CT-03

① a) what is terminal noise? what are the different between crosstalk and impulse noise? 1+3.

b) What is guided and unguided transmission medium? what is the frequency of omni-directional and directional unguided transmission medium? 2+2

c) convert given digital data (0 1 0 1 0 1 1 0 0 1 1) into digital signal: using- 3+3.

i) NRZ-L
ii) NRZ-I

Ans to the question no-1(a).

Terminal noise:

Terminal noise is the random motion of electrons in a wire which creates an extra signal not originally sent by the ~~to~~ transmitter.

Unguided media:

Wireless or open air space is said to be unguided media, because there is no connectivity between the sender and receiver. Information is spread over the air, and anyone including the actual recipient may conect the information.

Frequency:

Omni-directional – 3KHZ to 3GHZ.

Directional – 1KHZ to 300 GHZ.

Ans to the question no-1(c)

NRZ-L:

Positive voltage repreneents 1 and negative value represents 0. It is also NRZ because there is no rest condition. NRZ-L changes voltage level at when a different bit is encountered.

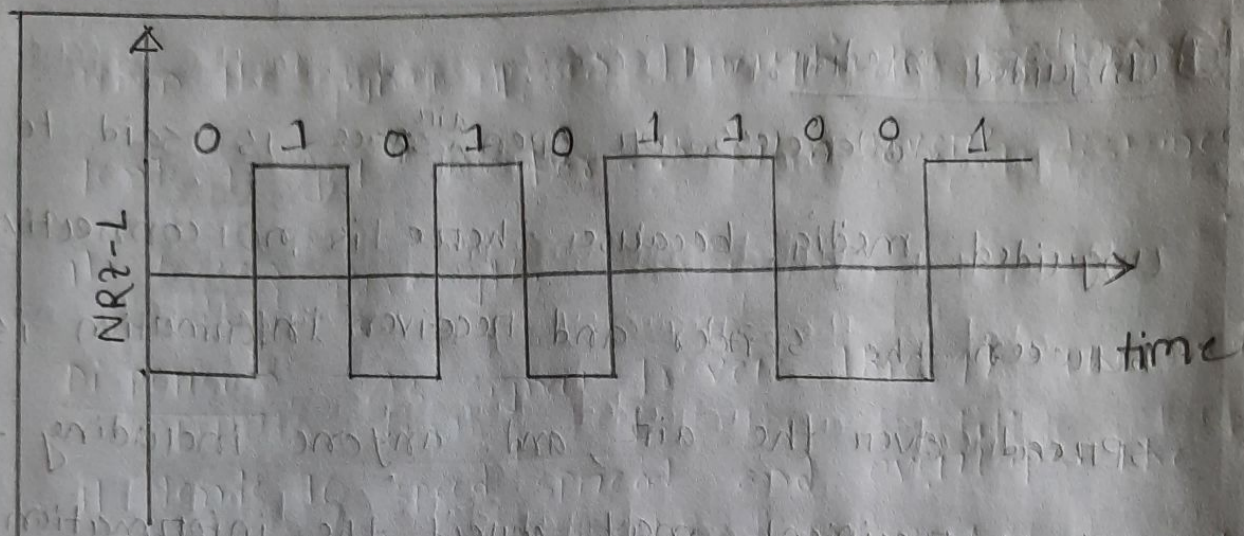


fig: NRZ-L

<u>NRZ-I</u>: positive voltage represents 1 and negative value represents 0. It is also NRZ because there is no rest condition. NRZ-I changes voltage when a 1 is encountered.

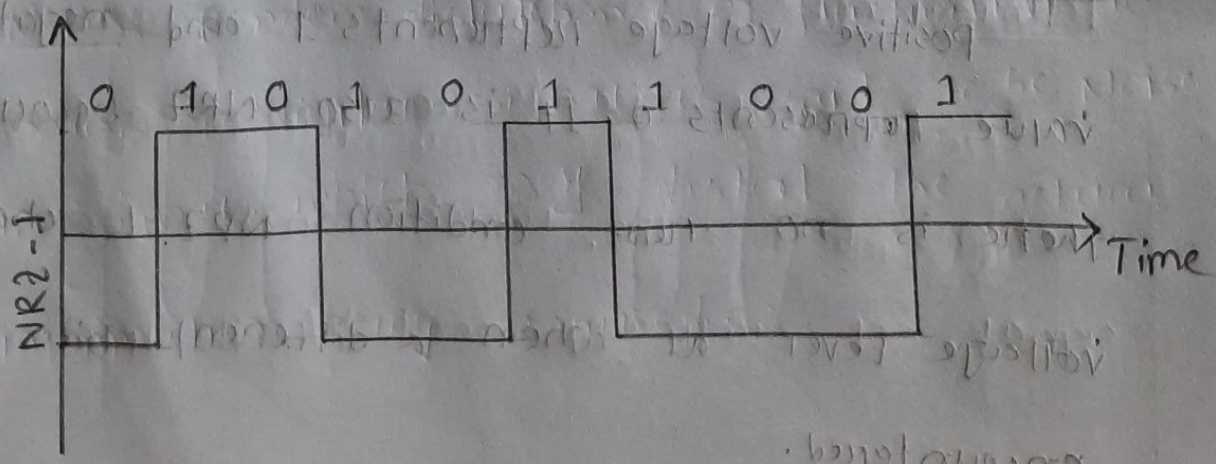


fig: NRZ-I

② a) Mention the different causes of transmission Impairment. Discuss any of them. 4.

b) what is carrier signal? with appropiate diagram describe the types of digital to analog signal conversion. 6.

c) If a channel has 10 MHz bandwidth and SNR for this channel is 127, then what are the bit rate? 4.

Ans to the question no- 2(a)

Different causes of transmission impairment:

when signal travel throug the medium they tend to deteriorate. This may have many reasons as given:

Attenuation: for the receiver to interpret the data accurately, the signal must be sufficiently strong.

when the signal passes through the medium, it tends to get weaker. As it covers distance, it losses strength.

Dispersion: As signal travels through the media, it tends to ~~speed~~ spread and overlaps. The amount of dispersion depends upon the frequency used.

Delay distortion: Signals are sent over media with pre-defined speed and frequency. If the signal speed and frequency do not match, there are possibilities that signal reaches destination in arbitrary fashion.

Noise: Random disturbance or fluctuation in analog or digital signal is said to be Noise in signal, which may distort the actual information being carried.

