Muhammad Idrees Khan
ID: 6659

Iqra *National University, Peshawar*
Department of Computer Science
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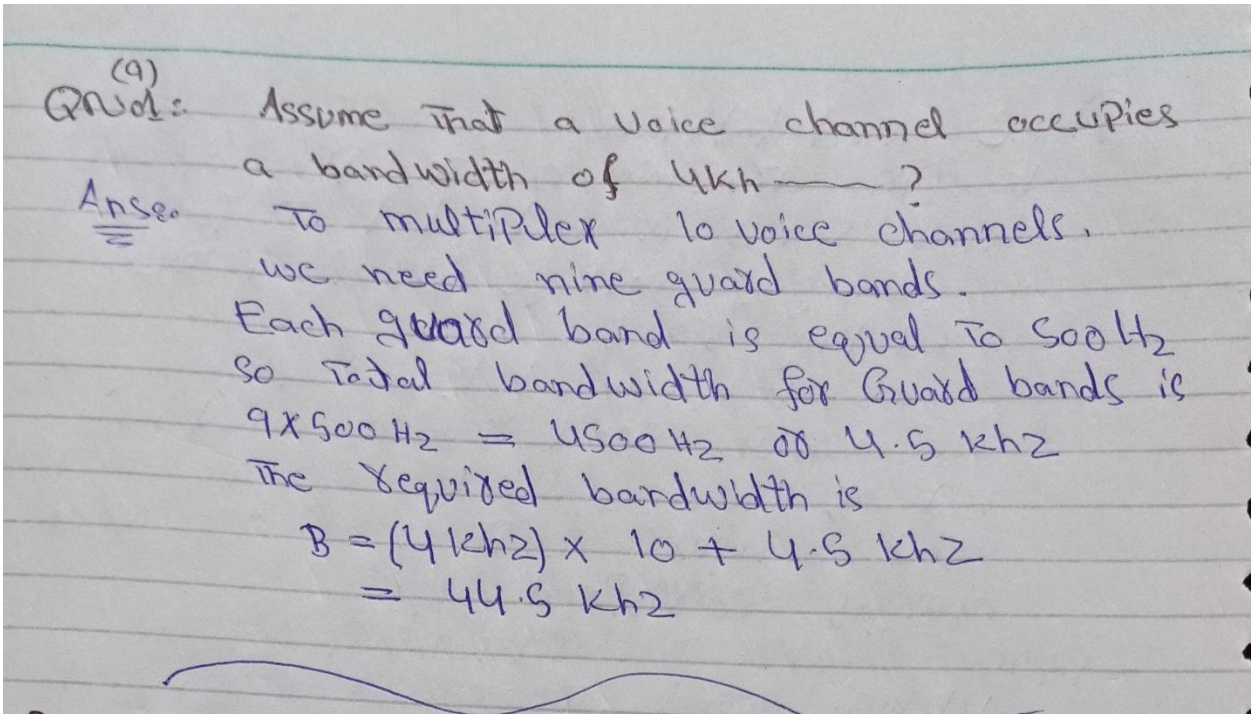
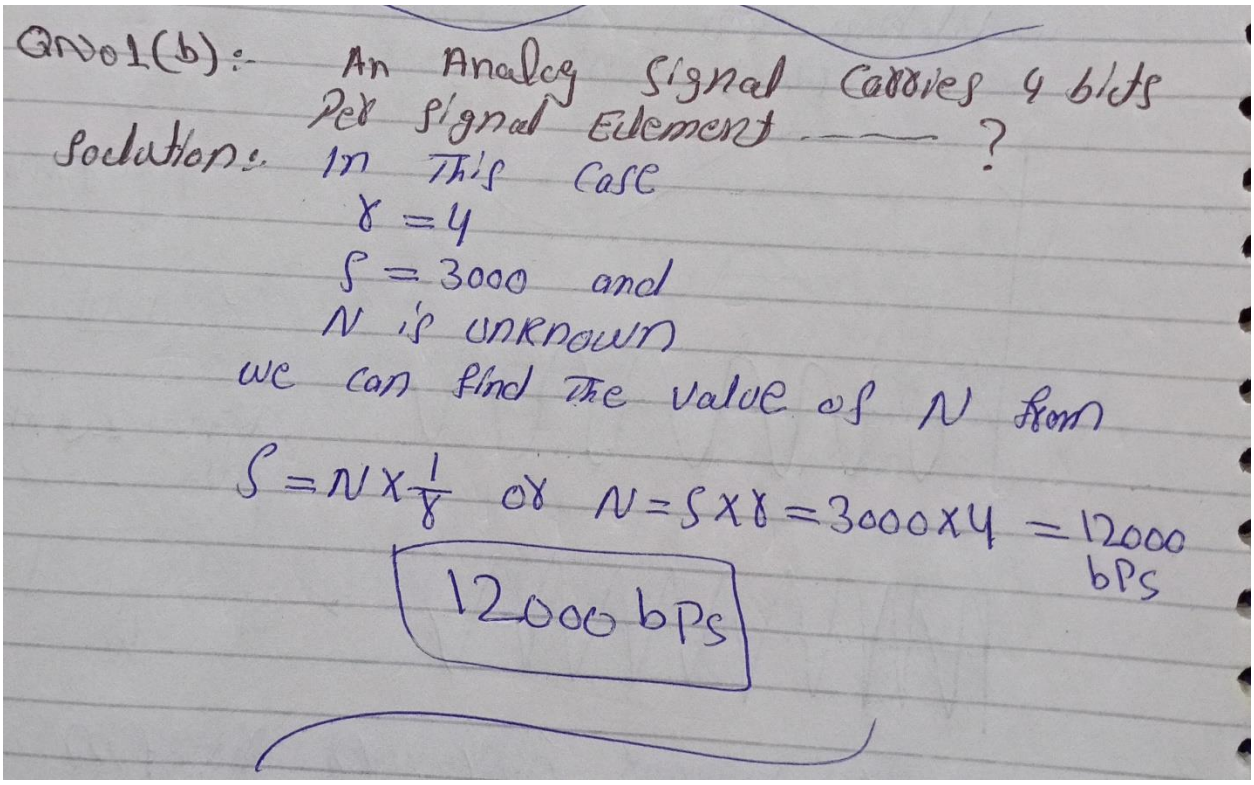
Online Final – Term Examination
Course Code: 102002090
Course Title: Data Communication and Networks
Instructor: Engr. Ghassan Husnain
Program: BS Computer Science
Note: Attempt all Questions

