UNIT-1

5MARKS

1) Develop an Expression for SNR of PCM in terms of number of bits?

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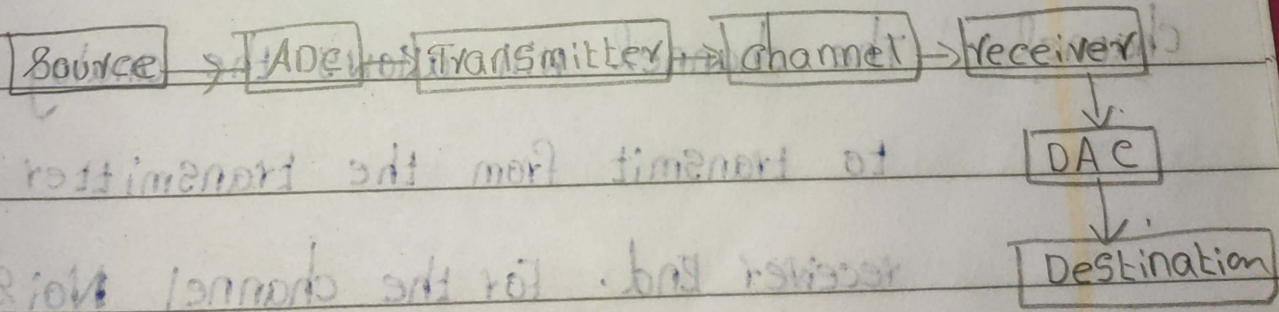
2) Explain digital communication system with block diagram?

Ans Any communication in which digital information can be transmitted through the digital circuits is called diagital communication system.

Ex :- Multiplixers, Encoders, Decoders.



Source :- The source is a nothing but the information which can be send to a circuit. The source is must be a Analog signal.

ADC :- The term ADC is defined as Analog to Digital convertor. Here the total Analog signal is converted to Digital signal because we are giving the digital information to the circuit.

Transmitter :- The transmitter is the input of ADC. Here the transmitter will receive the Digital information and it will transmit the Information to the channel.

channel :- The channel will allows the analog signal to transmit from the transmitter end to receiver End. For the channel Noise is also one of the input.

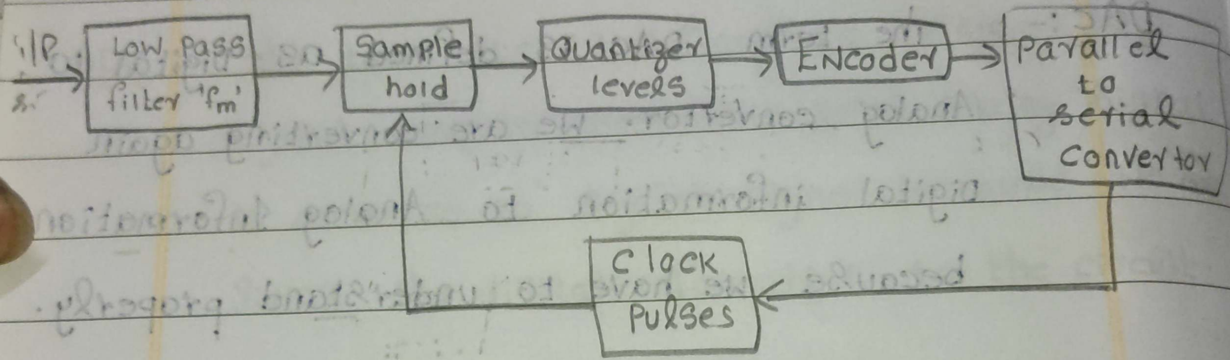
Receiver :- The receiver will receive the data in the digital form.

DAC :- The term DAC is defined as Digital to Analog convertor. We are converting again Digital information to Analog Information because we have to understand properly.

Destination :- The Destination point is the point which the information will reach the person properly.

3) Illustrate the transmitter and receiver of PCM?

PCM Transmitter :-



i) Here the above diagram represents the PCM transmitter.

ii) The Low pass filter will is used to block all frequencies greater than 'fm'.