Noise can be characterized in one of the following class:

1. Thermal noise
2. Impulse noise.
3. cross talk.
4. Induced noise etc.

Ans to the question no-2(b)

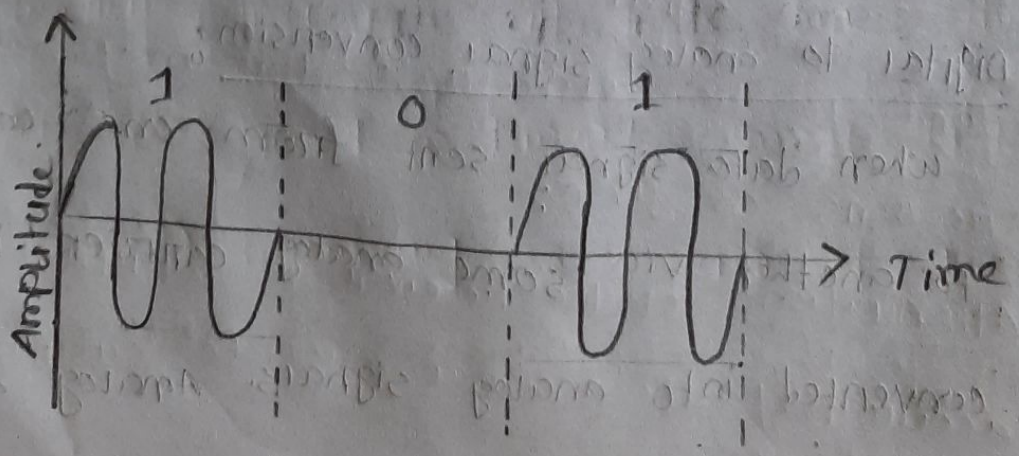
Carrier signal: Carrier signal is a waveform that is modulated with an input signal for the purpose of conveying information.

Digital to analog signal conversion:

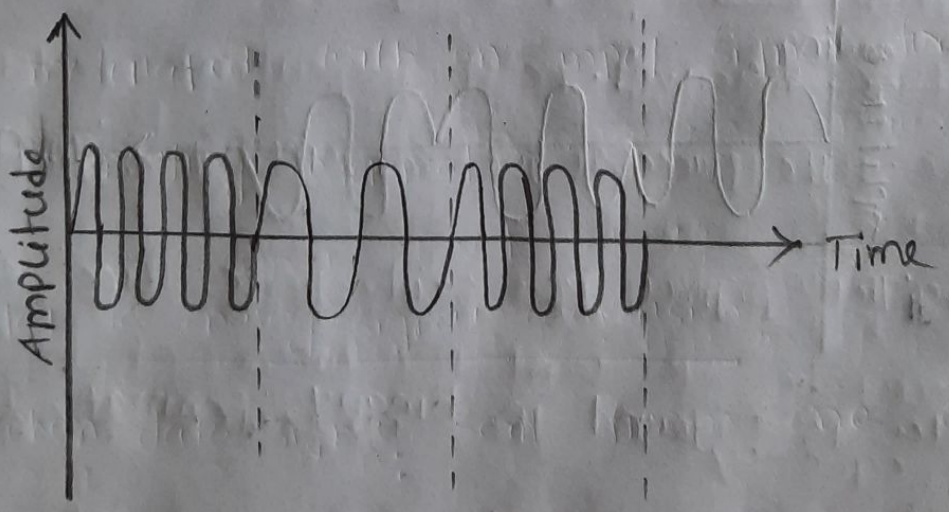
when data signal sent from one computer to another via some analog carrier, it is first converted into analog signals. Analog signals are modified to reflect digital data.

An analog signal is characterized by its amplitude, frequency and phase. There are three kinds of digital-to-analog conversions:-

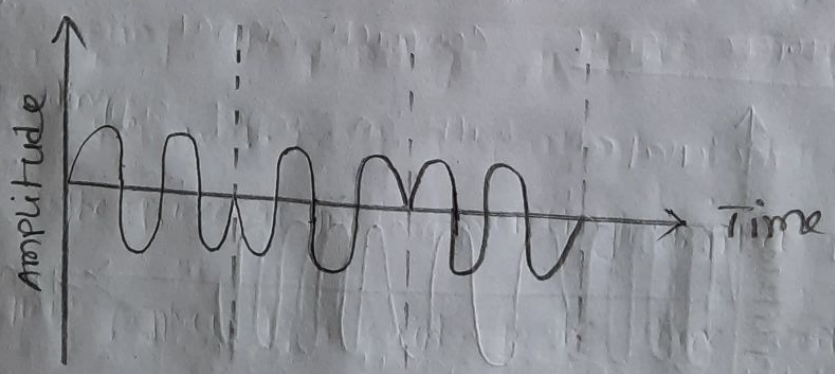
<u>Amplitude shifting key</u>: The amplitude of analog carrier signal is modified to reflect binary data. When binary data represents digit 1, the amplitude is held; otherwise it is set to 0. Both frequency and phase remain same as in the original carrier signal.



frequency shift keying: The frequency of the analog carrier signal is modified to reflect binary data. This technique uses two frequencies f1 and f2. f1 is chosen to represent binary digit 1 and the other one is used to represent binary digit 0. Both amplitude and phase of the carrier wave are kept intact.



Phase shift keying: The phase of the original carrier signal is altered to reflect the binary data. When a new binary symbol is encountered, the phase of the signal is altered. Amplitude and frequency of the original carrier signal is kept intact.



Ans to the question no-2(c)

Ans: Given, SNR = 127, B = bandwidth = 10MHz

using shannon capacity low,

$$\text{Bit rate} = B * \log_2(1 + SNR)$$

$$= 10MHz * \log_2(1+127)$$

$$= 10 * 10^6 * \log_2 128$$

$$= 10^7 * 7$$

$\therefore$ Bit rate = 70 Mbps.

