$$y[n] = \sum_m h[m]\, x[n-m]$$



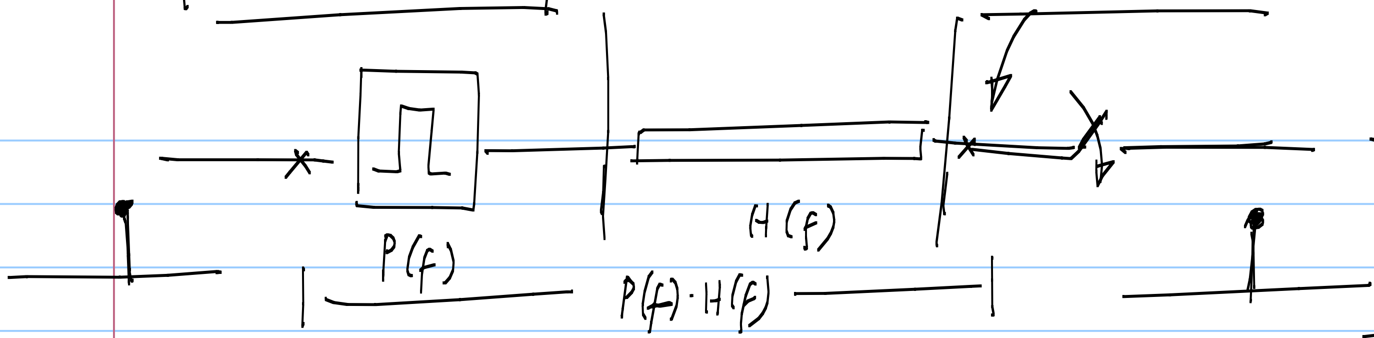


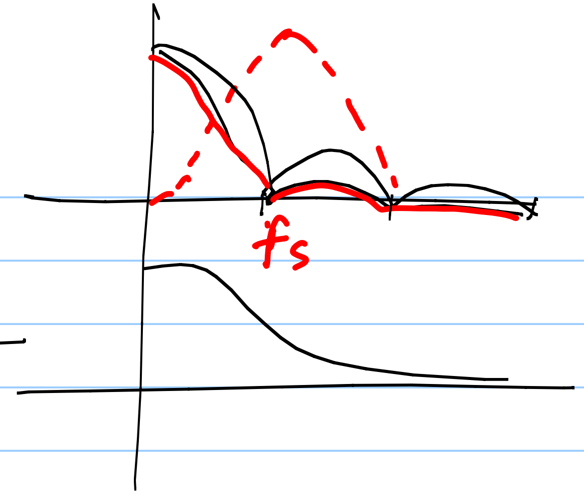
$$P(f) = T_s \operatorname{sinc}(f T_s) \cdot \exp(-j\pi T_s)$$



