DATE: __/__/____
PAGE _____

Experiment - 4

Aim :- To study the Delta Modulation.

Software Used :- MATLAB

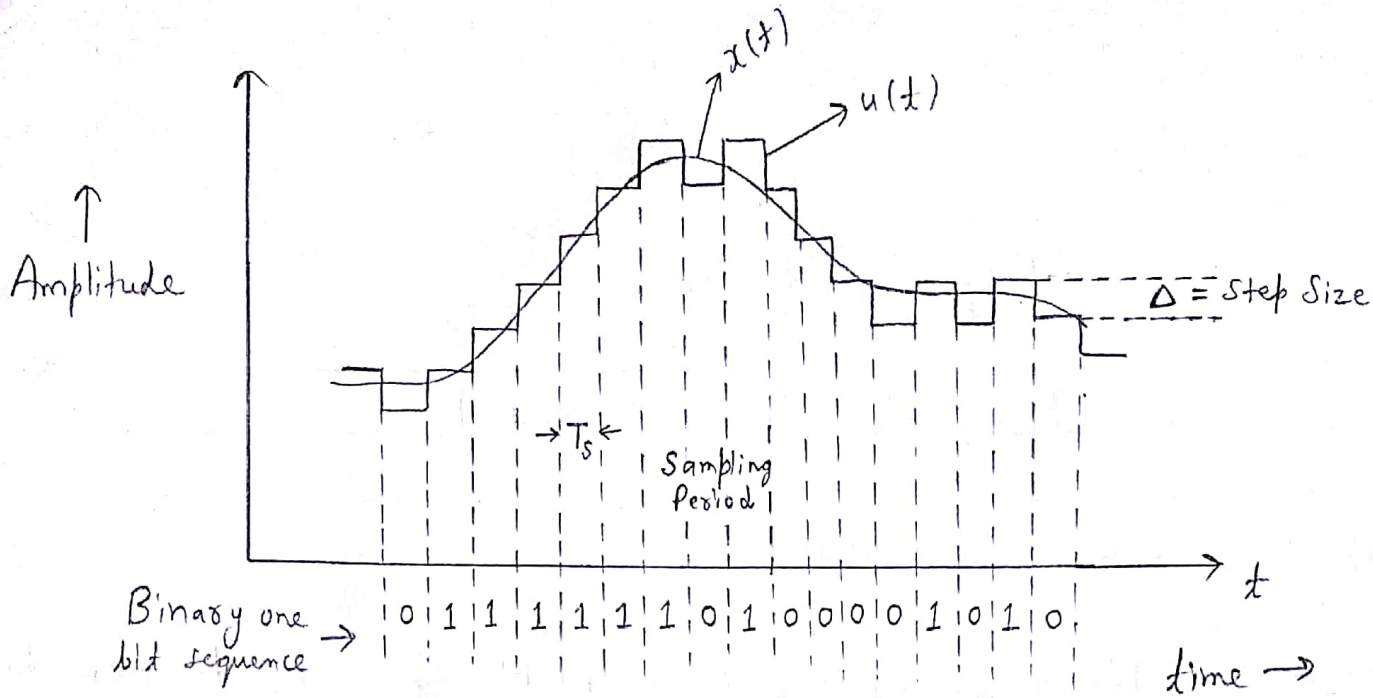
Theory :- We have observed in PCM that it transmits all the bits which are used to code a sample. Hence, signaling rate and transmission channel bandwidth are quite large in PCM. To overcome this problem, Delta Modulation is used.