3. a) What is line coding? Mention the different types of line coding. 4

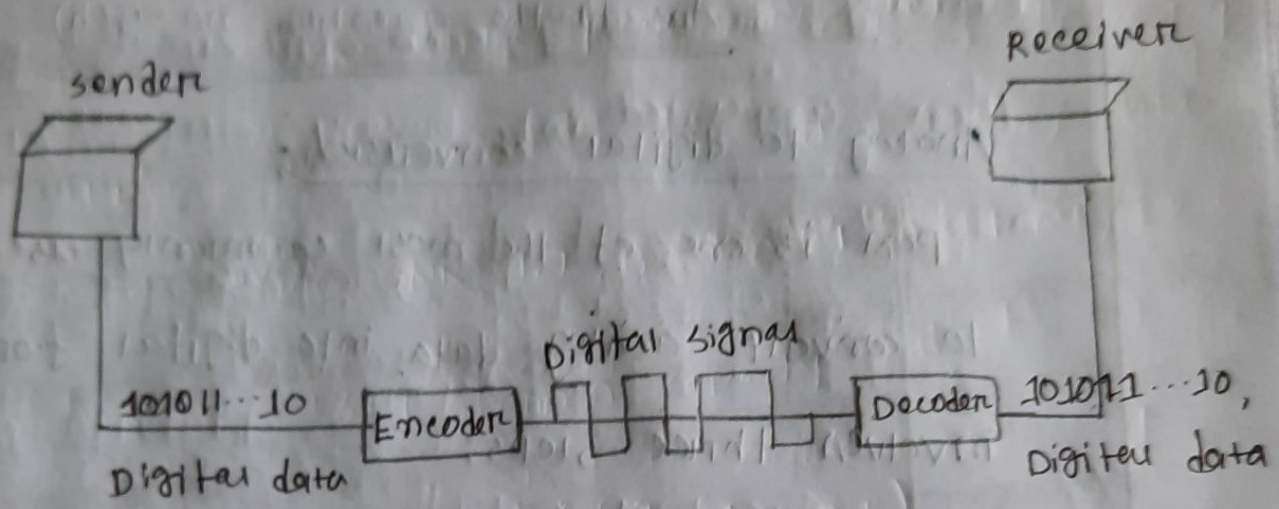
b) Explain the analog to digital signal conversion with appropriate diagram. 7

c) what is the significance of Twisting in twisted pair cable? 3.

Ans to the question no-3(a)

Line coding:

The process for converting digital data into digital signal is said to be line coding. Digital data is found in binary format. It is represented (stored) internally as series of 1s and 0s.



Types of line coding:

a. Unipolar line coding
   → unipolar NRZ
   → unipolar RZ

b. polar line coding
   → polar NRZ
   → polar RZ

c. Bipolar line coding
   → Bipolar NRZ
   → Bipolar RZ.

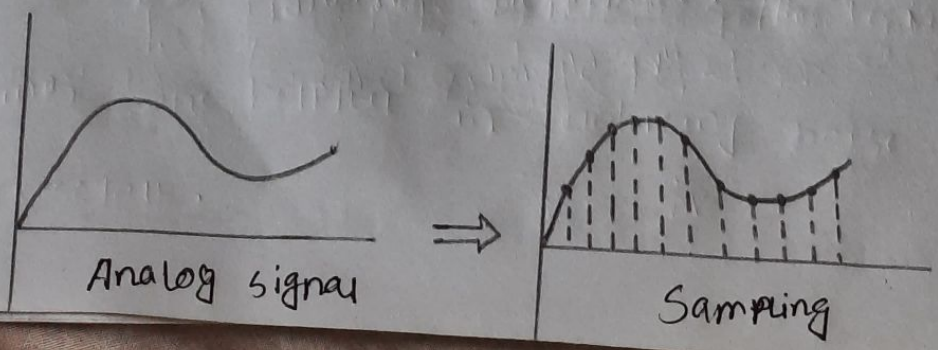
Ans to the question no-3(b)

Analog to digital conversion:

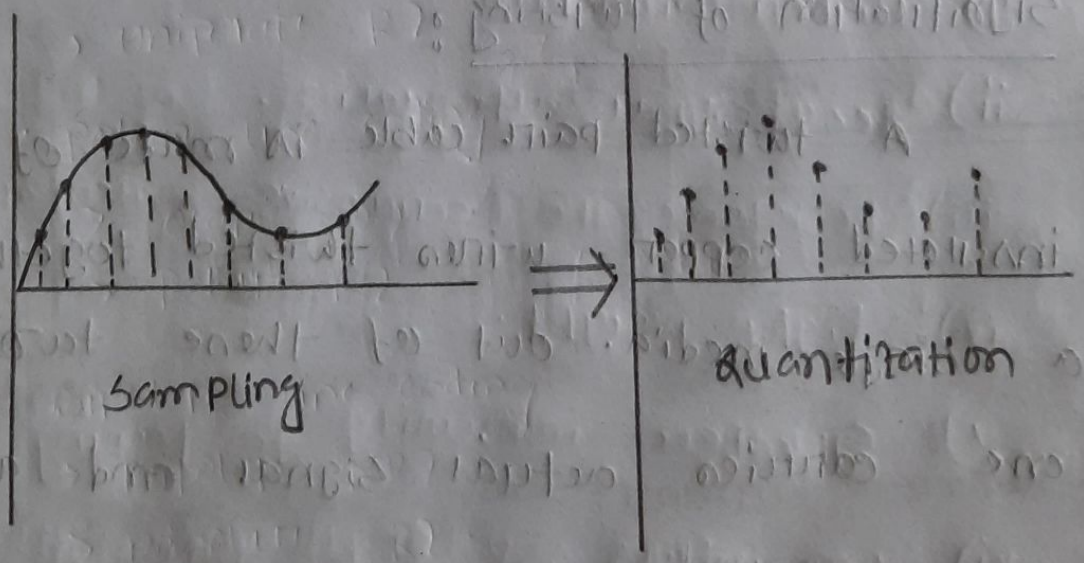
PCM is one of the most commonly used method to convert analog data into digital form. It involves three steps:

i) Sampling.
ii) Quantization.
iii) Encoding.

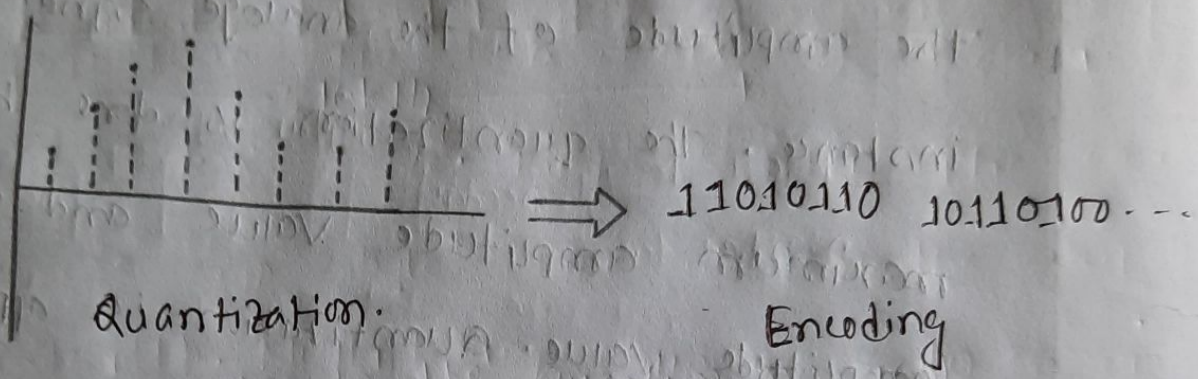
i) Sampling: The analog signal is sampled every time interval. most important factor in sampling is the rate at which analog signal is sampled. According to Nyquist Theorem, the sampling rate must be at least two times of the heighst frequency of the signal.



