Lec-23, DC, 24-25, Sec A

$$Y(f) = G(f)\, e^{-j2\pi f t_d} + k\left[G(f)\cos(2\pi f T)\right] e^{-j2\pi f t_d}$$

$\because$ $G(f)\, \Pi(f/2B) = G(f)$ since $g(t)$ is BL to B Hz

$G(f)$ exists from $-B$ ~~to~~ B.

$$y(t) = g(t-t_d) + k\ \mathrm{IFT}\left[G(f)\cos(2\pi f T)\, e^{-j2\pi f t_d}\right]$$

$$\cos(2\pi f T) = \frac{e^{j2\pi f T} + e^{-j2\pi f T}}{2},$$

$$G(f)\cos(2\pi f T)\, e^{-j2\pi f t_d} = \frac{G(f)}{2}\left[e^{j2\pi f(T-t_d)} + e^{-j2\pi f(T+t_d)}\right]$$

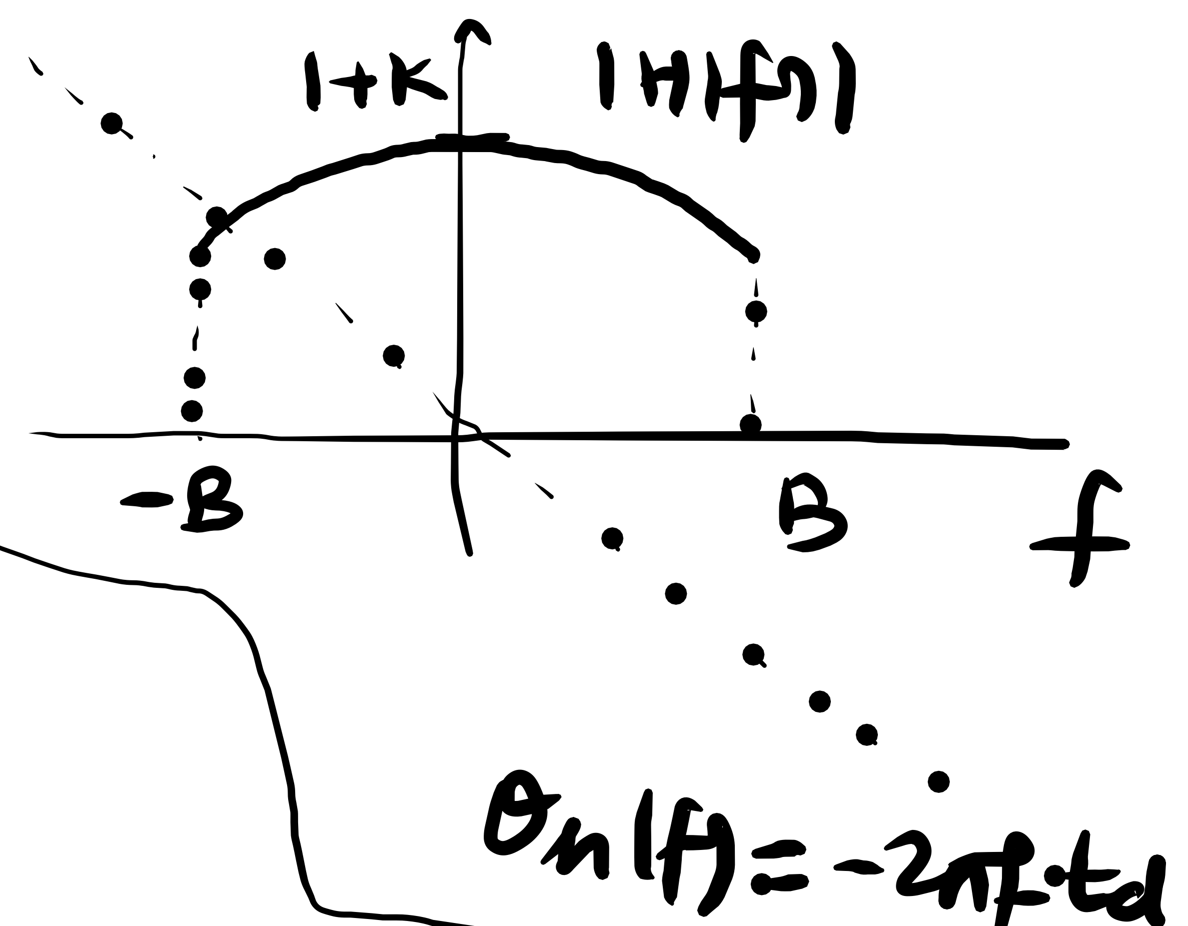
$$\mathrm{IFT} \rightarrow \frac{1}{2}\left[g(t-t_d-T) + g(t-t_d+T)\right]$$

$$y(t) \longrightarrow g(t-t_d) + \frac{k}{2}\left[g(t-t_d-T) + g(t-t_d+T)\right]$$