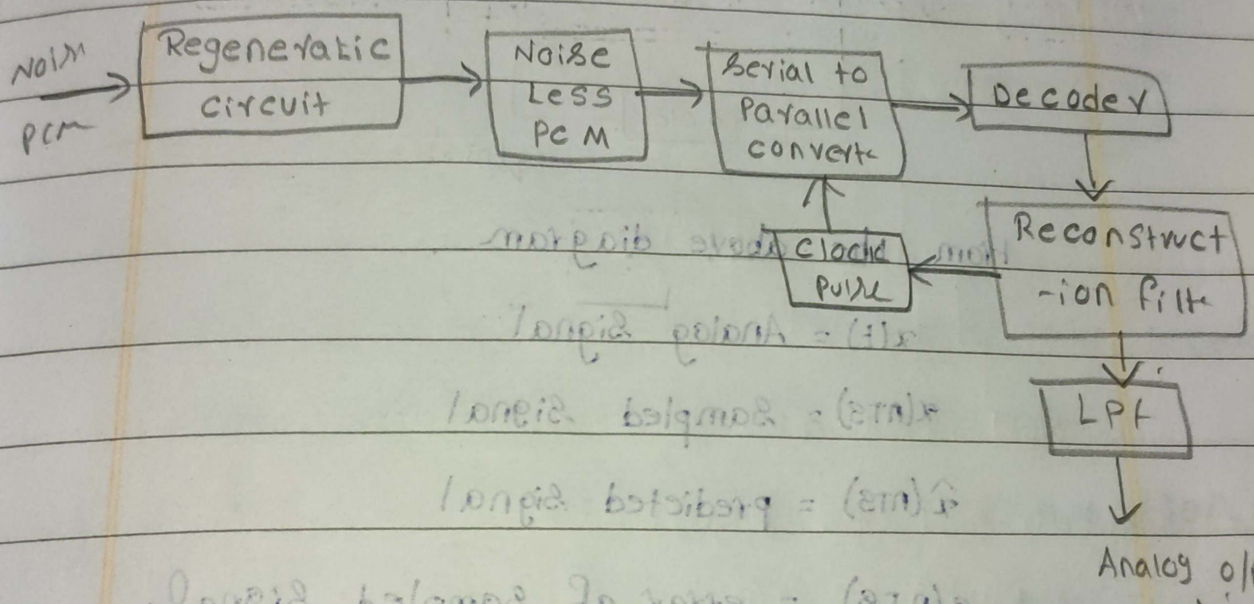
iii) The sample hold circuit will produce the flat-top sampling

iv) Then after how many levels that we are required to Quantize through formula $q = 2^n$

v) The Encoder will convert into the binary data

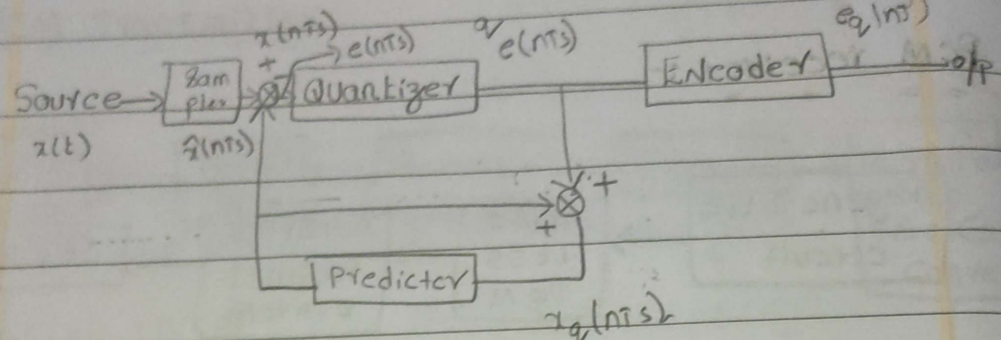
vi) Again that binary data is converted into bit stream by using parallel to serial convertor.

PCM receiver :-



4) Illustrate the transmitter and receiver of DPCM?

DPCM Transmitter :-



From the above diagram

$x(t)$ = Analog signal

$x(nTs)$ = Sampled signal

$\hat{x}(nTs)$ = predicted signal

$e(nTs)$ = error of sampled signal.