Quantization: sampling yeeids discrete from of continious analog signal. Every discreate pattern the amplitude of the analoge signal at that instance. The quantization is done between the maximum amplitude value and the minimum amplitude value. Quantization is approximation of the instantaneous analog value.



Encoding : In encoding, each approximated value is then converted into binary format.



Ans to the question no- 3(c)

Signification of twisting :

A twisted pair cable is made of two plastic insulated copper wires twisted together to form a single media. out of these two wires, only one carries actual signal and another is used for ground reference. The twists between wires are helpful in reducing noise and crosstalk.

4. a) five channels, each with a 100 KHz bandwidth, are to be multiplexed together. what is the minimum bandwidth of the link if there is a need for a guard band of 10 KHz between the channels to prevent interference? 6.

b) write some advantages of optical fiber over twisted pair cable. 3.

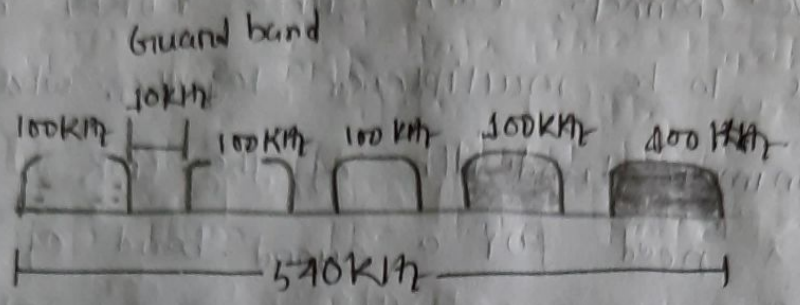
c) Explain three basic multiplexing technique with figure. 5

Ans to the question no - 4(a)

for Five channels, with each of a 10 KHz bandwidth we need at least four guard bands.

This means that the required bandwidth is at least

$$5 \times 100 + 4 \times 10 = 540 \text{ KHz}$$



Ans to the question no-4(b)

Advantage of optical fiber over twisted pair cable:

i) Higher bandwidth

ii) Less signal attenuation.

iii) Resistance to corrosive materials.

iv) Light weight

v) Greater immunity to tapping

vi) Immunity to electromagnetic interference.

Ans to the question no-4(c)

Three basic multiplexing techniques:

i) Frequency-division multiplexing: (FDM) is an analog technique that can be applied when the bandwidth of a link (in hertz) is greater than the combined bandwidth of the signals to be transmitted. In FDM, signals generated by each sending device modulate different carrier frequencies.

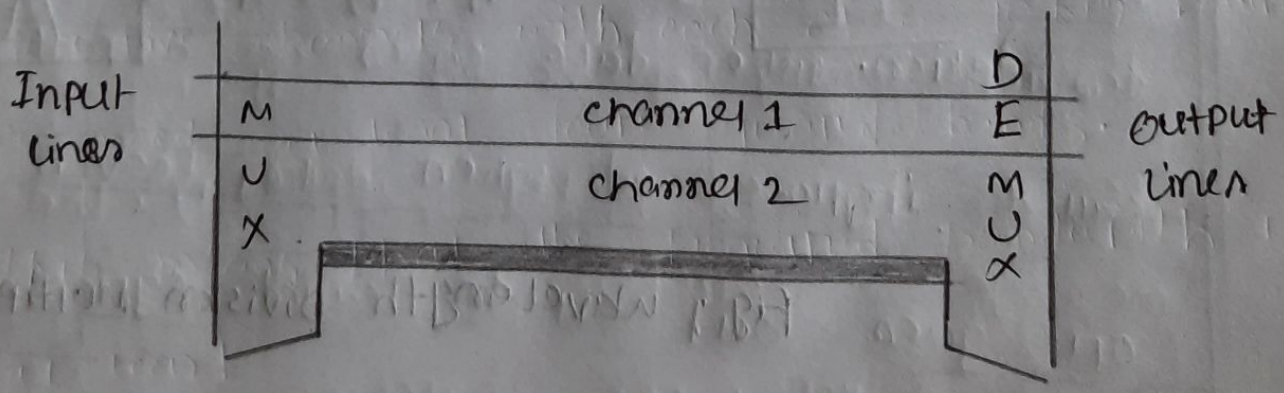


fig: frequency-division multiplexing.

ii) Wavelength-Division Multiplexing: (WDM) is designed to use the high-data-rate capability of fiber-optic cable. The optical fiber data rate is higher than the data rate of metallic transmission cable. Using a fiber-optic cable for one ~~sign~~ single line wasten the available bandwidth. Multiplexing allows us to combine several lines into one.

