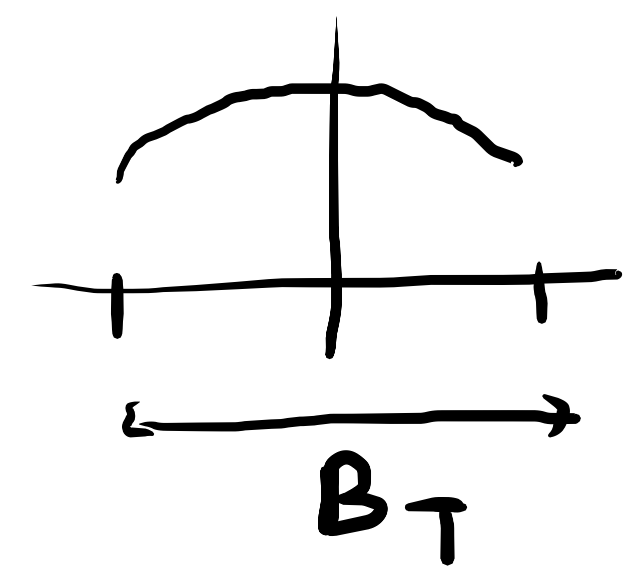
Lec-27, DC, 24-25, Sec A

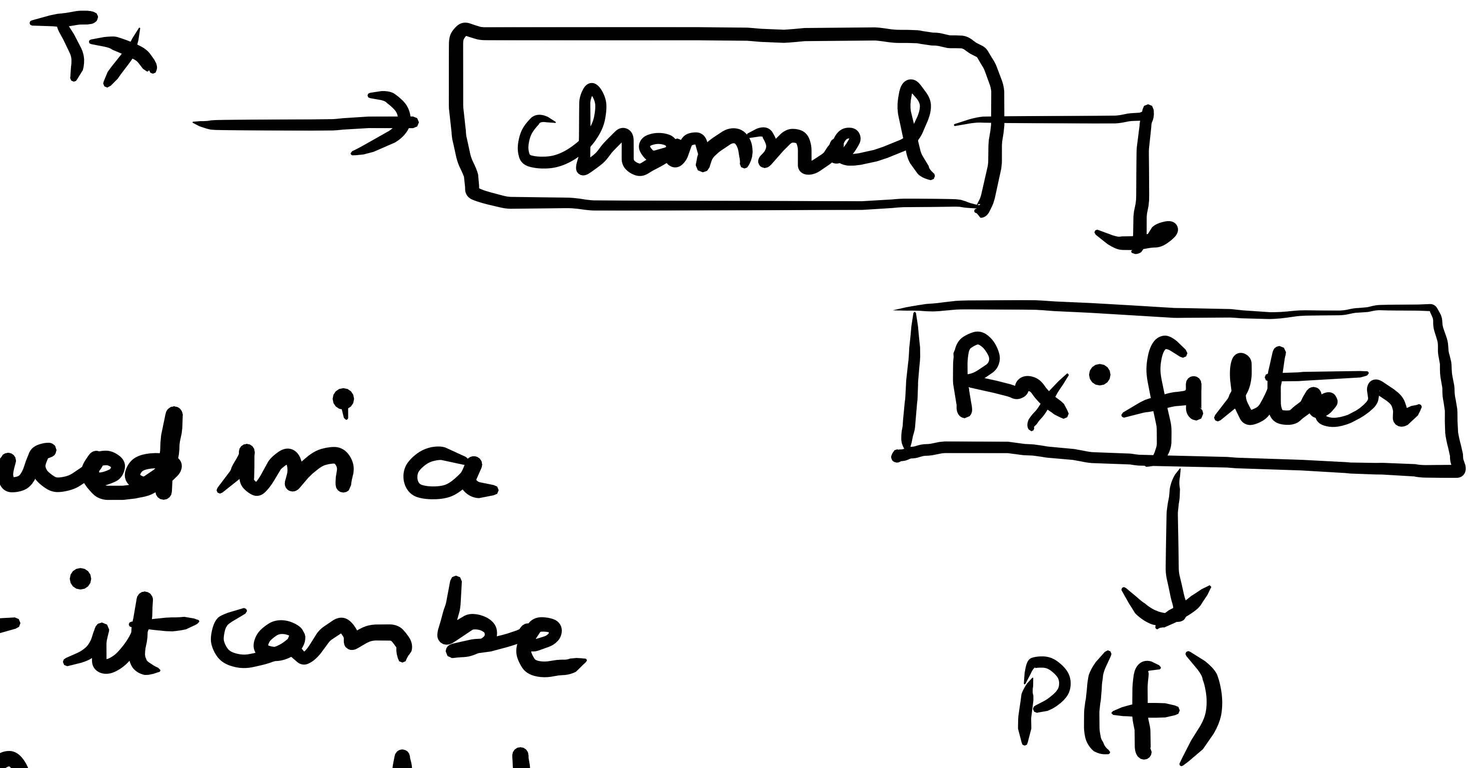
Note:- Pulses received at the detector input (at Rx) should have the form of zero ISI. Because channel is not ideal (distortionless), the txd. pulses should be shaped so that after passing through the channel with T.F. $H_c(f)$, they will be received with the proper shape (such as RC pulse) at the Rx.