So, the o/p is actually

$$y'(t) = g(t) + \frac{k}{2}\left[g(t-T) + g(t+T)\right]$$ delayed by t_d

Basically, $y(t)$ consists of $g(t)$ & its echoes shifted by $\pm t_d$. (?) H.W. – (9m-Sem-2)



Prob. 3.6-1 channel has ideal amplitude & non ideal phase response, given by

$$|H(f)| = 1$$

$$\theta_h(f) = -2\pi f t_0 - k \sin 2\pi f T, \quad k \ll 1$$

show that for a BL input pulse $g(t)$ (to B Hz) is $y(t) = g(t-t_0) + \frac{k}{2}\left[g(t-t_0-T) - g(t-t_0+T)\right]$

Hint :- use $e^{-jk\sin 2\pi fT} \approx 1 - jk\sin(2\pi fT)$

→ H.W.

--- x --- x --- x --- x ---

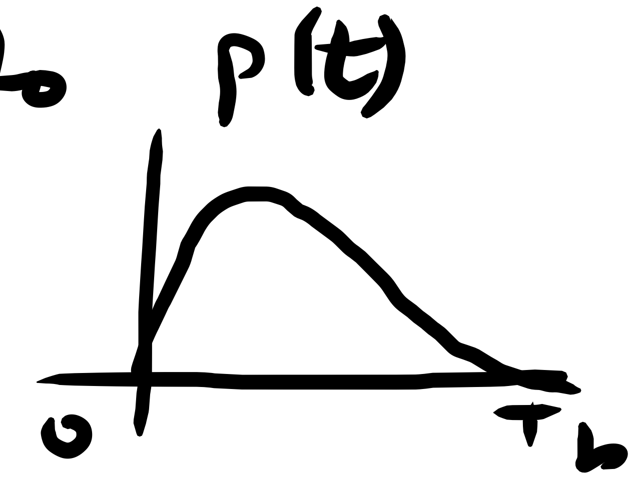
151- Let's go back to line codes. (waveforms corr. to bit seq.)

Can I write a line code as

$$\sum_{k=-\infty}^{\infty} a_k\, p(t-kT_b)$$

a_k → level corr. to the bit k

$p(t)$ → pulse — right now assume it to be time limited i.e, $0 \to T_b$

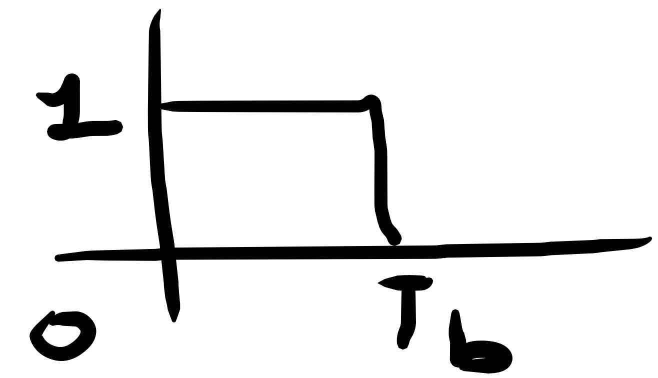


In order to observe it, let's take the case of polar NRZ.