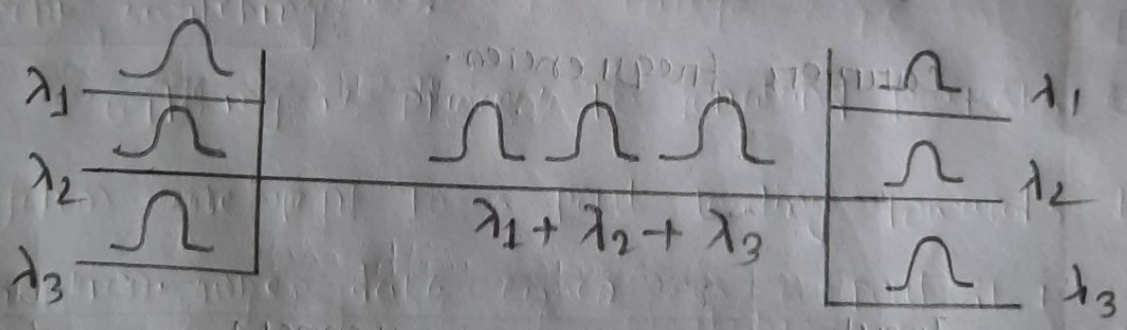
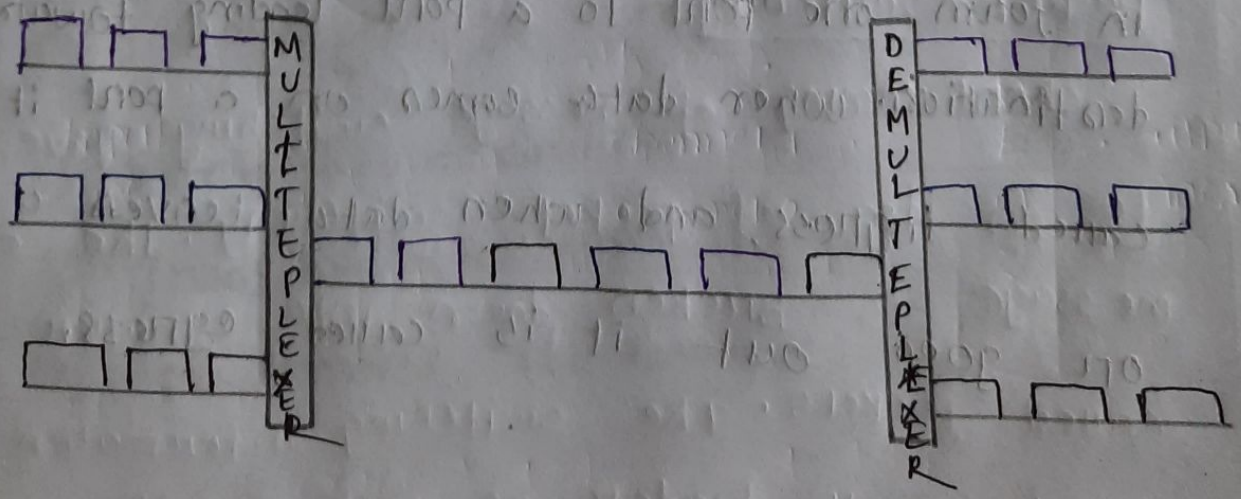


Fig: Wavelength Division Multiplexing

iii) Time Division Multiplexing : is applied primarily on digital signals but can be applied on analog signals as well. In TDM the shared channel is divided among its user by means of time slot. Each user can transmit data within the provided time slot only. Digital signals are divided in frames, equivalent to time slot i.e frame of an optimal size which can be transmitted in given time slot.



5. a) What is the network switching? Explain circuit switching, packet switching and message switching. ~~with diagram~~ 1+6

b) Discuss different types of error 4

c) What is the different between DSS and CM ESS 3.

Ans to the question no - 5(a)

Network switching:

Switching is process to forward packets coming in form one port to a port leading towards the destination. When data comes on a port it is called ingress, and when data leaves a port or goes out it is called egress.

Circuit switching:

When two nodes communication each other over a dedicated communication path, it is called circuit switching. There is a need of pre-specified route from which data will travels and no other data is permitted. In circuit switching, to transfer the data, circuit must be established so that the data transfer can take place. circuits can be permanent or temparary. Applications which use circuit switching may have to go through three phases;

i) Establish a circuit.

ii) Transfer the data.

iii) Disconnect the circuit

Message switching: This technique was somewhere in middle of circuit switching and packet switching. In message switching, the whole message is treated as a data unit and is switching/ transferred in its entirety. A switch working on message switching, first recieves the whole message and buffers it until there are resources available to transfer it to the next hop. If the hop is not having enough resource to accommodate large size message, the message is stored and switch waits.

packet switching:

short coming of message switching gave birth to an idea of packet switching. The entire message is broken down into smaller chunks called packets. The switching information is added in the header of each packet and transmitted independently.

Ans to the question no - 5(b)

Different types of error:

There are may have three types of error.

i) Single bit error:

In a frame, there is only one bit, anywhere through, which is corrupt.

1	0	1	1	0	0	1	1	→	1	0	1	1	0	1	1	1

sent → Received.

ii) Multiple bits error:

~~fo~~ frame is received with more than one bits in corrupted state.

1	0	1	1	0	0	1	1	→	1	0	1	0	0	1	1	1

sent → Received

iii) Burst error:

frame contains more than 1 consecutive bits corrupted.

1	0	1	1	0	0	1	1	→	1	1	0	0	0	1	1	1

sent → Received.

Ans to the question no-5(c)

The different between BSS and ESS:

BSS	ESS
1. Stand for basic circuit service.	1. Stand for extended service set.
2. BSS has only one access point	2. Has 2 or more access point.
3. Short range	3. more range than BSS.
4. The concept of roaming is not present	4. Roaming is present.

6. a) with suitable example describe the error detection method: cyclic Redundancy check. 5.

b) Explain the case of operations of stop-wait ARQ with necessary diagram. 6.

c) Explain briefly error correction 3.

Ans to the question no-6(a)

cyclic Redundancy check:

CRC is a different approach to detect if the received frame contains valid data. This technique involves binary division of the data bits beign being sent. The divisor is generated using polynomials. The sender performs a division operation on the bits being sent and calculates the remainder. Before sending the actual bits,

the sender adds the remainder at the end of the actual bits. Actual data bits plus the remainder is called a code word. The sender transmits data bits as code words.

```
Divisor
  101 | 11001      11
        101
        ---
         110
         101
         ---
          111
          101
          ---
           10
```

Data bits

CRC

```
Divisor
  101 | 1100110      111
        101
        ---
         110
         101
         ---
          111
          101
          ---
           101
           101
           ---
            000
```

Data bits + CRC

No ERROR

At the other end, the receiver performs division operation on codewords using the same CRC divisor.

Ans to the question no- 6(b)

case of operation of stop-and-wait ARQ:

i) The sender maintains a timeout counter.

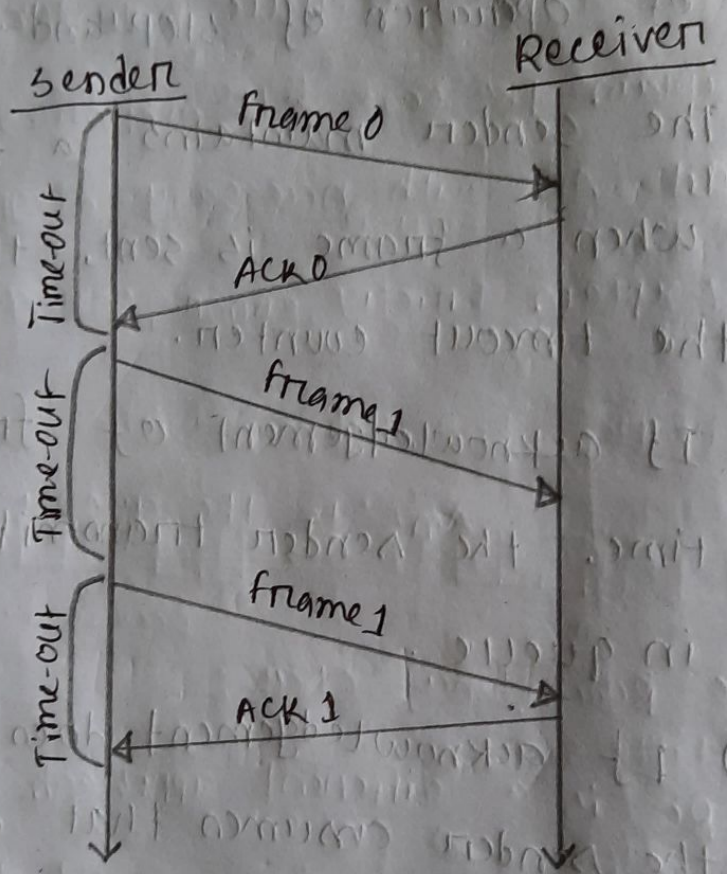
ii) when a frame is sent, the sender starts the timeout counter.

