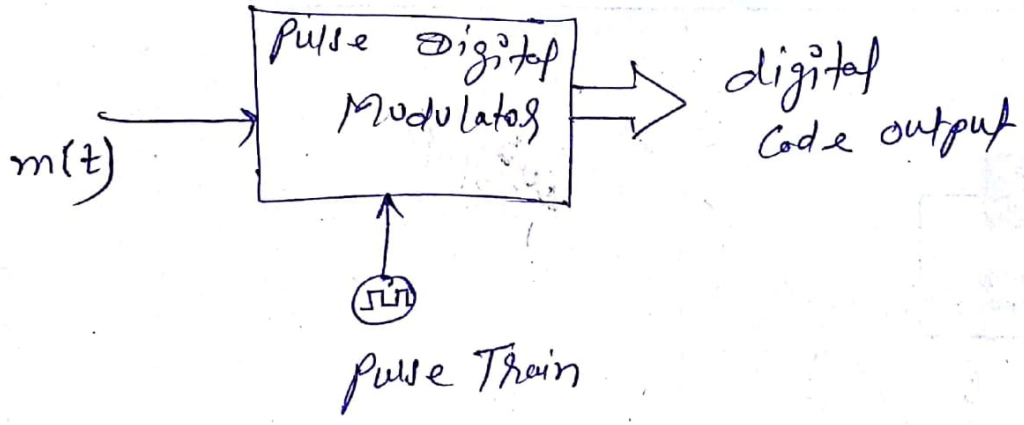
Pulse Digital Modulation

PAM, PWM & PPM are called as pulse analog modulation techniques because here in these modulation techniques, different parameters such as Amplitude, width & position changes in continuous fashion.

Pulse digital modulation can be visualized by the following diagram:



e.g. for each sample of the signal m(t) a code is produced.

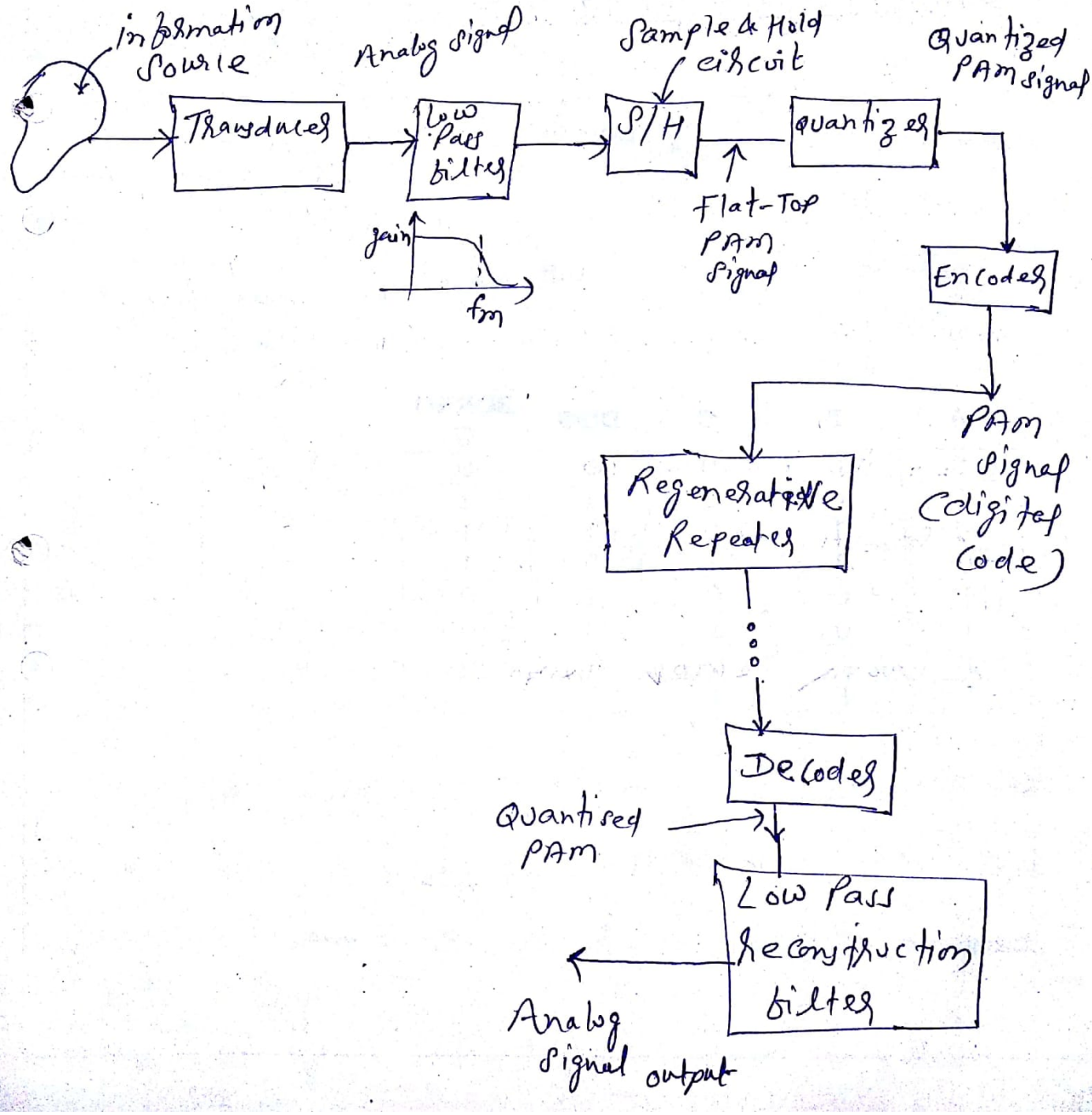
Digital Pulse coding is of the following type

