Assignment No-1

Q. 1. Draw & explain Digital communication system.

→ * Input / source signal:-
The I/P signal is generally an analog signal. e.g. A sound signal.

* Input transducer - This is a transducer which
- takes a physical input and convert it to an electrical signal. e.g. microphone.
It may consist of analog to digital converter.

* Source Encoder -
- The source encoder compresses the data into minimum no. of bits.
- It removes the redundant bits.

* Channel Encoder -
- The channel encoder does the coding for error correction.
- During the transmission due to noise the signal may get altered.
- To avoid this, some redundant bits to transmitted data.
- These are error correcting bits.

* Channel - The channel or medium, allows the signal to transmit from transmitter to receiver.

* Digital Modulator -
The signal to be transmitted is modulated by carrier signal in order to travel through the channel.

Q1 Draw and explain digital communication system.

→

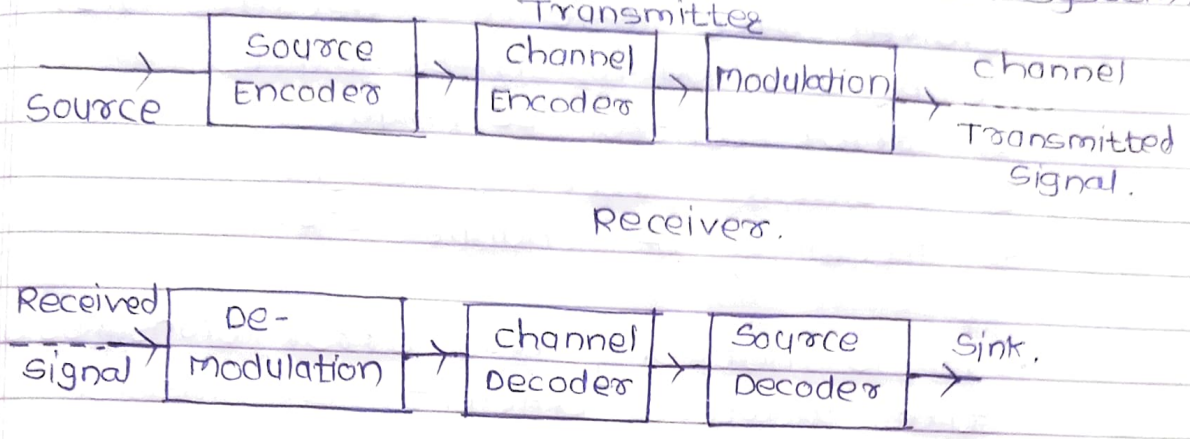


fig- Block diagram of Digital communication system.

A communication system consists of three blocks -

1) Transmitter
2) Channel
3) Receiver.

The system consists of two way transmission, wherein the transmitter & receiver will be there at both ends.

1. Information source.
2. Encoder.

At the receiver end,

1. Decoder
2. Information Sink.

- The designer has to understand the channel behaviour and design the encoder & decoder accordingly.
- An errorless transmission of information will be the aim of the designer.

- with this view, number of techniques are evolved over last few decades viz,
  1) Digital modulation techniques
  2) Error control techniques.
  3) optimum receiver design.
  4) Modelling of channel etc.

- It is not only less error transmission that matters, efficient transmission is also a key parameter. Hence, some more blocks are to be added as show in above figure.
- The communication systems used for transmission & receiving the information can be analog or digital.
- In the analog communication course we must have studied various analog communication system such as AM, FM, PM
- Digital communication system however have added advantages over analog systems.