1 → +2

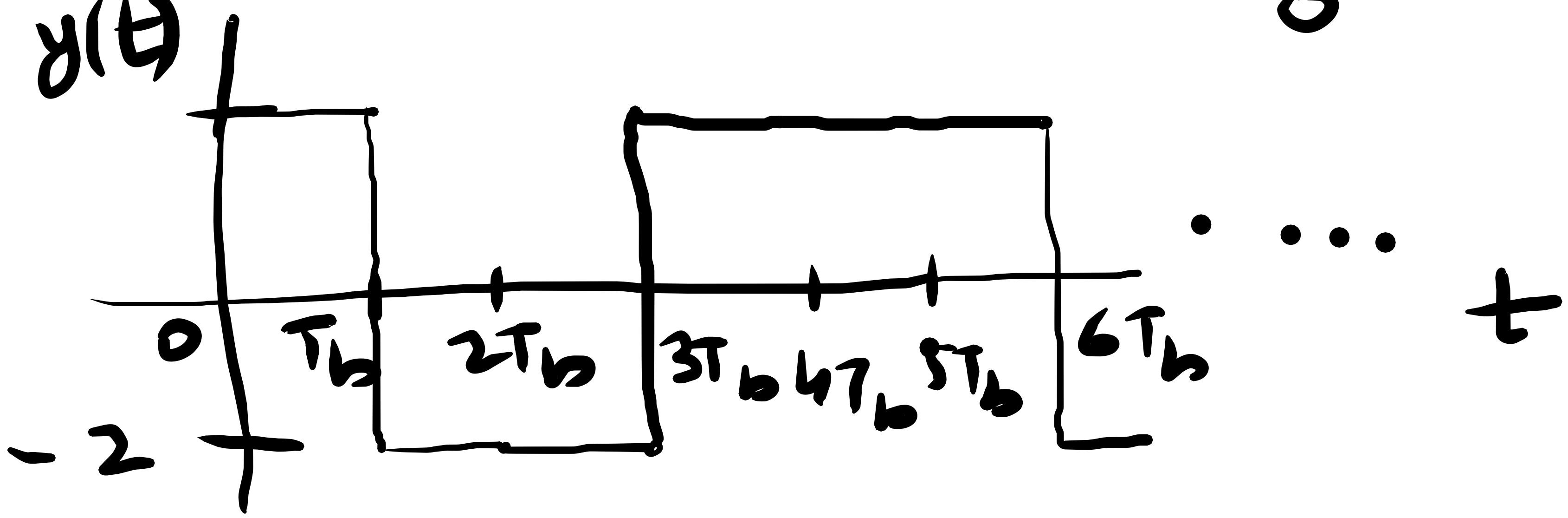
0 → −2

p(t) →



1001110

0123456



$$y(t) = \sum_{k=0}^{6} a_k \, p(t - kT_b)$$

→ such a signal (y(t)) is called linear modulation because y(t) depends on the levels (or bits) linearly.

$$m(t) \xrightarrow{PCM + LC} y(t)$$

↳ bandlimited to B Hz.

Let's say PCM uses n bits then min. B.W. reqd. → nB

Q. How do you find the B.W. or PSD (power Spectral density)?

A. $y(t) < \begin{matrix} a_k - \{\cdots, a_{-2}, a_{-1}, a_0, a_1, a_2 \cdots\} \\ p(t) \end{matrix}$

$\downarrow$

discrete time Stochastic (Random) process.

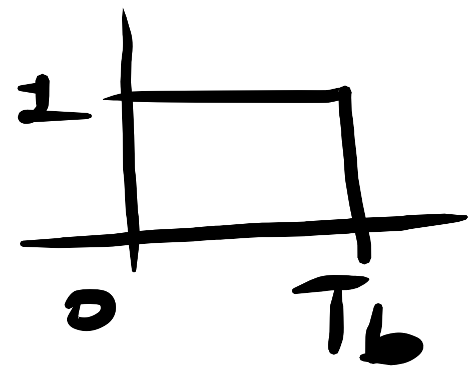
$\downarrow$

You can find the autocorrelation of the seq. & then its PSD, which is Fourier transform of the autocorr. func^n.

$S_y(f) < \begin{matrix} S_a(f) \\ P(f) \end{matrix}$

$$S_y(f) = |P(f)|^2 S_a(f)$$

The above result is stated without proof. Reader can refer to any of the course references for it.

Taking $p(t)$ as 

, $|P(f)| \rightarrow$ |sinc| function which extends from $-\infty$ to ∞ in f domain

Since not much of a control can be exercised with $S_a(f)$, $S_y(f)$ is highly affected by $|P(f)|$

The channels are mostly Band-limited i.e., they pass a set of freq. without attenuation & others with zero or some finite " . This will distort the o/p i.e $y'(t)$ rxd. at the Rx. will be very diff. from $y(t)$ which is Txd.