Hence, the Txd. pulses $p_i(t)$ should satisfy

$$P_i(f)\, H_c(f) = P(f).$$

T.F. $H_c(f)$ may also include a rx filter designed to reject interference & other out of band noises.



Nyquist Second criterion:-

Some ISI is introduced in a controlled manner so that it can be cancelled out at the Rx & the data can be recovered without error if no noise is present.

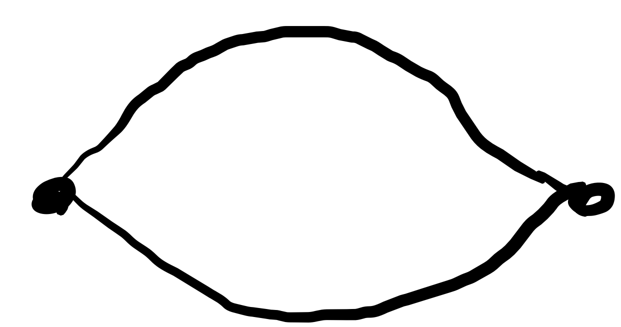
Nyquist third criterion:- choose a pulse s.t. area within the desired symbol interval T_s is not zero, but the area under adjacent symbol intervals is zero.

Such pulses exist but their performance under noise is not good.

<u>Eye diagram</u>:-

"synchronized superposition of all possible realizations of the signal of interest (e.g., rxd. sig. at rx. output) viewed within a particular signalling interval.

→ On the vertical plate of an



oscilloscope, we connect the rx. response to a random pulse seq.

→ On the horizontal time base, we connect a sawtooth wave at the signalling freq. i.e., horizontal time base of the oscilloscope is set equal to the symbol (pulse) duration.

→ This setup superimposes the waveform in each signalling interval into a family of traces in a single interval $(0, T)$.

For a binary pulse based system, the eye diagram for diff. cases is shown in fig 7.25 on pg. 367 B.P. Lathi

$0 \rightarrow L_1$

$1 \rightarrow L_2$

For M-ary system. eye diag. is given in fig. 4.34 — Simon Haykin's Comm. Sys. T.B.

0 — L_1 00 — L_1
1 — L_2 01 — L_2
10 — L_3
11 — L_4

$\left.\begin{matrix}00 - L_1\\01 - L_2\\10 - L_3\\11 - L_4\end{matrix}\right\}$ $M=4$ levels in a linear mod. sys.

↳ Such a system has $(M-1)$ eye openings.

→ See & study all the definitions related to eye dia. from B.P. Lathi's T.B.

Signal Space :- Let $s(t)$ be a full duration (T sec) real-valued energy signal

i.e., $\int_0^T s^2(t)\,dt < \infty$ — we are interested in geometric representation of signals. Set of M energy signals as linear Combination of N orthonormal basisfunctions, where $N \leq M$. i.e., $s_i(t)$ $i = 1, 2, \ldots, M$

$$s_i(t) = \sum_{j=1}^{N} s_{ij}\,\phi_j(t), \quad \begin{cases} 0 \leq t \leq T \\ i = 1, 2, \ldots, M. \end{cases}$$

$$s_i(t) \equiv \{s_{i1}, s_{i2}, \ldots s_{iN}\}$$

where $$s_{ij} = \int_0^T s_i(t)\,\phi_j(t)\,dt \quad \begin{cases} i = 1, 2, \ldots, M \\ j = 1, 2, \ldots, N \end{cases}$$

$\{\phi_j(t)s\}$ are orthonormal

$$\int_0^T \phi_i(t)\,\phi_j(t)\,dt = \delta_{ij} = \begin{cases} 1, & i = j \\ 0, & i \neq j \end{cases}$$