(I) Pulse code Modulation (PCM)
(II) Differential Pulse Modulation (DPCM)
(III) Delta Modulation (DM)
(IV) Adaptive Delta Modulation (ADM)

Code

Pulse Code Modulation (PCM)

This Modulation technique is a type of Analog to digital Convertor (A/D) which Produces binary codes for each sample taken from the input signal



PPM demodulation:

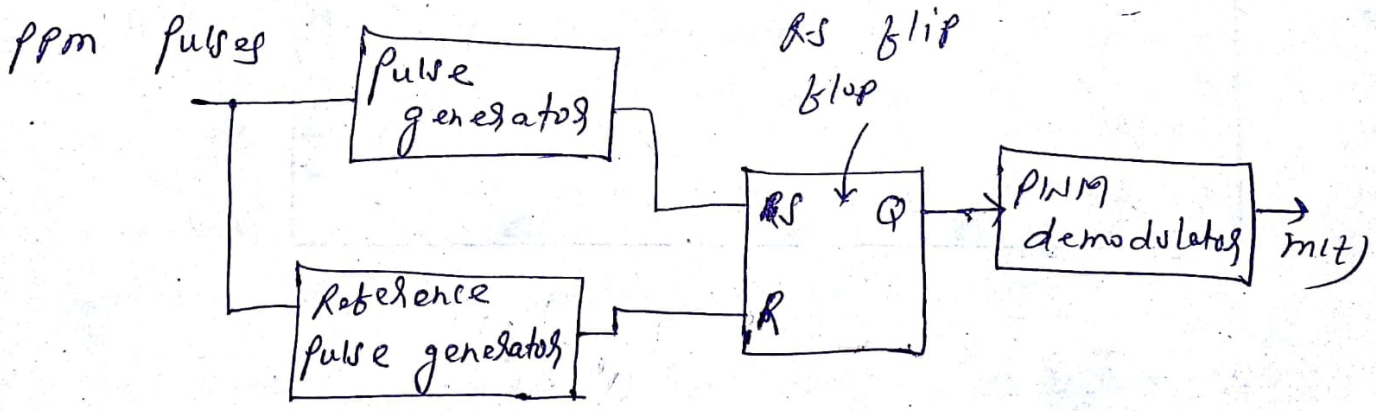
Demodulation from the PPM signal is done on the basis of the following logic

PPM signal → PWM signal → modulating signal

PWM signal is generated with the help of R-S flip-flop. Then the output of PWM demodulator gives modulating signal.