Q1) Sec a) Assume that a voice channel occupies a bandwidth of 4 kHz. We need to multiplex 10 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth.



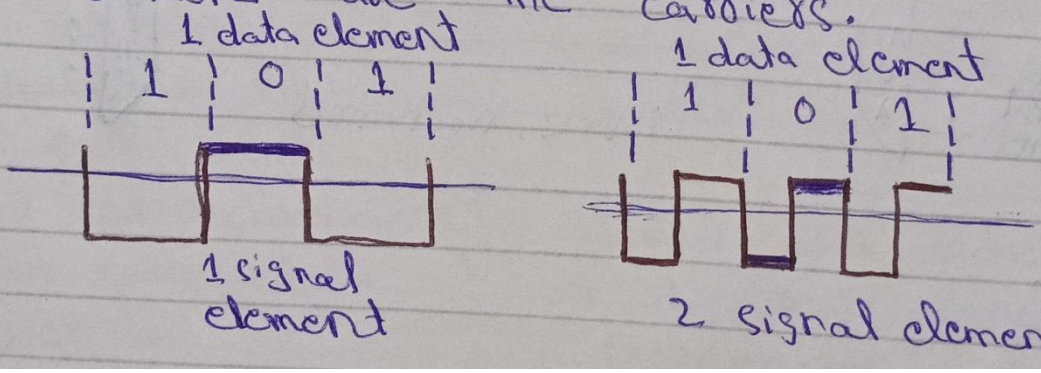
Q1) Sec b) An analog signal carries 4 bits per signal element. If 3000 signal elements are sent per second, find the bit rate.



Q1) Sec c) Distinguish between a signal element and a data element.

Qno 1:- Sec d:- Distinguish between a signal element and data element.

Ans:- The main goal of communication is to send data element or data. A data element is the smallest entity that can represent a piece of information. This is the bit. Because a bit is the smallest element of digital data. In digital communication a "signal element" carries data element i.e, the bits. if we measure in time, a signal element is the shortest unit of a digital signal. In other words data element are what we need to send. i.e, the data; signal element are what we can send, i.e, the signal Data element are being carried, signal element are the carriers.