Q.2 Explain PCM transmitter with neat diagram

→

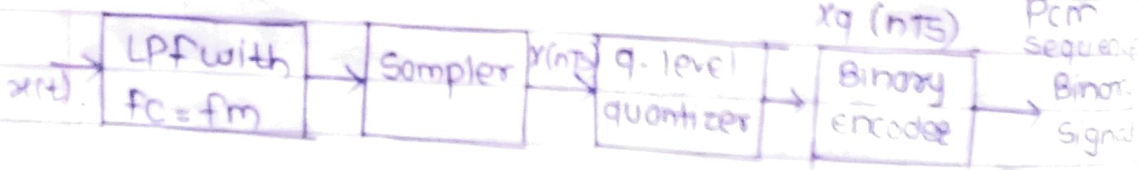


fig - PCM transmitter

LPF -

As the name implies, a filter passes a certain range of frequencies & reject the other

A Low pass filter (LPF) reject the higher frequencies from the input signal & passes the other frequencies, specified by the filter. It is done to avoid any aliasing or distortion in the input signal.

Sampler -

sampling refers to the process of measuring the instataneous value of the continous signal is the discrete form. The input signal of the PCM system is analog, which is a continous time-varying signal. The analog signal passes through the sampler, where it is sampled periodically. The sampler measures the instataneous value of the analog signal, converts it to the discrete symbols & sends it to the quantizer

Quantizer -

After passing through the sampler, the samples are subjected to quantization operation. It reduces the number of discreet symbols. The quantizer performs the process of data compression and data redundancy. It adds some redundant bits and compresses the data to make it suitable for storage and transmission.

Encoder -

An encoder is a device that converts the analog signal to digital pulses. It responds to each sample by generating a binary pulse or pattern.

Q.3 What is delta modulation ? explain with block diagram?

→ • The type of modulation where the sampling rate is much higher & in which the step size after quantization is of a smaller value Δ, such a modulation is termed as delta modulation.

• Delta modulator transmits binary output pulses whose polarity depends on difference between the modulating signal and feedback signal constituted from history of the signals previously sent.

• It has simple hardware and is less costly the PCM system.

• It is also more tolerant to transmission errors & does not need synchronization like PCM.

• But then all this comes with increased signaling rate and hence increased bandwidth requirements & possibility of slope-overload distortion. It consist of a sampling block which samples the input analog signal

• Each sample is compared with predicted version of previous sample by the comparator

• The difference signal of the comparator is the DM output.

• The DM output is accumulated by the feedback accumulator circuit which gives approximate or predicted version of previous sample value