Working Principle of Delta Modulation :-

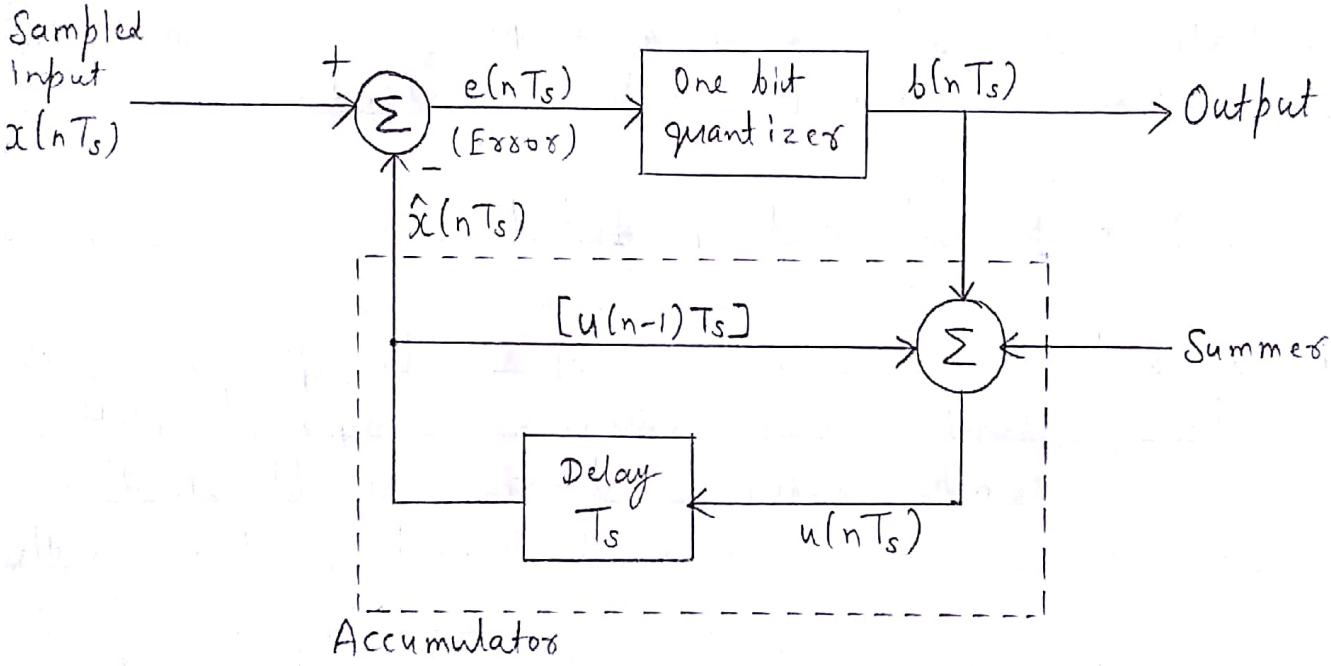
Delta modulation transmits only one bit per sample. Here, the present sample value is compared with the previous sample value and this result whether the amplitude is increased or decreased is transmitted.

Input signal $x(t)$ is approximated to step signal by the delta modulation. This step size is kept fixed. The difference between the input signal $x(t)$ and the staircase approximated signal is confined to two levels, i.e., $+\Delta$ and $-\Delta$. Now, if the difference is positive, then approximated signal is increased by one step, i.e., 'Δ'. If the difference is negative, then approximated signal is reduced by 'Δ'.

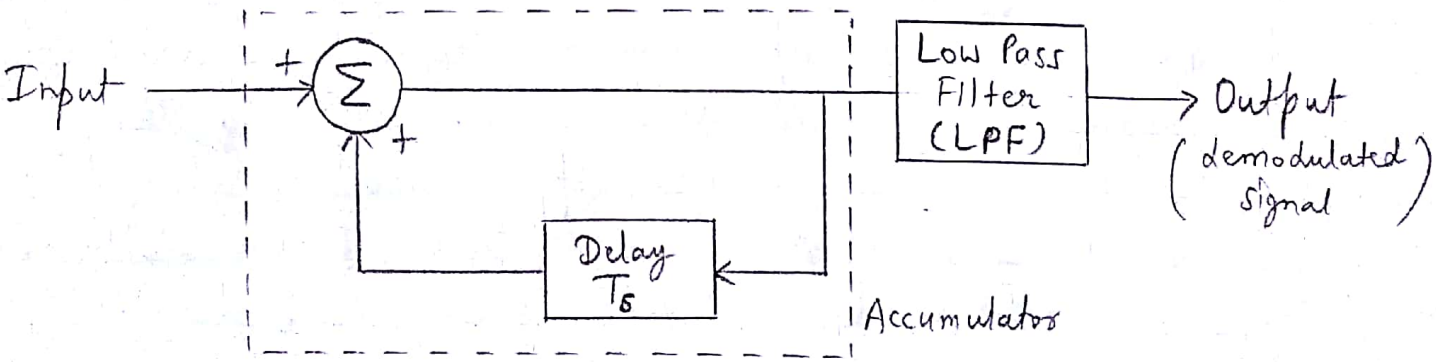
GOOD WRITE



Delta Modulation waveform



A Delta Modulation Transmitter



A Delta Modulation Receiver

DATE: __/__/____
PAGE _____

When the step is reduced, '0' is transmitted and if the step is increased, '1' is transmitted. Hence, for each sample, only one binary bit is transmitted.

Mathematical Expressions :-

The error between the sampled value of $x(t)$ and last approximated sample is given as,

$$e(nT_s) = x(nT_s) - \hat{x}(nT_s)$$

Where $e(nT_s)$ = error at present sample
$x(nT_s)$ = sampled signal of $x(t)$
$\hat{x}(nT_s)$ = last sample approximation of the staircase waveform.

$$b(nT_s) = \Delta \, sgn[e(nT_s)]$$

$$b(nT_s) = \begin{cases} +\Delta & \text{if } x(nT_s) \geq \hat{x}(nT_s) \\ -\Delta & \text{if } x(nT_s) < \hat{x}(nT_s) \end{cases}$$

Also, If $b(nT_s) = +\Delta$ then a binary '1' is transmitted and if $b(nT_s) = -\Delta$ then a binary '0' is transmitted
Here, T_s = Sampling interval.

Conclusion :- Successfully studied and implemented the delta modulation.

GOOD WRITE