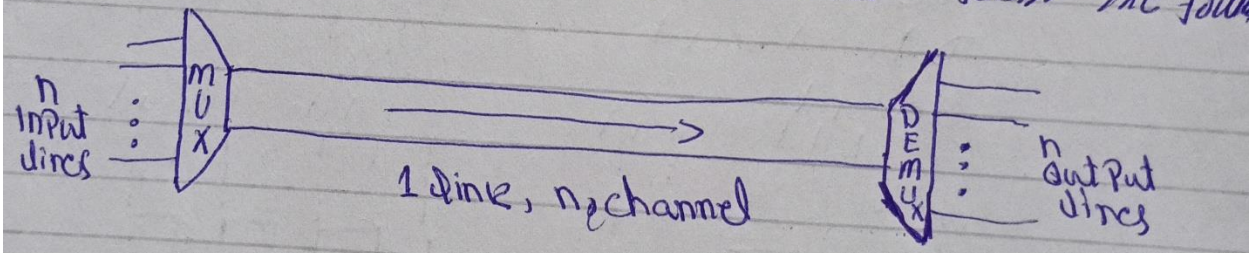


Q1) Sec d) Distinguish between a link and a channel in multiplexing.

QNo1:- sec D:- Distinguish between a link and a channel in multiplexing.

Ans:- Multiplexing is the set of techniques that allows ~~and bandwidth~~ the simultaneous transmission of multiple signal across a signal data link if the link allows and bandwidth available, so, from the above definition "Link refers to the physical path of transmission while channel refers to the portion of a link that carries a transmission between a given pair of lines one physical link can have many (n) channel.

This can be illustrated from the foll



Q1) Sec e) List three different techniques in serial transmission and explain the differences.

Qno1. Sec 8. List three different Techniques in serial Transmission and explain the differences

Ans: The Transmission of binary data accross a link can be accomplished in either Parallel or serial mode. In Parallel mode, multiple bits are sent with each clock Tick. In serial mode, 1 bit is sent with each clock Tick. There are three Techniques of serial Transmission Asynchronous, Synchronous, and Isochronous.

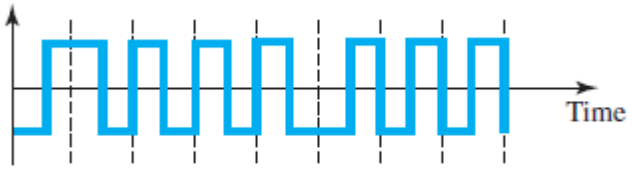
While there are very obvious differences between Asynchronous and Synchronous Communication, The Isochronous is used for a different type of communication as given below.

Synchronous	Asynchronous
① A data Transfer method that sends a continous stream of data To the received using regular timing signals That ensures both Transmitter and received as synchronized with each other.	① A data Transfer method that sends data from Transmitter To reciver with Parity bits (start and stop bits) in uneven Intervals.
② sender and receiver operate on the same clocks frequencies	② sender and reciver operate on different clock frequencies.
③ Faster	③ Slower
④ There are no gaps b/w data - data flows as a continous stream	④ There can be gaps between data interval
⑤ Uses constant Time intervals	⑤ Uses random or Irregular Time
⑥ Used in chat rooms and video conferencing	⑥ Used in emails