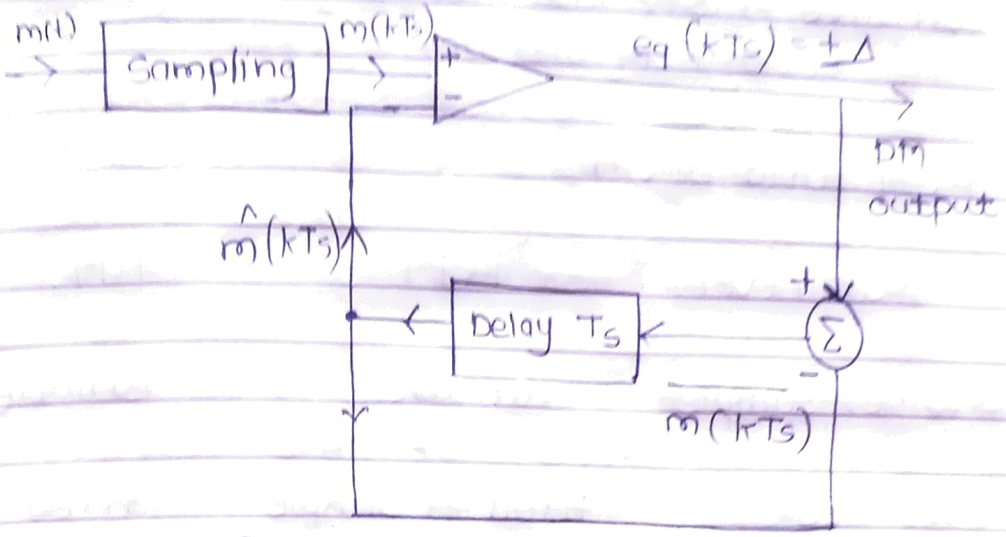
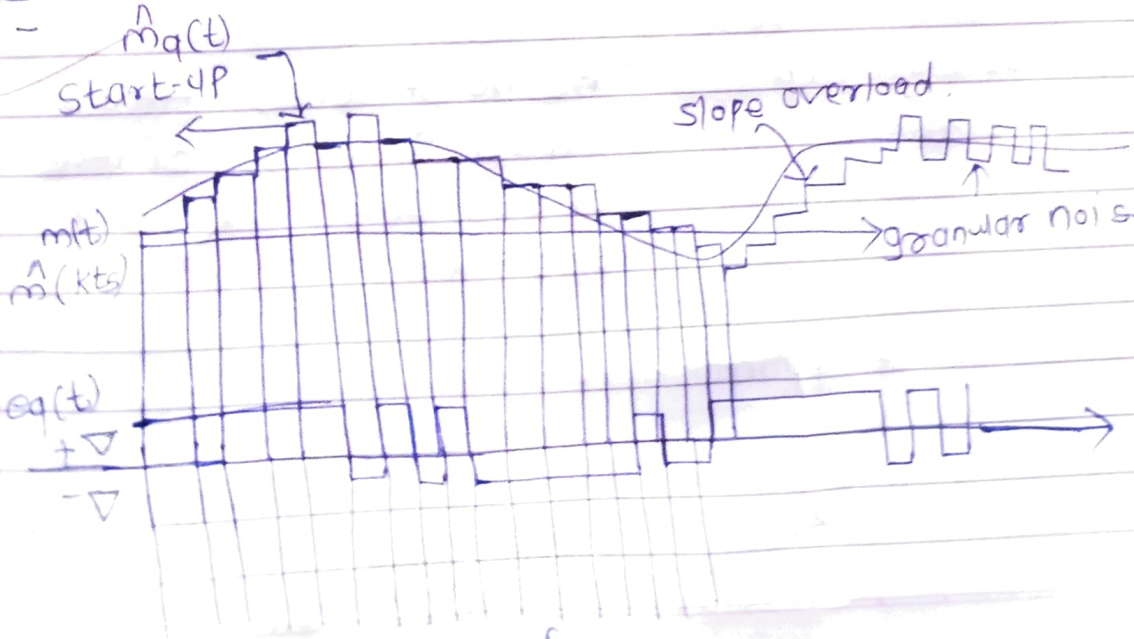


fig- DM transmitter.

1. m(t) is the analog information signal
2. m(kTs) is sampled version of m(t) at time kTs, where k = 0, 1, 2, ----
3. eq (kTs) is the difference between current sample and predicted version of various sample. eq(kTs). is going to be either +Δ or -Δ.
4. Here $\hat{m}(kTs) = \overline{m(k-1)Ts}$ i.e. $\overline{m(kTs)}$ delayed by one sampling time.
5. The waveforms are



Q.4 compare 1) PCM and DPCM
2) PCM and DM.

1) PCM and DPCM.

	Parameter.	PCM	DPCM.
1)	Bits per sample	variable	variable
2)	Step size	fixed in simple PCM variable	fixed
3)	maximum quantization error	$\pm \frac{D}{2}$	$\pm \frac{D}{2}$
4)	feedback	There is no feedback in transmitter or receiver	feedback exists.
5)	signal to noise ratio	Good	Fair.
6)	Levels, step size	The no. of levels depend on number of bits. Level size fixed.	fixed number of level are used.
7)	Area of application	Audio & video Telephony	speach & video

2)

	Parameter	PCM	DM
1)	Numbee of bits	It can use 4, 8, or 16 bits pee sample	~~Bits~~ can be ~~more than~~ one ~~but less than~~ Pcm. sample.
2)	Bandwidth	Highest	Lowest
3)	complexity	complex	simple.
4)	Signal to noise ratio	Good	Poor.
5)	feedback	There is no feedback	feedback exists.
6)	Area of applications	Audio & video Telephony	speech & images.

