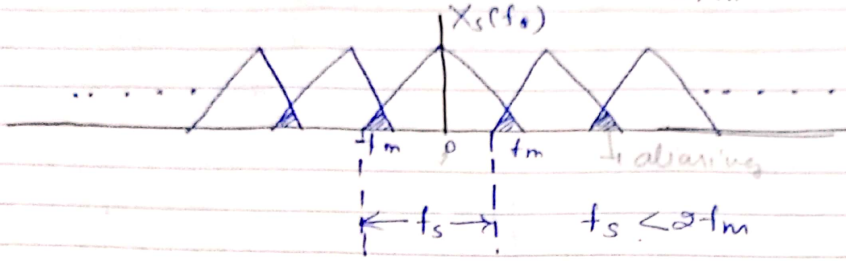
Case (iii) $f_s < 2f_m$ or $T_s > \frac{1}{2f_m}$ (Under Sampling)




it give rise to aliasing so it is least used

→ Minimum possible sampling rate and maximum sampling interval allowed to avoid aliasing are called as Nyquist rate and Nyquist interval respectively.

Nyquist Rate = $2f_m$ Samples/sec

Nyquist interval = $\frac{1}{2f_m}$ sec

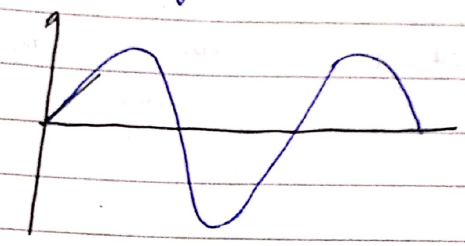
## Pulse amplitude Modulation :→ (PAM)

→ Pulse Amplitude modulation is a pulse Analog modulation scheme in which the amplitude of a train of carrier pulses are varied according to the amplitude variations of message signal

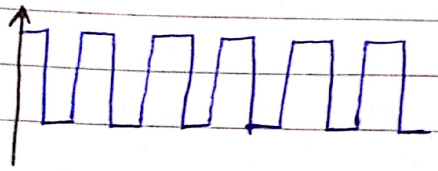
→ In pulse analog modulation pulse by pulse transmission will occured. Each of the pulse to be transmitted corresponds to baseband signal and can be directly transmitted through baseband channel only

## PAM Generation :-

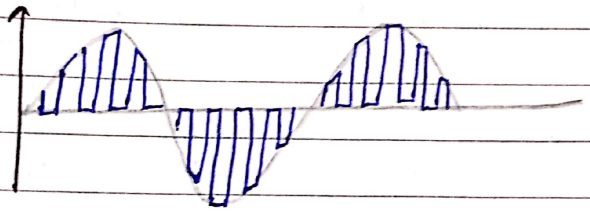
PAM signal can be generated either using natural sampling or using flat-top sampling as shown in fig 1.



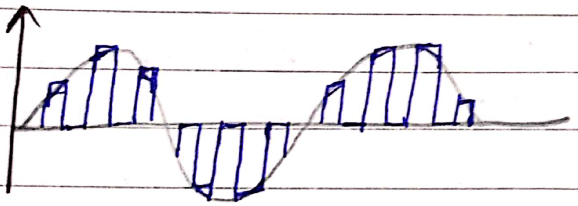
message signal



Sampling pulse train



PAM Signal
(Natural sampling)



PAM Signal
(flat-top sampling)

[Fig. 1]

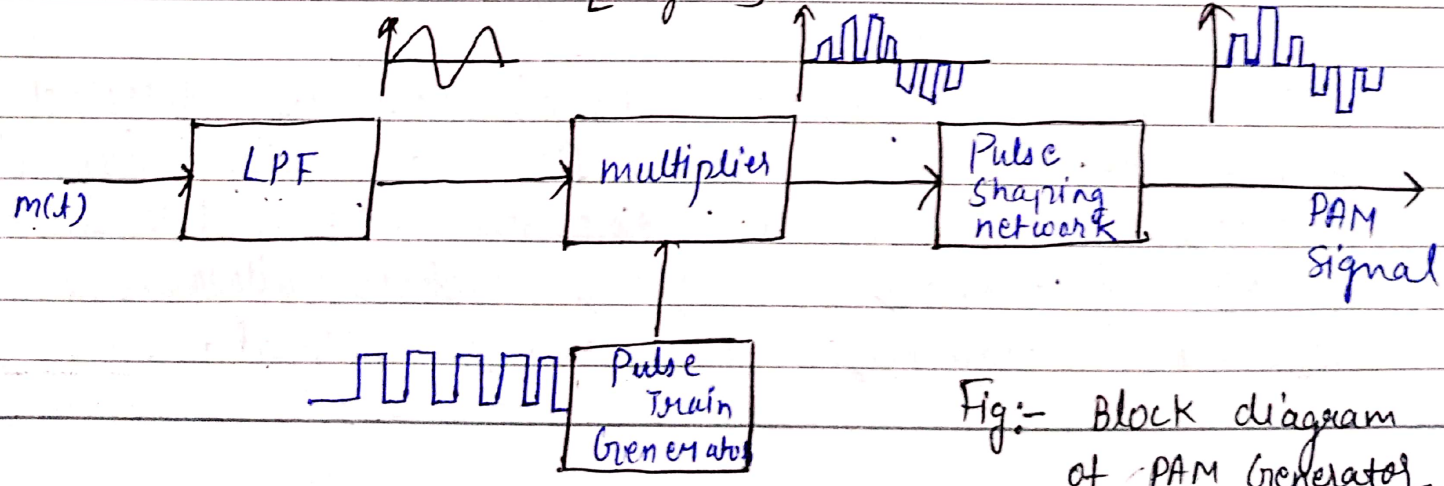



Fig:- Block diagram of PAM Generator

→ Fig 2 shows the block diagram of PAM Generator.
→ It consist of LPF, a multiplier and a pulse generator.
→ Initially the modulating signal m(t) is passed through LPF to band limit the message signal.
→ The band limiting is necessary to avoid aliasing effect in the sampling process.
→ Pulse shaping network does the shaping work to give flat tops.
→ If the generator pulses are narrow, PAM signal require little power for transmision and are suitable for Time Division multiplexing (TDM).
→ Flat topped pulses are easily regenerated by Repeaters and can be used for transmision over long distances.
→ One disadvantages of PAM signals is they are affected by noise as much as analog signals.

## Reconstruction of message signal →

→ The original message signal can be detected from PAM signal by passing PAM signal through a low pass reconstruction filter with cut-off frequency slightly higher than the maximum frequency in message signal.