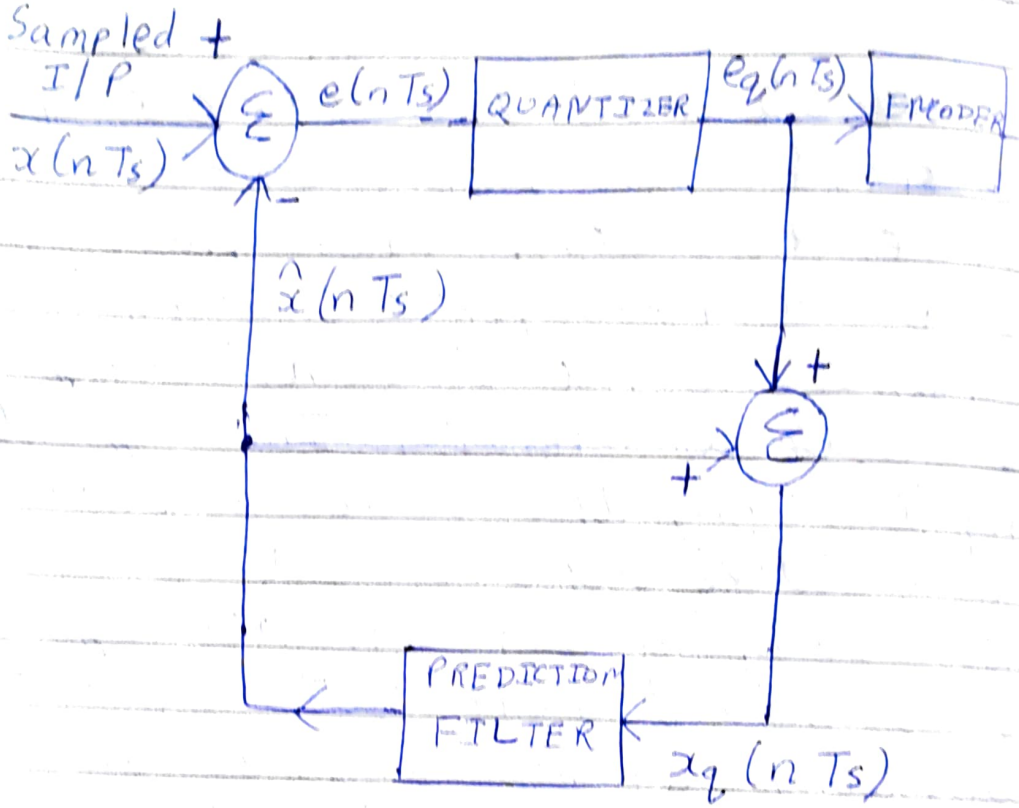
If Differential Pulse Code Modulation DPCM

It is observed that samples of the signal are highly correlated with each other. This means its value from present sample to next sample does not change by a large amount. The adjacent samples carry the same information with a little difference. When these samples are encoded by the standard PCM system, the resulting encoded signal contains some redundant Information. If this Redundancy is reduced, overall bit Rate will ↓ and no of bits required to transmit one sample will also be reduced. This technique is known as Differential Pulse Code Modulation (DPCM).

Working Principle:- It works on the principle of Prediction. The value of present sample is predicted from the past samples.



DPCM Transmitter

Sampled signal is denoted by $x(nT_s)$ and Predicted signal is denoted by $\hat{x}(nT_s)$.

Difference b/w Present sample $x(nT_s)$ and Predicted sample value $\hat{x}(nT_s)$ is found out known as Prediction Error denoted by $e_q(nT_s)$.

$$e(nT_s) = x(nT_s) - \hat{x}(nT_s) \quad (1)$$

predicted value is produced by using a Prediction Filter. Quantizer o/p signal $e_q(nT_s)$ and previous Prediction is added and given as I/p to Prediction Filter. This signal is called $x_q(nT_s)$.

Quantized Error signal $e_q(nT_s)$ is very small and can be encoded by using small no of bits. Thus no of bits per sample are reduced in DPCM.

Quantizer o/p is :-

$$e_q(nT_s) = e(nT_s) + q(nT_s) \quad \text{--- (2)}$$

$q(nT_s) \rightarrow$ Quantization Error

Prediction Filter I/p $x_q(nT_s)$ is

$$x_q(nT_s) = \hat{x}(nT_s) + e_q(nT_s) \quad \text{--- (3)}$$

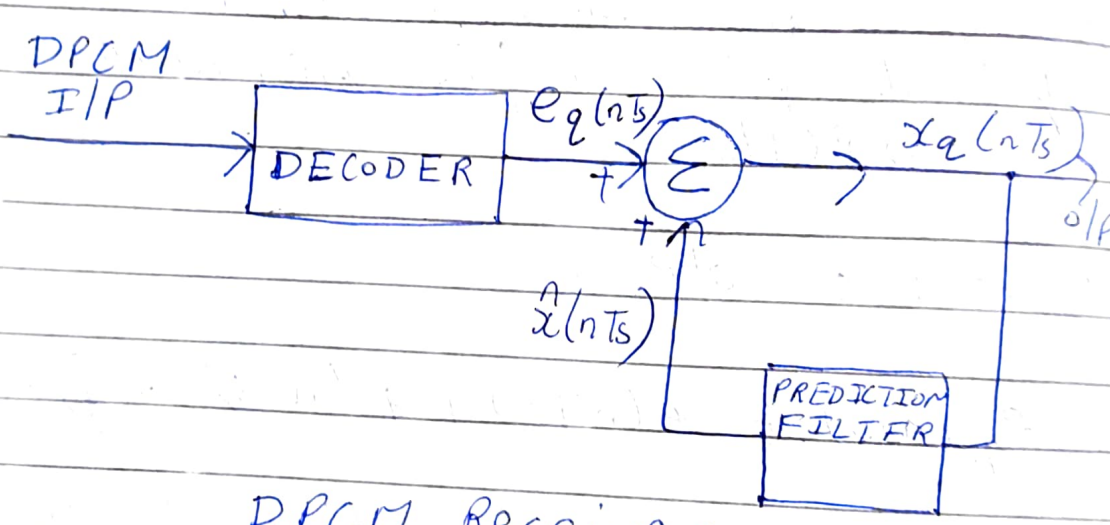
Put (2) in (3)

$$x_q(nT_s) = \hat{x}(nT_s) + e(nT_s) + q(nT_s) \quad \text{--- (4)}$$

$$x_q(nT_s) = x(nT_s) + q(nT_s)$$

Quantized signal → Sum of Original sample value and Quantization Error.

Reception of DPCM signal



DPCM Receiver

Decoder first reconstructs the Quantized Error signal from Incoming Binary signal.

Prediction Filter O/P and Quantized Error signals are added to give Quantized version of Original signal.

Signal at Receiver differs from actual signal by $q(nT_s)$ Quantized Error signal.

Advantages of DPCM :-

1) As difference b/w $x(nT_s)$ and $\hat{x}(nT_s)$ is being encoded and transmitted, a small difference voltage is to be quantized and encoded.

2) Signalling Rate and BW is less than that of PCM system.