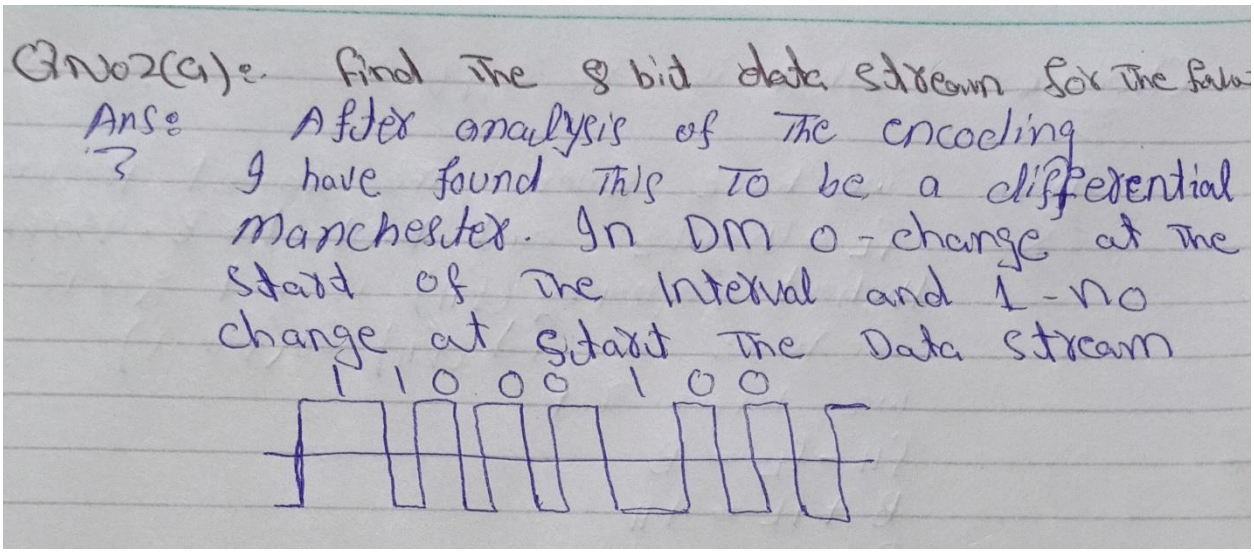
Isochronous Transmission :-

- In real time audio and video, in which uneven delays between frame are not Acceptable. They must be viewed at the same rate.
- A ~~A~~ dedicated type of communication defined at the data link layer used to support real-time applications.
- Data must be delivered at just the right speed (real time) — not too fast and not too slow. Typically an isochronous connection must allocate resources on both ends to maintain real time.
USB and firewire can both support isochronous.

Q2) Sec a) Find the 8-bit data stream for the following case:



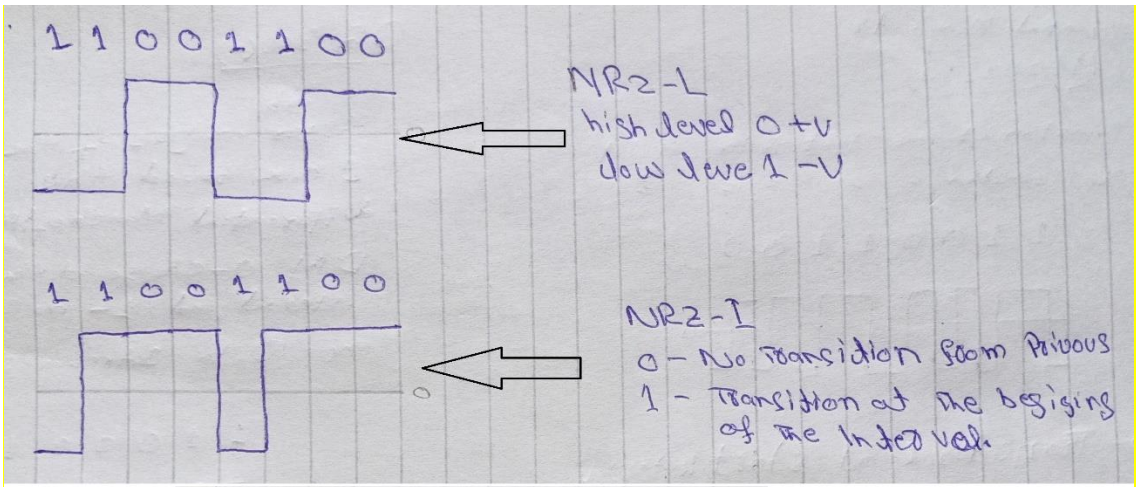
b. differential Manchester

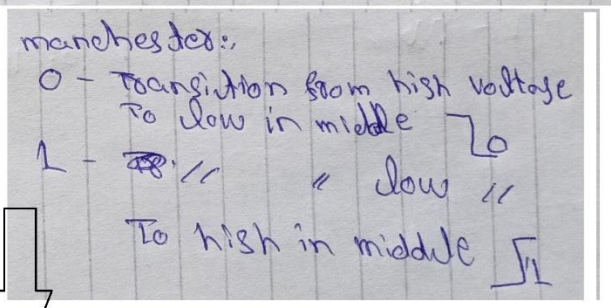


Bit stream is: 11000100

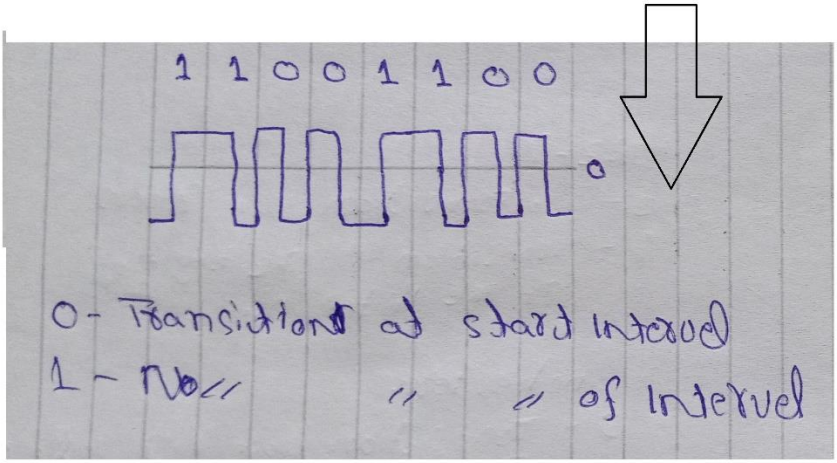
Q2) Sec b) Draw the graphs of the Manchester, differential Manchester, NRZ-I and NRZ-L schemes for each of the following data streams: (4 marks)