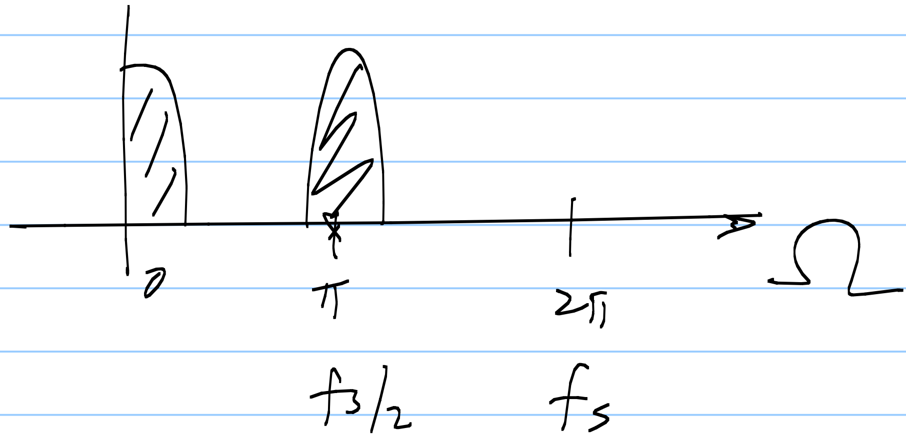


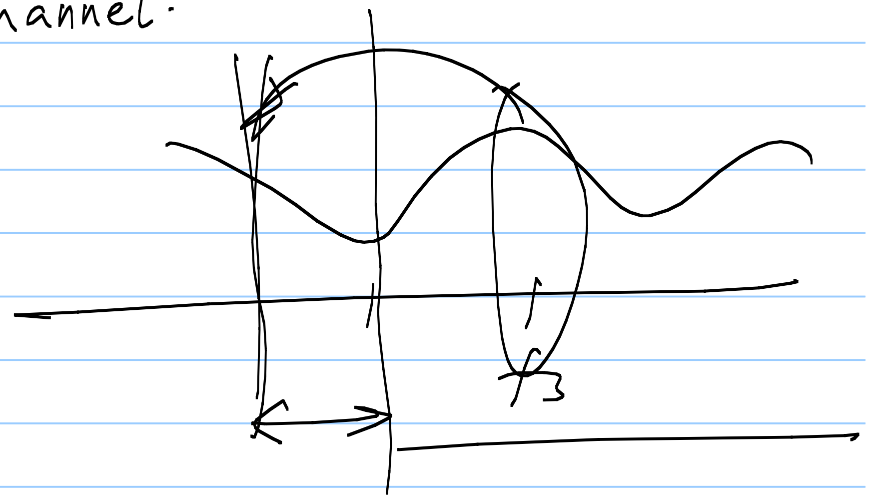
$P(f)$: T_x response

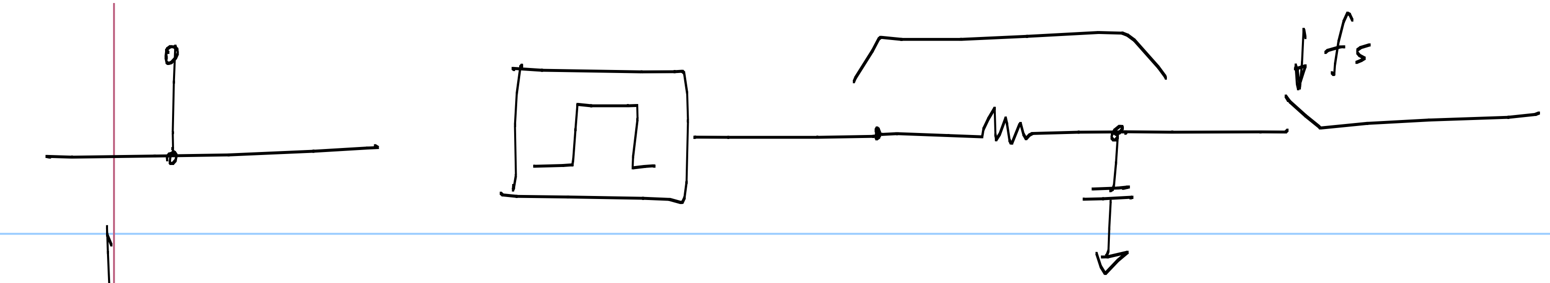


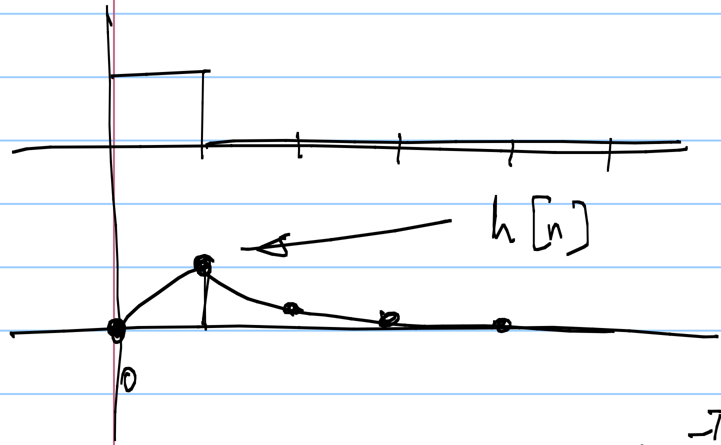


* Transmit response : ~~H(f)~~ $P(f)$
* channel response : $H(f)$
* Overall discrete time response : Aliased $P(f) \cdot H(f)$
  - Constant for an ideal channel.