iii) If acknowledgement of frame comes in time, the sender transmits the next frame in queue.

iv) If acknowledgement does not come in time, the sender assumes that either the frame or its acknowledgement is lost in transmit. Sender retransmits the frame and starts the timeout counter.

v) If a negative acknowledgement is received, the sender retransmits the frame.

Stop-and-wait ARQ



Ans to the question no-6(c)

Error correction:

In the digital world, error correction can be done in two ways:

i) Backward Error correction:

When the receiver detects an error in the data received, it request back the sender to retransmit the data unit. Backward Error correction, is simple and can only be efficiently used where retransmitting is not expensive. For example, fiber optics.

ii) forward Error correction:

When the receiver detects some error in the data received, it executes error-correcting code, which helps it to auto-recover and to correct some kinds of error. But in case of wireless transmission retransmitting may cost too much.

7. a) What is Hamming distance? What is the minimum Hamming distance? 5.

b) What is framing? Discuss the concept of redundancy in error detection and correction 1+4

c) What kind of arithmetic is use in checksum calculations? 4.

Ans to the question no-7(a)

Hamming distance:

The Hamming distance between two words in the number of differences between corresponding bits. we show the Hamming distance between two words x and Y as d(x,y)

Minimum Hamming distance:

Although the concept of the Hamming distance is the central point in ~~the~~ dealing with error detection and correction codes. The measurement that is used for designing a code is the minimum Hamming distance. In a set of words, the minimum Hamming distance is the smallest Hamming distance between all possible pairs. We use d min to define the minimum Hamming distance in a coding scheme. To find this value, we find the Hamming distances between all words select the smallest one.

Ans to the question no -7(b)

Framing: Data-link layer takes packets from network layer and encapsulates them into frames. Then, it sends each frame bit-by-bit on the hardware. At receiver end, data link layer picks up signals from hardware and assembles them into frames.

Redundancy in error detection and correction:

One's complement arithmetic is used to add data item in checksum calculation. In this arithmetic when a number needs more than n bits the extra bits are wrapped and added to the number. In this arithmetic the complement of a number is made by inverting all bits. The checksum is used in the internet by several protocols although not at the data link layer.

Ans to the question no-7(c)

Arithmetic used in checksum calculation:

one's complement is used to add data item in checksum calculation. In this arithmetic when a number needs more than n bits the extra bits are wrapped and added to the number. In this arithmetic the complement of a number is made by inverting all bits. The checksum is used in the internet by several potocols although not at the data link layer. Like linear and cyclic codes, the checksum is based on the concept of redundancy. Several potocols still used the checksum for error detection.

8. a) Define the type of the following destination addresses: i) 4A:10:21:10:1A

ii) 47:20:1B:2E:08:EE

iii) FF:FF:FF:FF:FF:FF 3.

b) Describe the structure of pico-net and scatter-net 4

c) Define ~~an~~ CDMA. Describe analog to analog conversion with figure. 1+6.

Ans to the question no-8(a)

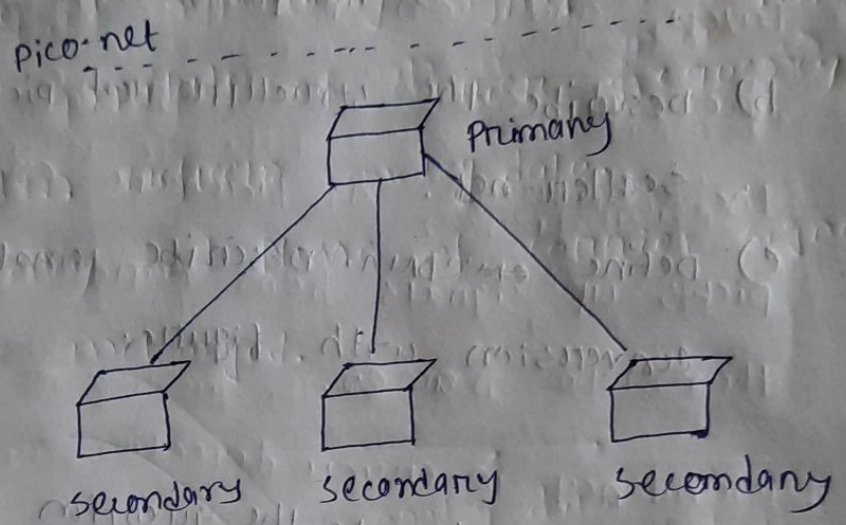
i) 4A:30:10:21:10:1A this is a unicast address because A binary is 1010 (even)

ii) 47:20:1B:2E:08:EE This is a multicast address because 7 in binary is 0111 (odd)

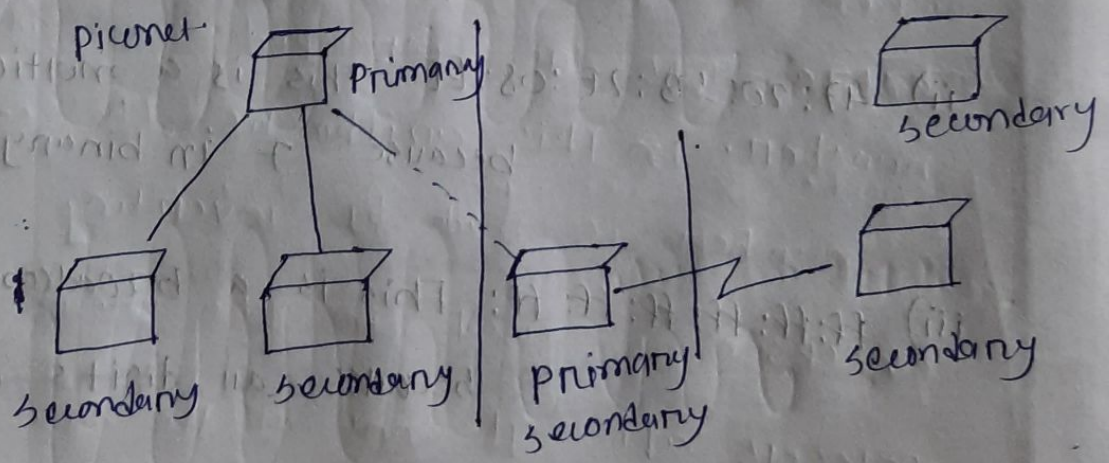
iii) FF:FF:FF:FF:FF:FF: This is a broadcast address because all digits are F's

Ans to the question no-8(b)

Pico-net



scatter-net:



Ans to the question no-8(c)

CDMA: code division multiple access or CDMA is a sort of multiplexing that facilitates various signals to occupy a ~~signal~~ single transmission channel.