Now

$$e(nTs) = x(nTs) - \hat{x}(nTs) \rightarrow ①$$

$$e_q(nTs) = e(nTs) + q_e(nTs) \rightarrow ②$$

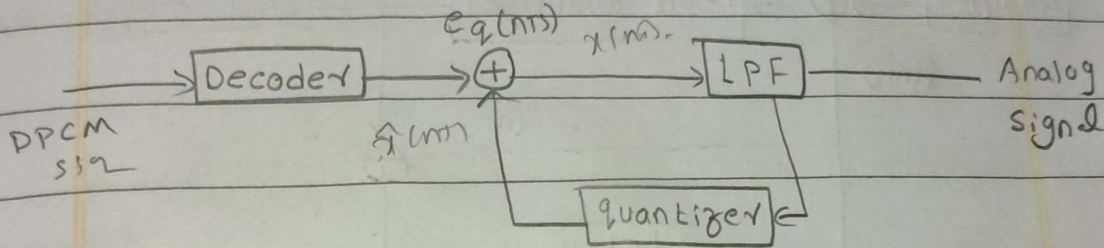
$$x_q(nTs) = e_q(nTs) + \hat{x}(nTs) \rightarrow ③$$

Sub ① & ② in ③

$x_q(nTs) = \cancel{e(nTs)} + q_e(nTs) + x(nTs) - \cancel{e(nTs)}$

$x_q(nTs) = q_e(nTs) + x(nTs)$.

DPCM Receiver :-



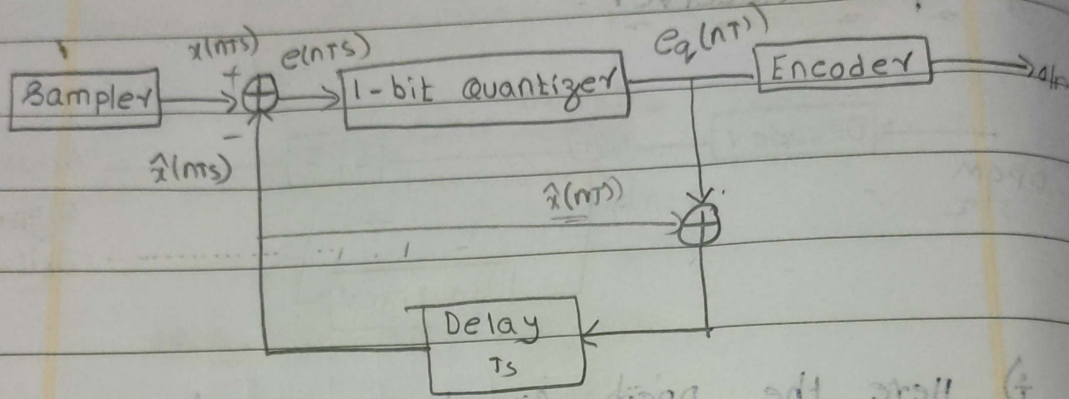
i) Here the DPCM signal is passed into Decoder then error signal will be obtained

ii) then it will passes through summation the digital signal will be obtained.

iii) Now after that it pass through LPF then 'f_m' is obtained.

5) Illustrate the transmitter and receiver of Delta modulation?

Delta modulation Transmitter:-



Now From the block diagram

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

Here

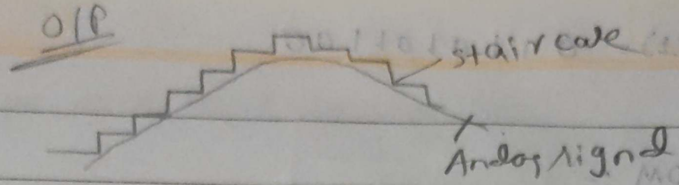
if $e(nTs) \geq 0$ then $e_q(nTs) = +\delta$

$e(nTs) < 0$ then $e_q(nTs) = -\delta$.

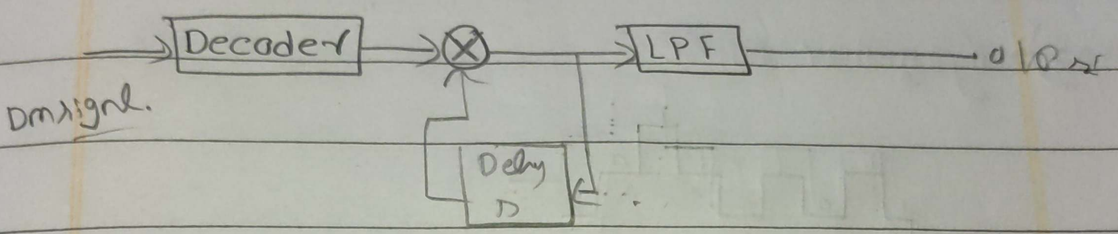
If $e_q(nTs) = +\delta$ then $\delta(nTs) = '1'$

$e_q(nTs) = -\delta$ then $\delta(nTs) = '0'$

O/P



Delta modulation Receiver :-



0 1 1 1 1 0 0 1 0

$-\delta$ $+\delta$ $+\delta$ $+\delta$ $-\delta$ $-\delta$ $+\delta$ $-\delta$.

i) Now on applying signal into Decoder then the binary data is converted into $\pm\delta$ values.

ii) By using feedback it will added simuntaneously.

iii) This will be resultant to form a stair case signal.