a. 11001100

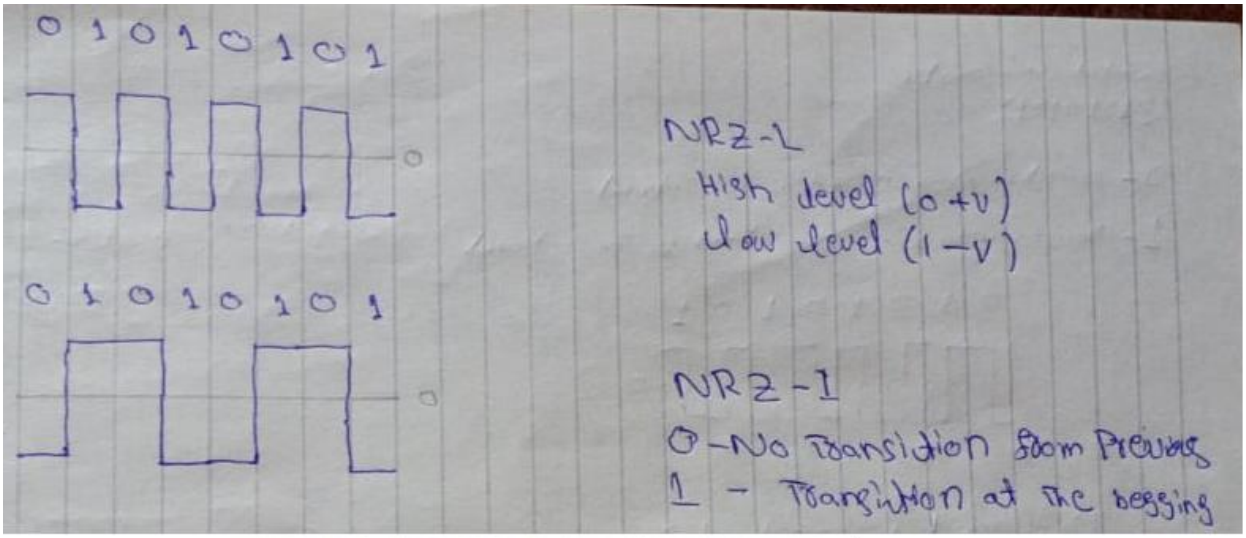


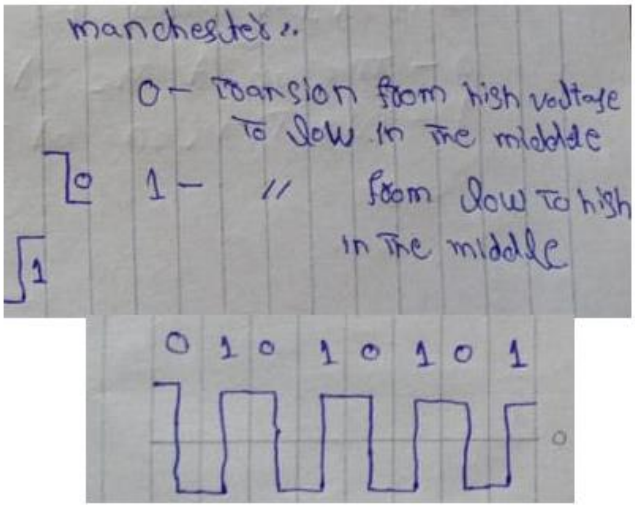


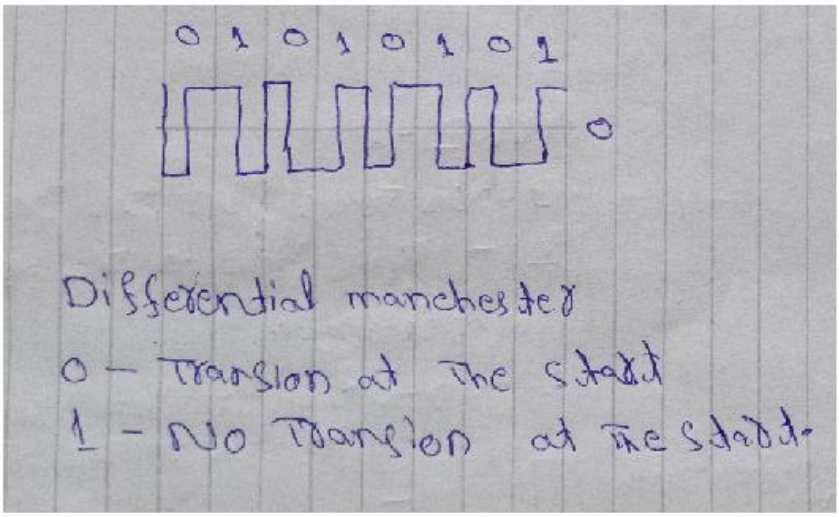
Differential Manchester



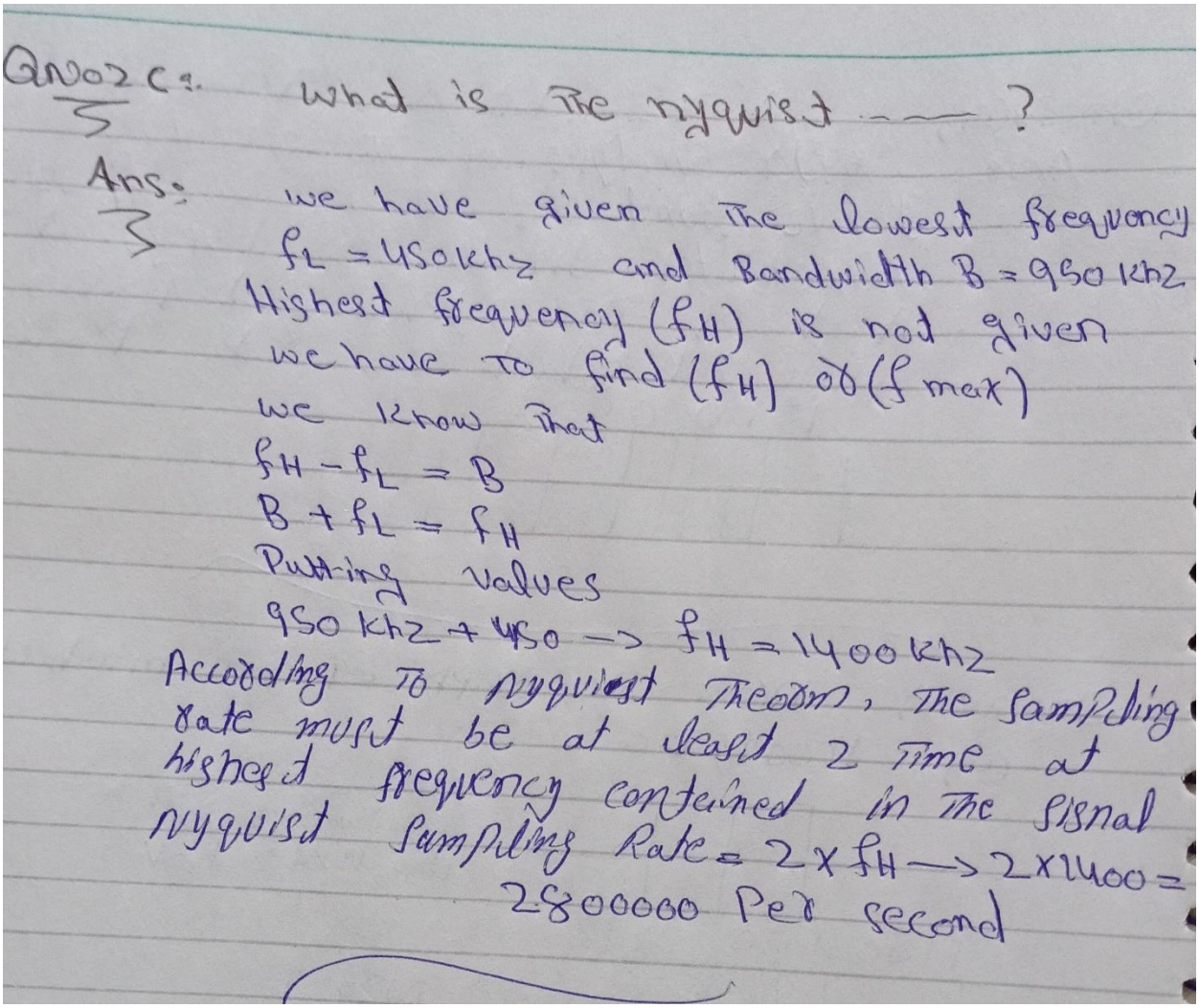
b. 01010101


0 1 0 1 0 1 0 1
NRZ-L
High level (0 +V)
Low level (1 -V)
0 1 0 1 0 1 0 1
NRZ-I
0 - No Transition from Previous
1 - Transition at the beggining


manchester:
0 - Transion from high voltage to low in the middle
1 - // from low to high in the middle
0 1 0 1 0 1 0 1


0 1 0 1 0 1 0 1
Differential manchester
0 - Transion at the start
1 - No Transion at the start.

Q2) Sec c) What is the Nyquist sampling rate for the band-pass signal with bandwidth of 950 KHz if the lowest frequency is 450 KHz?



Q3) Sec a) We have an available bandwidth of 300 kHz which spans from 500 to 800 kHz. What are the carrier frequency and the bit rate if we modulated our data by using ASK with d = 1?