(c)

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Assignment No-2

Q. 1 Write short note on Digital Multiplexing

→ The term digital multiplexing represent the discrete bits of information

i) Multiplexing is a technique of accommoding signals from number of sources for transmitting them on a single channel.

2) Multiplexing help in considerable reduction of cost of the communication system.

3) The device that takes output from a number of terminals and combines the various data streams into one composite output signal is called as multiplexer. A similar device will be required at the receiver end to separate these signals. This device called as demultiplexer.

Ex: Time Division Multiplexing.-

- In TDM, the time frame is divided into slots.
- This technique is used to transmit a signal over a single communication channel by allowing one slot for each message.

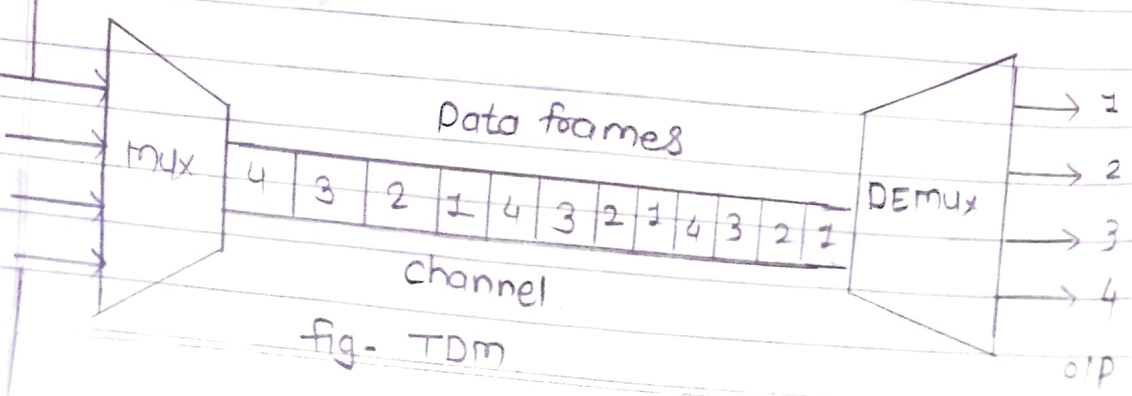


fig- TDM

Q.2 Explain in detail Multiplexing Hierarchy

→ There are two types of digital multiplexers

1) Low speed multiplexers:-

- These are used with digital computer system to merge digital signals from several sources.
- The output rates of these multiplexers are standardized to 1.2, 2.4, 3.6, 4.8, 7.2, 7.6 and 19.2 kbps. The output is designated as digital signal level 0 (DS0).

2) High speed multiplexers-

- They are used in commercial data transmission systems.
- Two different multiplexing standards have been adopted for digital communication
- The AT & T hierarch in north america and Japan and CCITT hierarchy ~~is~~ in Europe and rest of world. Both hierarchies are based on 64 kbps voice PCM unit.
- The telephone industry has standardized the bit rates to 1.544 Mbps, 6.312 Mbps, etc. and designated them as DS-1, DS-2 etc.
- Thus, higher the DS level, higher will be data rate. different transmission medium is used for different DS levels.
- for example for higher DS-level, fibre optic cables, microwave links are used.
- A single DS-1 signal is usually transmitted over a pair of twisted pair cables.
- This type of DS-1 transmission over a twisted pair medium is called T1- carries systems.

Q 8 What is synchronization & why it is need

i) The timing operation at the receiver should closely follow the corresponding operation at the receiver.

2) This is called synchronization between transmitter and receiver.

3) for synchronization we require a clock signal at the receiver that should have a precise frequency and phase relationship with the received signal.

4) of course, some allowance has to be made to take into account propogation delay between transmitter and receiver.