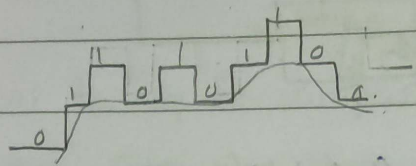
iv) Then this signal is passes through LPF it will convert into Analog signal.

6) Given b(t) = 0110101100

For DM :-

0 1 1 0 1 0 1 1 0 0

-δ +δ +δ -δ +δ -δ +δ +δ -δ -δ



7) Explain how the Drawbacks of DM can be overcome?

→ There are two types of Drawbracks :-

i) Slope overload distortion

ii) Granular noise.

i) Slope -

a) Th

b)

c)

i) Slope - overload distortion:-

a) The distortion will occur when analog signal slope is high

b) Here step size is very small

c) So by increasing the step size we can reduce the distortion.

$$\text{slope of stair case} = \frac{\delta - 0}{T_s - 0} = \frac{\delta}{T_s}.$$

$$\text{Slope of Analog signal} = V_m \sin \omega t$$

$$\frac{dv}{dt} = V_m \cos \omega t \; (\omega)$$

$$= V_m(\omega) \cos \omega t$$

Now

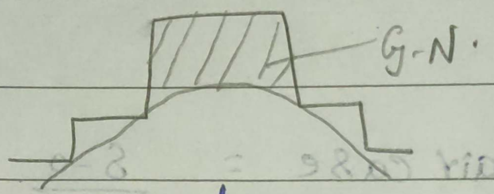
$$V_m \omega > \frac{\delta}{T_s}$$

$$V_m W > \frac{\delta}{T_S}$$

$$\boxed{V_m > \frac{\delta}{W T_S}}$$

So, when signal amplitude is high then "δ" should be high.

ii) Granular noise:-



-> Here in the analog signal the stair case is continously fluctuates.

-> This noise is nothing but Granular noise

-> It will be reduced by maintain "δ" value is small.

1st QUESTION

* Signal to noise Ratio:

Let x_{max} be the peak value of $x(t)$ such that The power of signal x_{max}^2 $P = x_{max}^2$

Noise Power:

Let, δ be the step size so that $error_{max} = \left|\frac{\delta}{2}\right|$

$$e_{max} = \pm \frac{\delta}{2} \qquad -\frac{\delta}{2} < e < \frac{\delta}{2}$$

∴ error is uniform Random Variable distributed b/w $\left[-\frac{\delta}{2}, \frac{\delta}{2}\right]$

$$f(e) = \frac{1}{b-a} = \frac{1}{\frac{\delta}{2} - \left(-\frac{\delta}{2}\right)}$$

$$= \frac{1}{\delta}$$

The average power of a R.V is $R_{XX}(0)$

$$R_{XX}(0) = E\left[e^2\right] \quad (\because \text{from } E(x^2))$$

$$= \int_{-\delta/2}^{\delta/2} f(e)\, e^2\, de$$

$$= \frac{1}{\delta}\left[\frac{e^3}{3}\right]_{-\delta/2}^{\delta/2}$$

$$= \frac{1}{\delta} \cdot \frac{\left(\frac{\delta}{2}\right)^3 + \left(\frac{\delta}{2}\right)^3}{2}$$

$$= \frac{1}{\delta} \cdot \frac{\delta^3}{12} = \frac{\delta^2}{12}$$

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Step size,

$$\delta = \frac{x_{max} - [-x_{max}]}{\text{Qun. level}} = \frac{2x_{max}}{2^n}$$

$\therefore$ Signal - Noise ratio

$$1 = \frac{\text{Signal Power}}{\text{Noise Power}}$$

$$= \frac{P}{\delta^2/12}$$

$$= \frac{x_{max}^2}{\left(\frac{2x_{max}}{2^n}\right)^2} \times 12$$

$$= \frac{\cancel{x_{max}^2}}{4 \times \cancel{x_{max}^2}} \times 12 \times 2^{2n}$$

$$S.N.R = 3.2^{2n}$$

$$\therefore SNR_{dB} = 10 \log (3.2^{2n})$$

$$= 10 \log 3 + 10 \log 2^{2n}$$

$$= 4.6 + 6n$$

From the expression has n increases then step size increases, error decreases and SNR increase.