$n \le 0$: 0

$n = 1$: $1 - e^{-T_s/RC}$

$n > 1$: $\left(1 - e^{-T_s/RC}\right) \cdot \underbrace{e^{-(n-1)\,T_s/RC}}$

$$\overline{\left(1 - e^{-T_s/RC}\right) e^{-(n-1) \cdot T_s/RC}}$$

n	
1	$1 - e^{-T_s/RC}$
2	$e^{-T_s/RC} - e^{-2T_s/RC}$
3	$e^{-2T_s/RC} - e^{-3T_s/RC}$
	⋮

$e^{-T_s/RC} = 0.1$

0.9

0.09 *

0.009 *

0.0009

$T_s = RC \ln(10)$

$$f_{BW} = \frac{1}{2\pi RC} = \frac{\ln(10)}{2\pi} \cdot f_s$$

$$\simeq f_s / 3$$

n	$e^{-T_s/RC} = 0.1$	$e^{-T_s/RC} = 0.25$	$e^{-T_s/RC} = 0.5$
1	0.9	0.75	0.5
2	0.09	0.1875	0.25
3	0.009	0.05	0.125
4	0.0009		

BW $\downarrow$

* cursor amplitude reduces

* ISI increases

$h[n]$, cursor: $h[0]$

$h[n] = 1 \quad n = 0$

$\quad\;\; 0 \quad n \neq 0$

± 1 sequence input

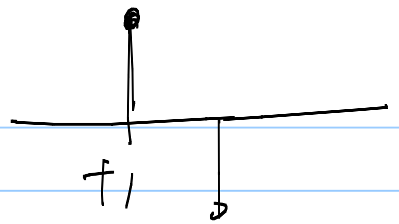
$h[0]\,x[0] + h[1]\,x[-1] + \ldots$

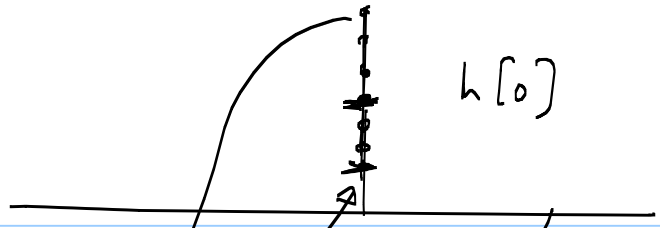
$1 \qquad + h[-1]\,x[1] + \ldots$

$h[n] * x[n]$

$$\sum_{n=\infty}^{\infty} |h[n]|$$

$$\left[h[0] - \sum_{\substack{n=-\infty \\ n \neq 0}}^{\infty} |h[n]| \right]$$





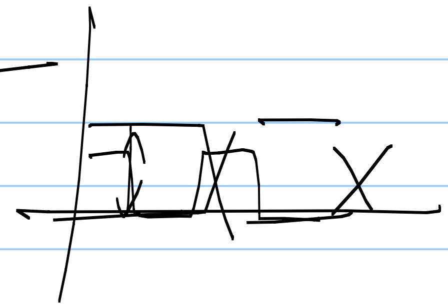
$h[0]$

$h[n]$

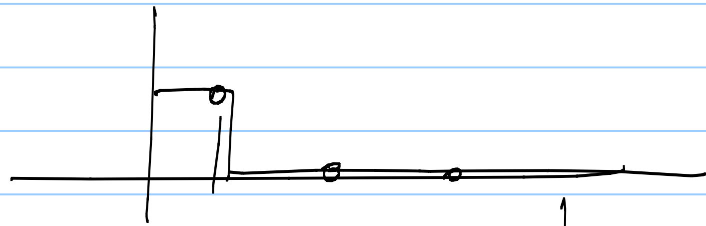
$h[0] - \sum_{n \neq 0} |h[n]|$

$h[0] + \sum_{n \neq 0} |h[n]|$

$h[0] > 0$



$BW \downarrow \Rightarrow h[0] \downarrow$ & $|h[n]| \uparrow$
$n \neq 0$



$H(f) = 1$