5) Digital communication needs three types of synchronizing signals.

1) Bit synchronization.
2) Frame synchronization.
3) carrier synchronization.

6) Bit synchronization is required to identify the bit interval.

7) frame synchronization identifies a group of bits belonging to a time slot

8) carrier synchronization extracts carrier signals timing with coherent detection.

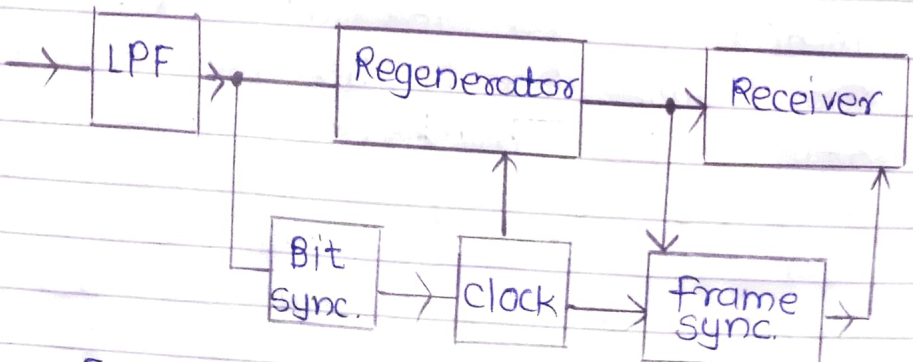


fig- Frame and bit synchronization.

Q4 What is scambler and descrambler Explain with examples.

→ 1) The synchronization technique used on zero crossing detectors suffers from loss of synchronisation due to long stream of 1's and 0's.

2) Scrambling techniques is a solution to this example.

3) A Long ~~term~~ stream 1's or 0's is converted into random 1's and 0's.

4) This apart from helping synchronisation will also eliminate DC components in the power spectrum and avoid DC wandering.

5) This requires a scrambling operation.

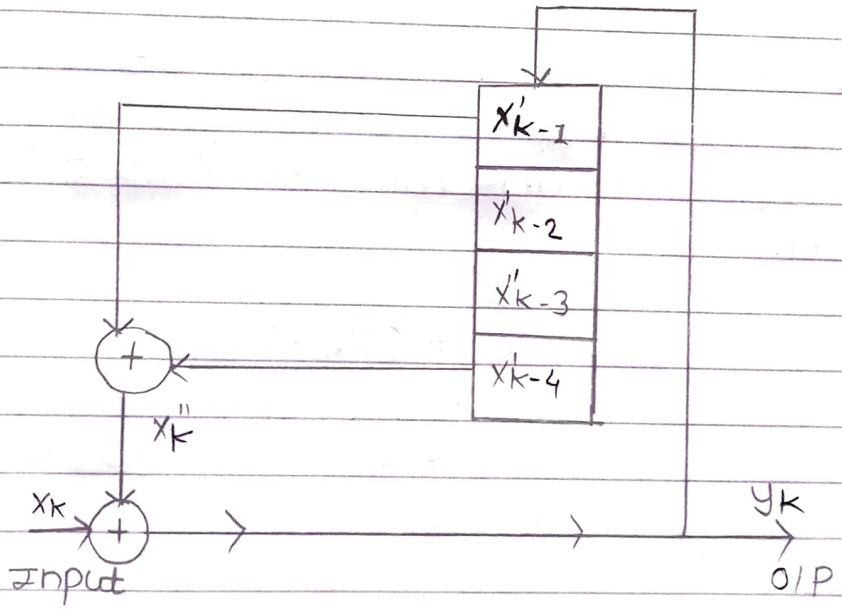


Fig- Scrambler.

1) Descrambling operation at the receiver end to get back the original sequence.

2) A simple shift register and modulo-2

(Ex-OR) adder arrangement as shown in figure. can be used for scrambling and descrambling

3) The scrambler and descrambler circuits as shown in figure.