Analog to analog conversion:

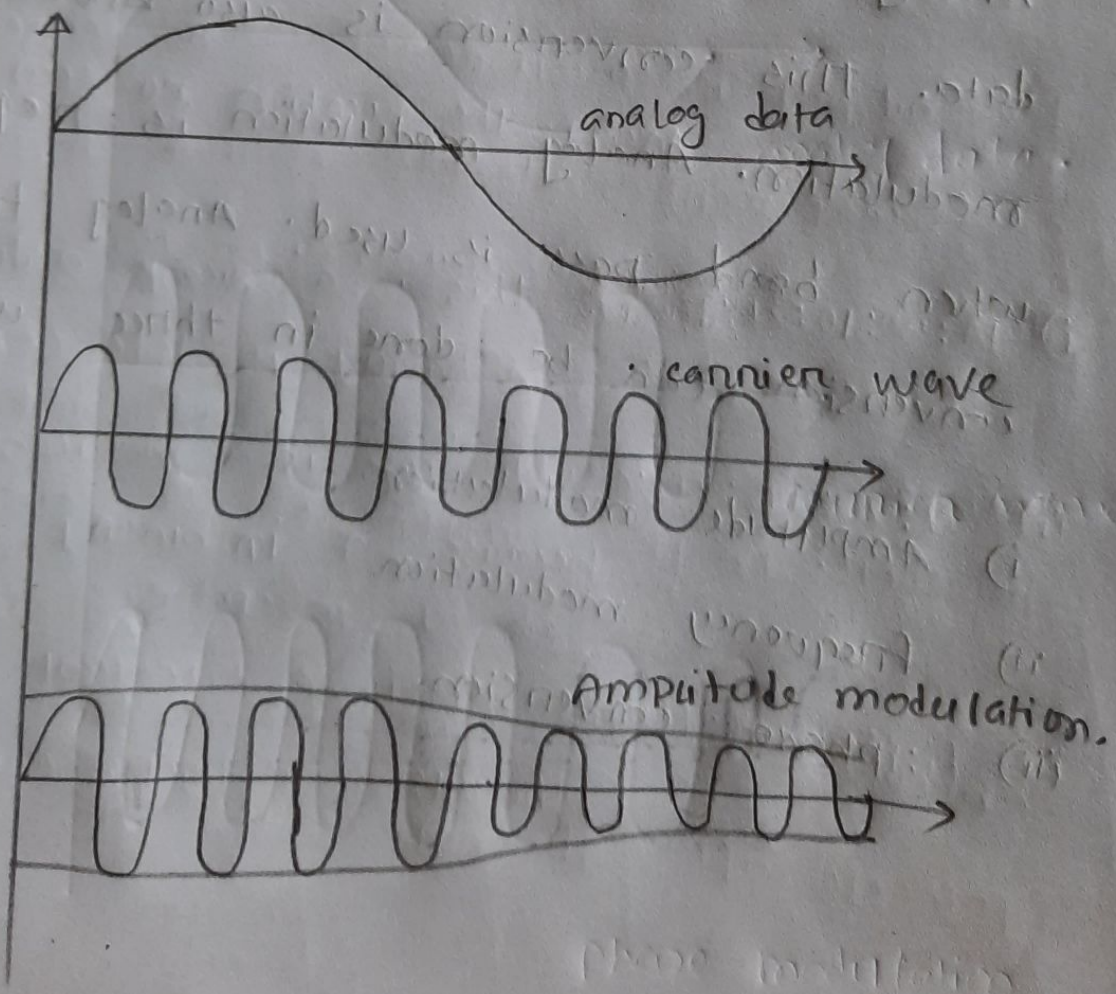
Analog signals are modified to represent analog data. This conversion is also known as analog modulation. Analog modulation is required when band pass is used. Analog to analog conversion can be done in three ways:

i) Amplitude modulation
ii) Frequency modulation
iii) phase conversion.

Amplitude modulation :

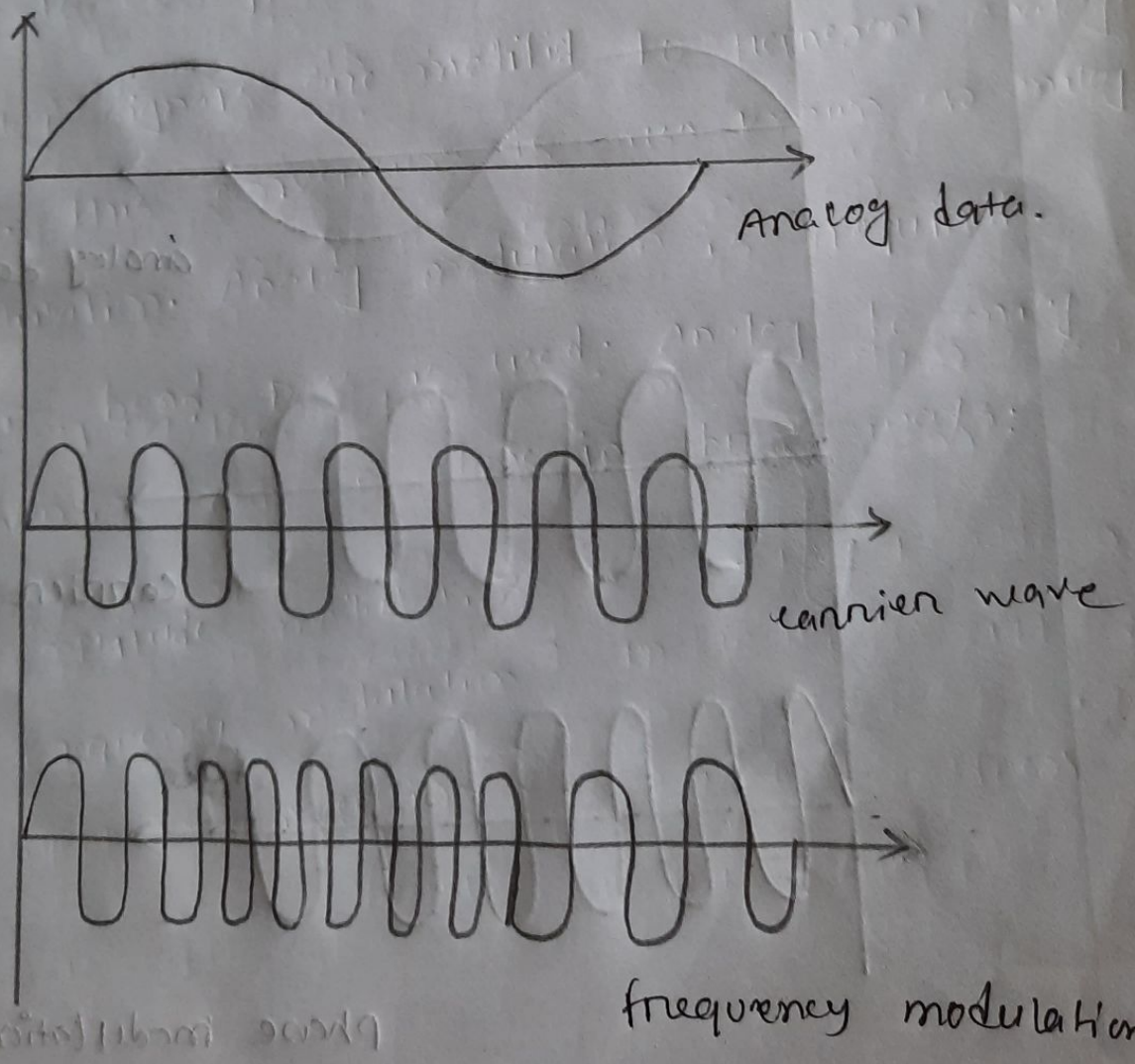
The amplitude of the carrier signal is modified to reflect the analog data. The amplitude of modulating signal is multiplied by the amplitude of carrier frequency, which then reflects analog data.

The frequency and phase of carrier signal remain unchanged.



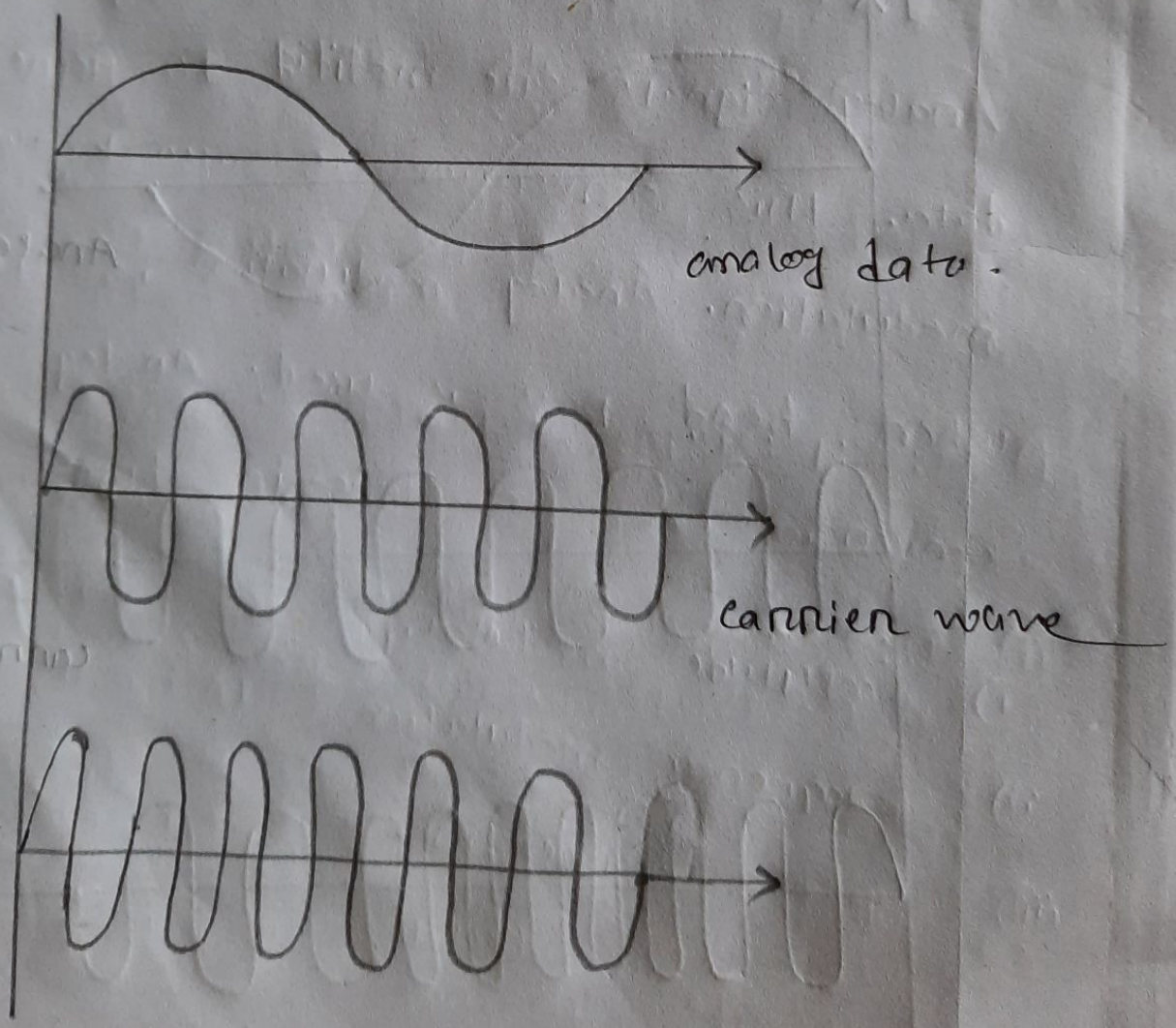
Frequency modulation:

The frequency of the carrier signal to reflect the change in the voltage levels of the modulating signal. The amplitude and phase of the carrier signal are not altered.



phase modulation:

The phase of carrier signal is modulated in order to reflect the change in voltage of analog data signal. The phase modulation frequency of the carrier signal is not increased.



phase modulation