Flip flop o/p is fed to the PWM demodulator.

Demodulation of PPM signal is given as follow



R-S flip-flop will produce a pulse whose width will change in accordance with the values coming at R & S terminals of the flip-flop.

Explanation of PCM block diagram:

① Low Pass filter:

This limits the range of components of signal passing in the next stage. By the filtering action at this stage, effect of noise is reduced upto 90%. Hence this increases the signal to noise ratio

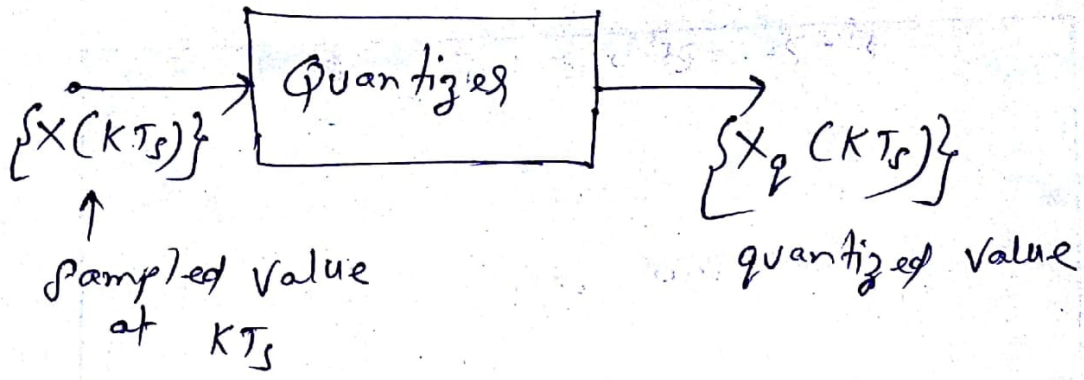
② Sample and Hold circuit

Here the signal $m(t)$ is sampled at Nyquist rate ($f_s \geq 2f_m$), then that sample is held upto the time that sample is converted into a digital code. If it is not done then another sample will come & output code will be in error because it will not confine to a certain sample. Hence sampled value should be kept hold until it is fully converted into a digital code

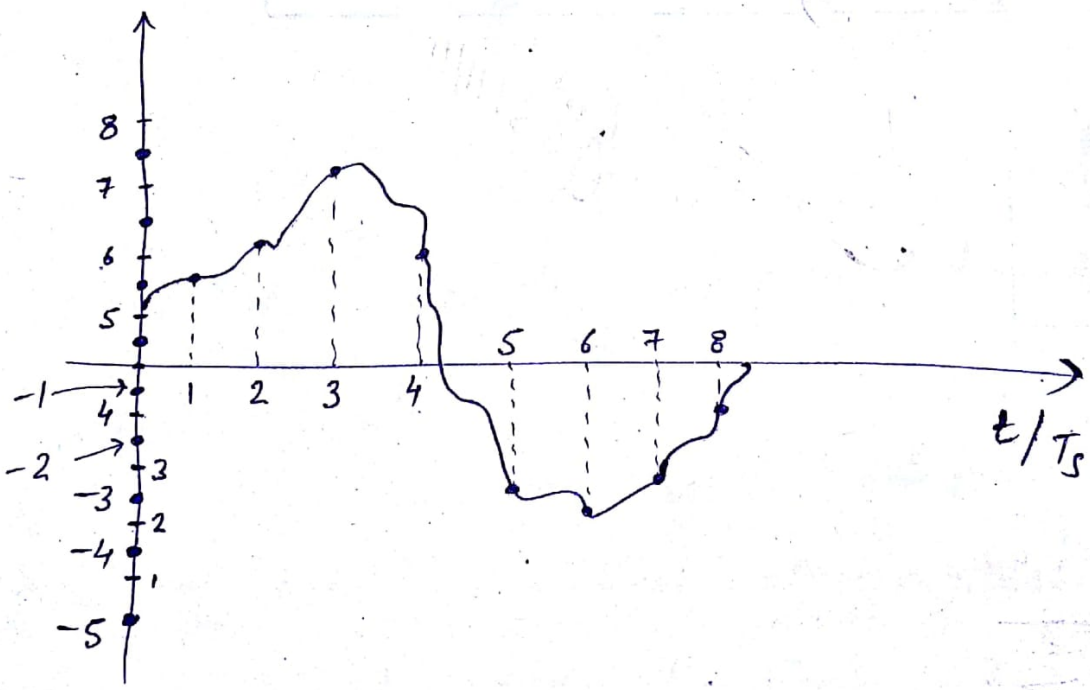
③ Quantizer:

Here the sampled signal value is compared to certain levels

& quantizer and in the output a quantized value is obtained



Each quantized values corresponds to a certain binary address and hence the input analog signal can easily be encoded



Sampled time (t/T_s)	0	1	2	3	4	5	6	7
Sampled values	0.58	1.02	1.27	1.25	0.75	-1.25	-1.45	-0.30
level Number	7	8	8	8	7	3	2	5
Binary Code	0111	1000	1000	1000	0111	0011	0010	0101

Encoder:

Encoder is the central part which produces a binary code for every sampled value

Transmission bandwidth for PCM:

Required bandwidth for PCM depends on:

① Sampling Rate:

For better Reconstruction the sampling rate is kept at Nyquist Rate which follows the following Relation

$$f_s \geq 2f_m$$

where f_m is the maximum frequency Component of message signal $m(t)$

(2) No. of bits used in coding the samples in PCM system, which further depends on the no. of levels.

let total no. of levels being used = M

and let no. of bits used in a coded word = n

the

$$M = 2^n$$

or $$n = \log_2 M$$

Low bit rate = n (Sampling rate)

$$= nf_s$$

$$= n(2f_m) = 2nf_m$$

Hence $$R = 2nf_m$$

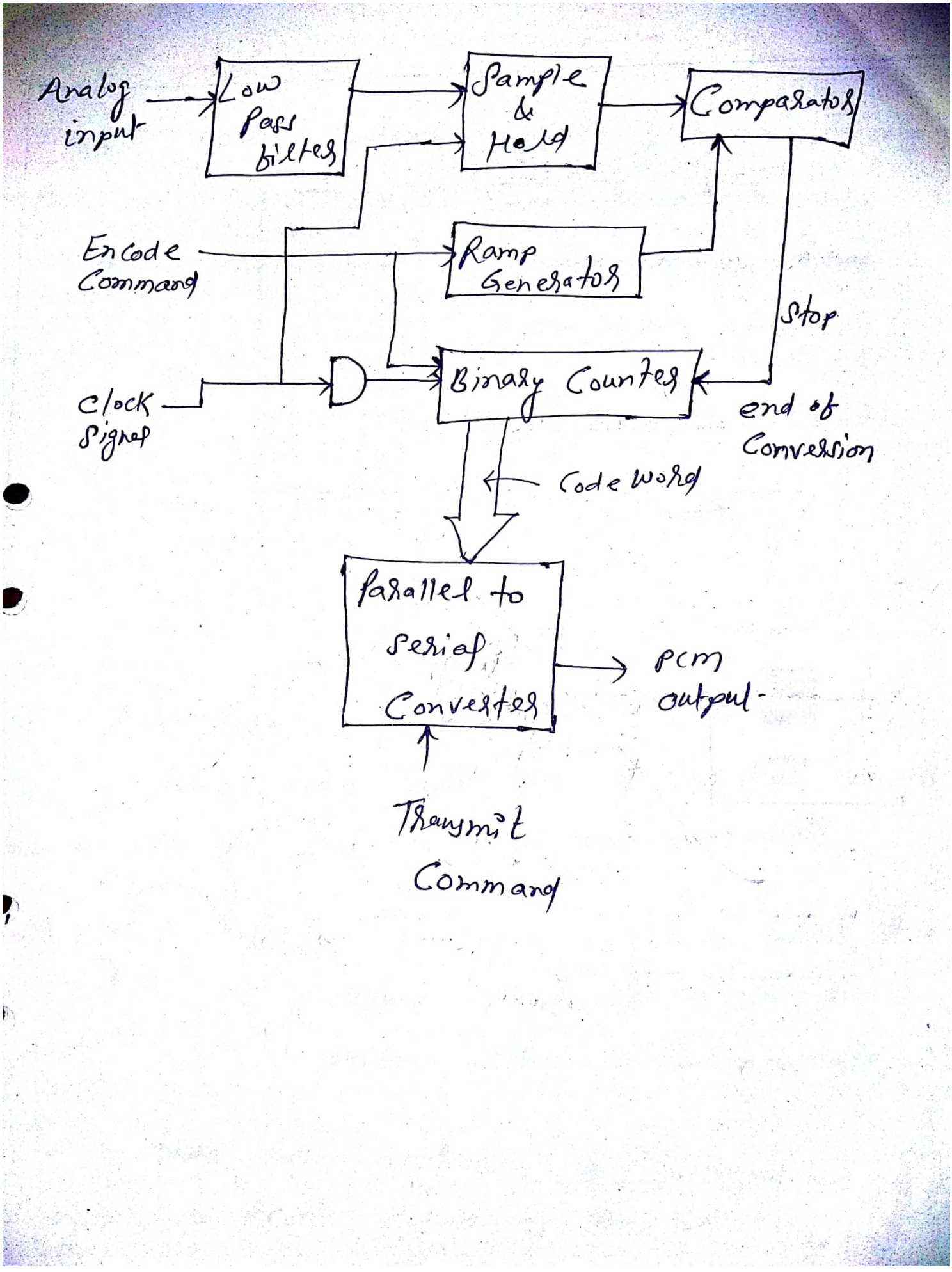
Transmission rate = $\frac{1}{2}$ (Signaling rate)

$$= \frac{1}{2}(2nf_m) = nf_m$$

Working model for PCM:

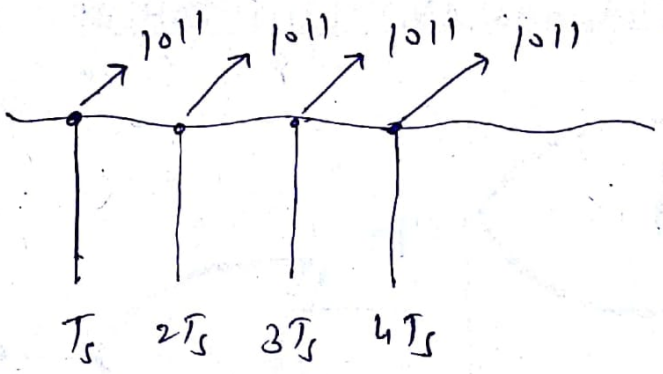
This way of representation explains how PCM works in actual sense.

Analog to digital conversion take place in a close feedback.



Differential Pulse Code Modulation

Normal PCM System suffers from a serious problem for those cases in which the variation of signal is very much small.



in such cases, on each interval T_s, $2T_s$, $3T_s$ & $4T_s$ same code will be transmitted which proves to be a wastage of bandwidth.

Now one possible solution is to detect the variation of signal level from sample to sample and encode the difference only.

Such type of approach is followed in a type of PCM called as the differential Pulse Code Modulation (DPCM)

In terms of bandwidth of transmission DPCM

System is more efficient. Here only few bits are required to encode a slowly changing signal.

Basic DPCM System is shown as follow: