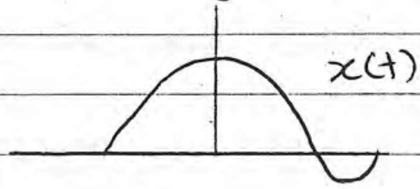
2012 / 9 / 17 التاريخ — الموضوع : المحاضرة الثانية Equilizer

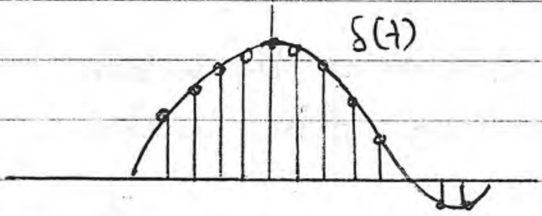
1.7 Pulse Amplitude Modulation (PAM) :-

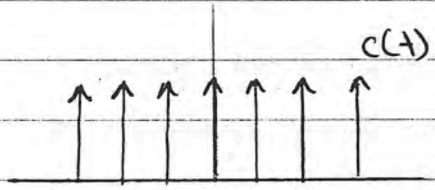
The amplitude of apulse is changed according to the signal

$S(t) = x(t)$, $c(t) = A$

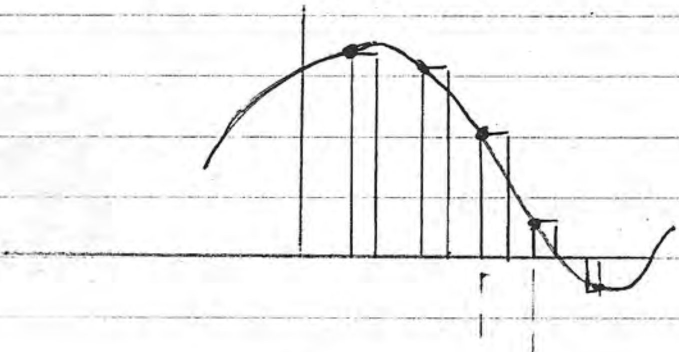
$\delta(t) = 0$, $c(t) = 0$

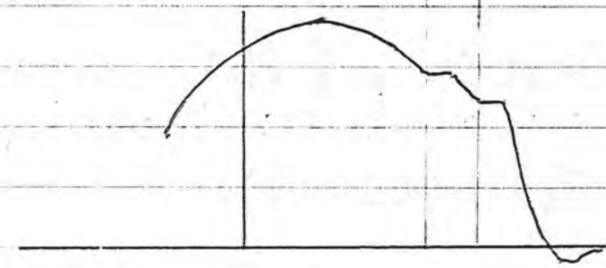






$$x_s(t) = \sum_{K=-\infty}^{\infty} x(KT_s)\,\delta(t-KT_s)$$





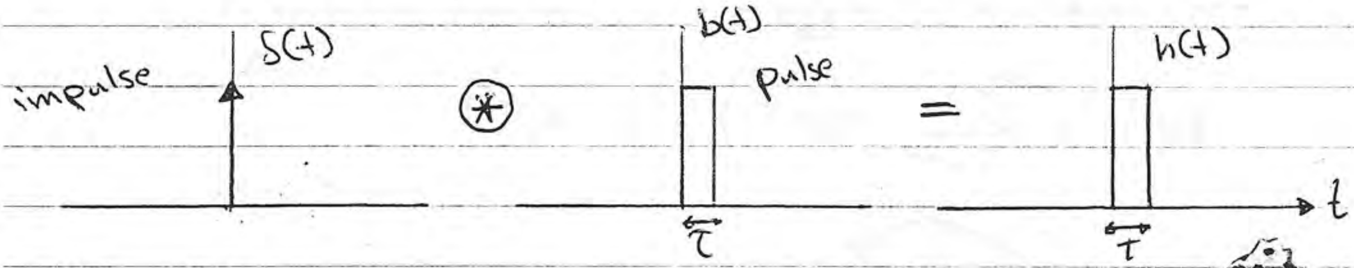
$$X_s(t) = S(t) * x_s(t) \quad \text{----} \quad (1)$$

$$X_s(t) = \sum_{K=-\infty}^{\infty} X(KT_s)\,\delta(t-KT_s)$$

from eq ① we can write the convolution

$$S(t) = x_s(t) \circledast h(t) \quad \text{----} ②$$

The width of the pulse in $S(t)$ is determine by width $h(t)$ and the Sampling instant is determined by delta function.



from ②

$$= \int_{-\infty}^{\infty} x_s(t)\, h(t-u) \cdot dt$$

$$= \int_{-\infty}^{\infty} \sum_{K=-\infty}^{\infty} x(KT_s)\, \delta(u-KT_s)\, \overset{f(t)}{h(t-u)} \cdot du$$

, but $\int_{-\infty}^{\infty} f(t)\, \delta(t-t_0) = f(t_0)$ --- So

$$S(t) = \sum_{K=-\infty}^{\infty} x(KT_s)\, h(t-KT_s)$$

The equation represents value of $S(t)$ in terms of Sampled value and function $h(t-KT_s)$

Looking in to the spectrum :

$$S(f) = X_s(f)\, H(f)$$

$$X_s(f) = f_s \sum_{K=-\infty}^{\infty} x(f-Kf_s)$$

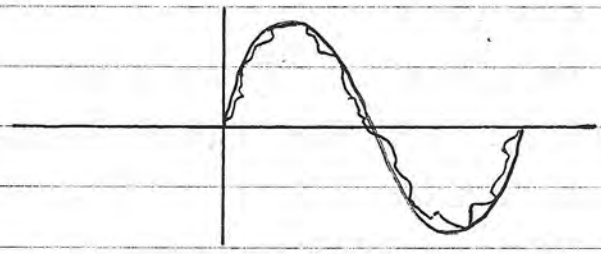
∴ The spectram of the flattop Signal is :

$$\boxed{S(f) = f_s \sum_{K=-\infty}^{\infty} x(f - Kf_s)\, H(f)}$$

Reconstruction of PAM :

· Pass the PAM on L.P.F and the High frequency ripple will be removed

$$\text{PAM Signal} \longrightarrow \boxed{\text{L.P.F}} \longrightarrow \text{demodulated PAM}$$



To reduce the Apreture effect an equilizer is used for Compensation

$$s(t) + \text{noise} \longrightarrow \boxed{\text{L.P.F}} \xrightarrow{x(t)+\text{noise}} \boxed{\text{Equilizar}} \longrightarrow x(t)$$

$$S(f) = f_s \left[\sum_{K=-\infty}^{\infty} x(f - Kf_s)\, H(f) \right]$$

$$= f_s \left[x(f)\, H(f) + f_s \sum_{|K| \geq 1} x(f - Kf_s)\, H(f) \right.$$

$$\boxed{\therefore \text{Equalizer} = \frac{1}{H(f)}}$$

$$S(f) = f_s \sum_{K=-\infty}^{\infty} x(f - Kf_s)\, H(f)$$

frequency of fm

If $H(f) = \tau \, \text{sinc}(f\tau)$

$$H_{eq}(f) = \frac{K}{H(f)} = \frac{K}{\tau \, \text{sinc}(f\tau)}$$

Ex|| A flat top Sampler is sampling asignal which passesa highst frequency of 1KHz at 2.5 HZ. The duration of the pulse is 0.2 sec. Calcalate the Apreture effect which creat distortion in the amplitude of the signals highst frequency? Also find the equalization c/s? $H(f) = \tau \, \text{sinc}(f\tau)$

Sol:- $f_{s'} = 2.5\,HZ$, $f_m = 1\,KHZ$, $\tau = 0.2\,sec$

$H(f) = \tau \, \text{sinc}(f\tau)$ at the highst frequency

$H(f_m) = H(1) = 0.2 \, \text{sinc}(0.2) = ?\ 0.0035$

The equalizer c/s

$$H_{eq}(f) = \frac{K}{\tau \, \text{sinc}(0.2f)} \qquad K = 1$$

$$H_{eq}(f) = \frac{1}{0.2 \, \text{sinc}(0.2f)} = 286.48$$

Advantage :-

1- Good Modulation for TDM

disadvantage :-

1- The modulation is not immune to noise
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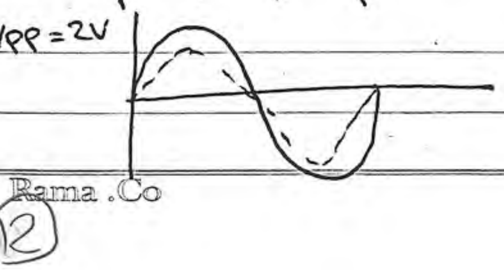
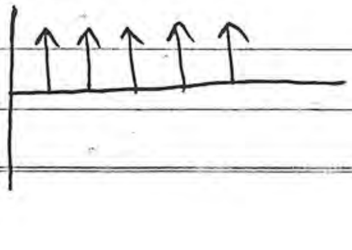
2- Noise is not removed easily because the amplitude is varied

3- High band width $B_T = \frac{1}{2\tau}$, where $\tau = \frac{1}{2W}$

$f_{s'} = 2W$

• Pulse Amplitude modulation





$f_s = n f_m$
$n = 1$
$n = 2$
$n = 3$