4) If y is the output of the scrambler and x is the input sequence, then we can write

$$y_k = a_1 x_{k-1} + a_2 x_{k-2} + \cdots + a_n x_{k-n}$$

5) A scrambler with 4 shift register is in fig. Hence we can write.

$$y_k = x_k + x_k = x_k + x_{k-1} + x_{k-3}$$

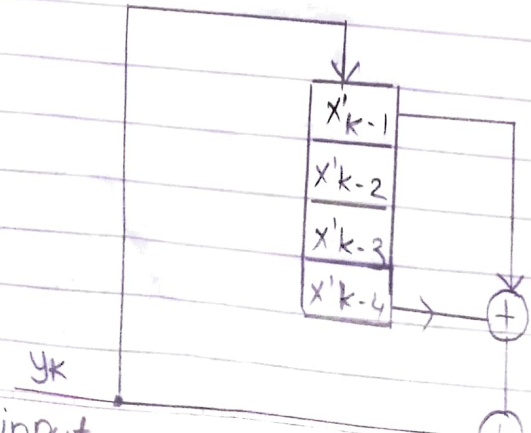
6) The unscrambler has reverse structure. Let us see how it reproduces original message. The unscrambled output can be written as,

$$x_k + y_k = x_k + (x_k + x_k)$$

(substitute $y_k = x_k + x_k$)

$$= x_k + x_k + x_k = x_k.$$

Thus we get ~~blact~~ back original x_k at the output.



Q 5 Write short note on

1) Bit synchronization

→
- In order to detect a binary signal at the receiver, we have to sample received signal at a precise instant.
- This will require clock signal at the receiver in synchronisation with receiver
- The method of extracting bit duration is called bit synchronisation.
- There are three methods of bit synchronisation -
  1) Derivation of clock signal from master timing source both at transmitter and receiver.
  2) Transmitting the clock from transmitter to receiver
  3) Extracting clock signal from the signal itself called self-synchronisation.
- The first method is used for large volume of data and high speed communication. Its cost is high.
- The second method uses channel capacity for transmission of clock. Hence, there should be spare capacity available.
- The third method is more efficient & used very often.

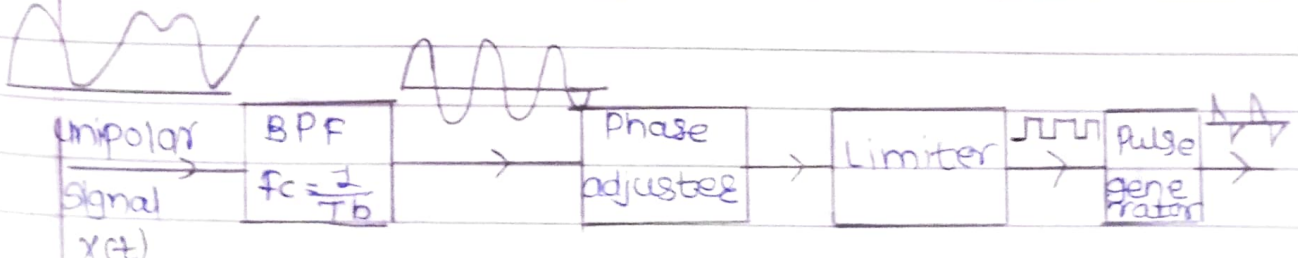
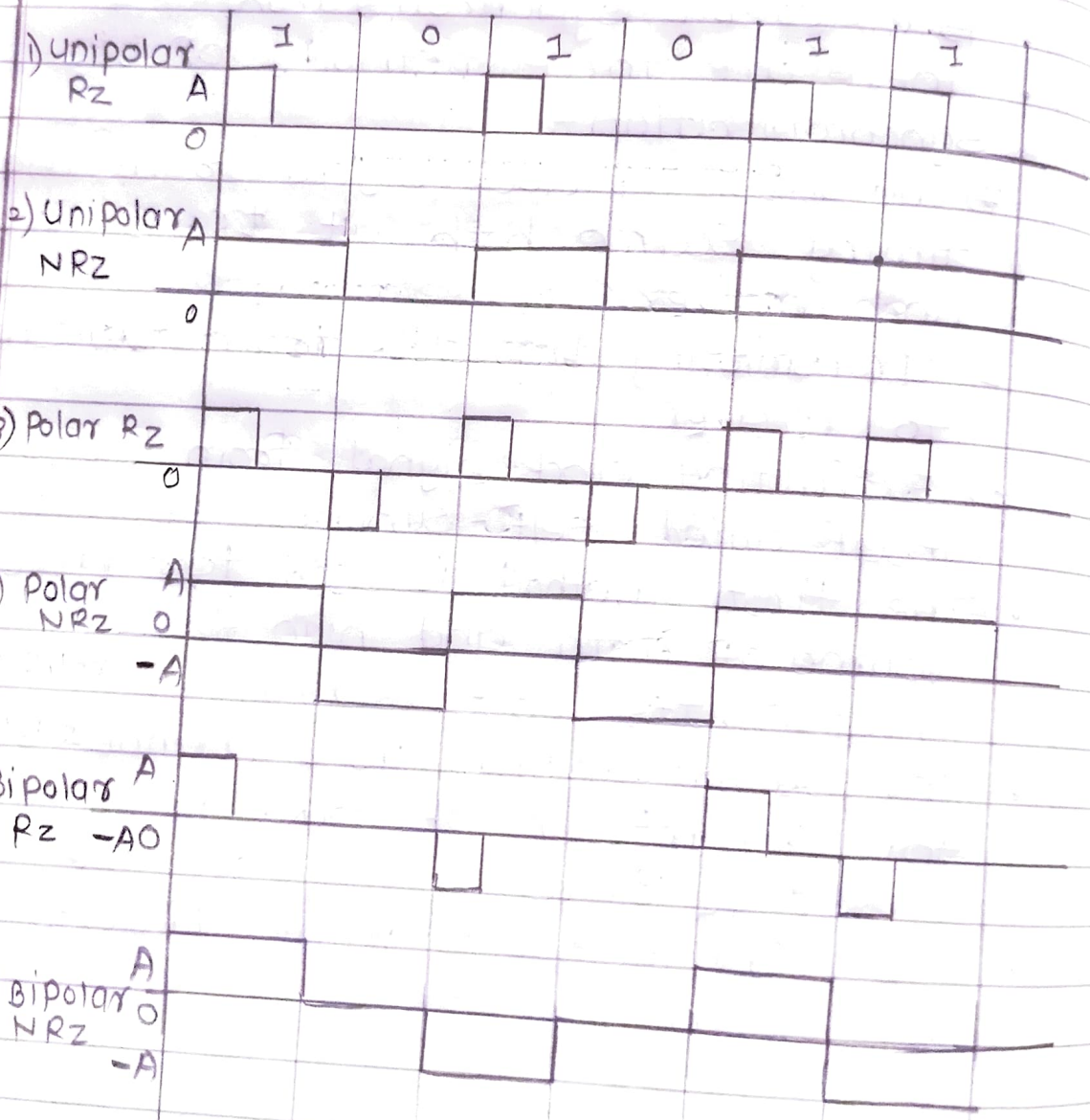


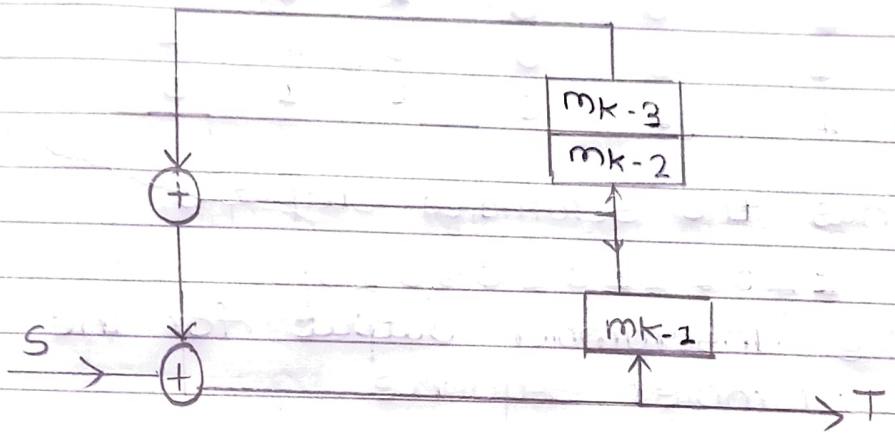
Fig. Bit synchronizer for unipolar signal

Q 6. Sketch the following line coding format for bit pattern 1010011.

1) Unipolar RZ
2) Unipolar NRZ
3) Polar RZ
4) Polar NRZ
5) Bipolar RZ
6) Bipolar NRZ.



Q7 A scrambler is shown in figure. Design the corresponding unscrambler if a sequence 1010101000001111 is applied to the input, determine the is sequence T. Verify if this T is applied to the input the output is S.



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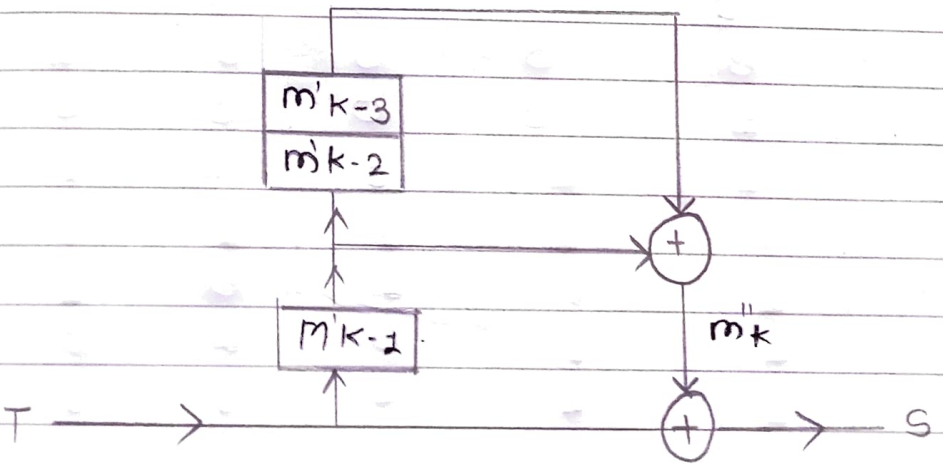

Scrambling operation for given input is,

Input	m'k-1	m'k-2	m'k-3	m''k	T(O/P)
	0	0	0	0	
1	0	0	0	0	1
0	1	0	0	1	1
1	1	1	0	1	0
0	0	1	1	1	1

1	1	0	1	0	1
0	1	1	0	1	1
0	1	1	1	0	0
0	0	1	1	1	1
0	1	0	1	0	0
0	0	1	0	0	0
1	0	0	1	1	0
1	0	0	0	0	1
1	1	0	0	1	0

Thus, the scrambled output is,

1 1 0 1 1 1 0 1 0 0 0 1 0.

The unscrambler output for the scrambler sequence.

Input	m'_{k-1}	m'_{k-2}	m'_{k-3}	m'_k	SS
	0	0	0	0	
1	0	0	0	0	1
1	1	0	0	0	0
0	1	1	0	0	1
1	0	1	1	1	0
1	1	0	1	0	1
1	1	1	0	1	0
0	1	1	1	0	0
1	0	1	1	1	0
0	1	0	1	0	0
0	0	1	0	0	0
0	0	0	1	1	1
1	0	0	0	0	1
0	1	0	0	1	1