(9)

Qno3: We have an available bandwidth of 300 kHz which spans from 500 to 800 kHz

Solution: The middle of the bandwidth is located at 650 kHz. This means that our carrier frequency can be at $f_c = 650$

We can use the formula for bandwidth to find the bit rate with $d = 1$ Here γ is the bits per signal element, so we suppose $\gamma = 1$. Because we cannot find the value of γ as we dont have N.

carrier frequency $\rightarrow f_c = 650$ kHz

And the formula for bit rate is

$B = (1 + d) \times S$

The value are $B = 300$ kHz

$d = 1$

$\gamma = 1$ So we place the value in the ~~below~~ above formula.

$B = (1 + d) \times S$

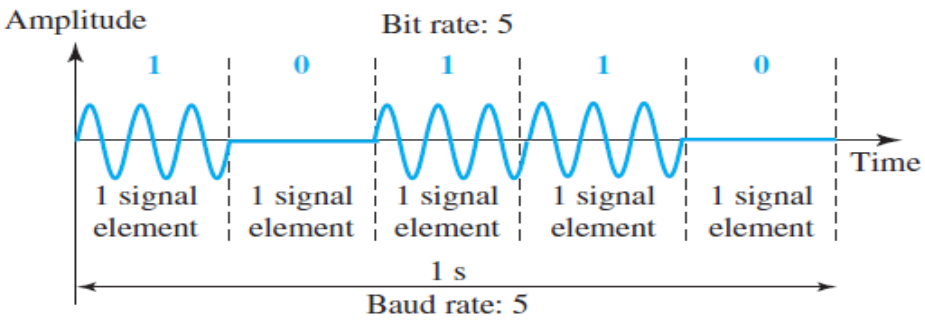
$(1+1) \times N \times \frac{1}{8} \rightarrow 2 \times N \times \frac{1}{1} \rightarrow$

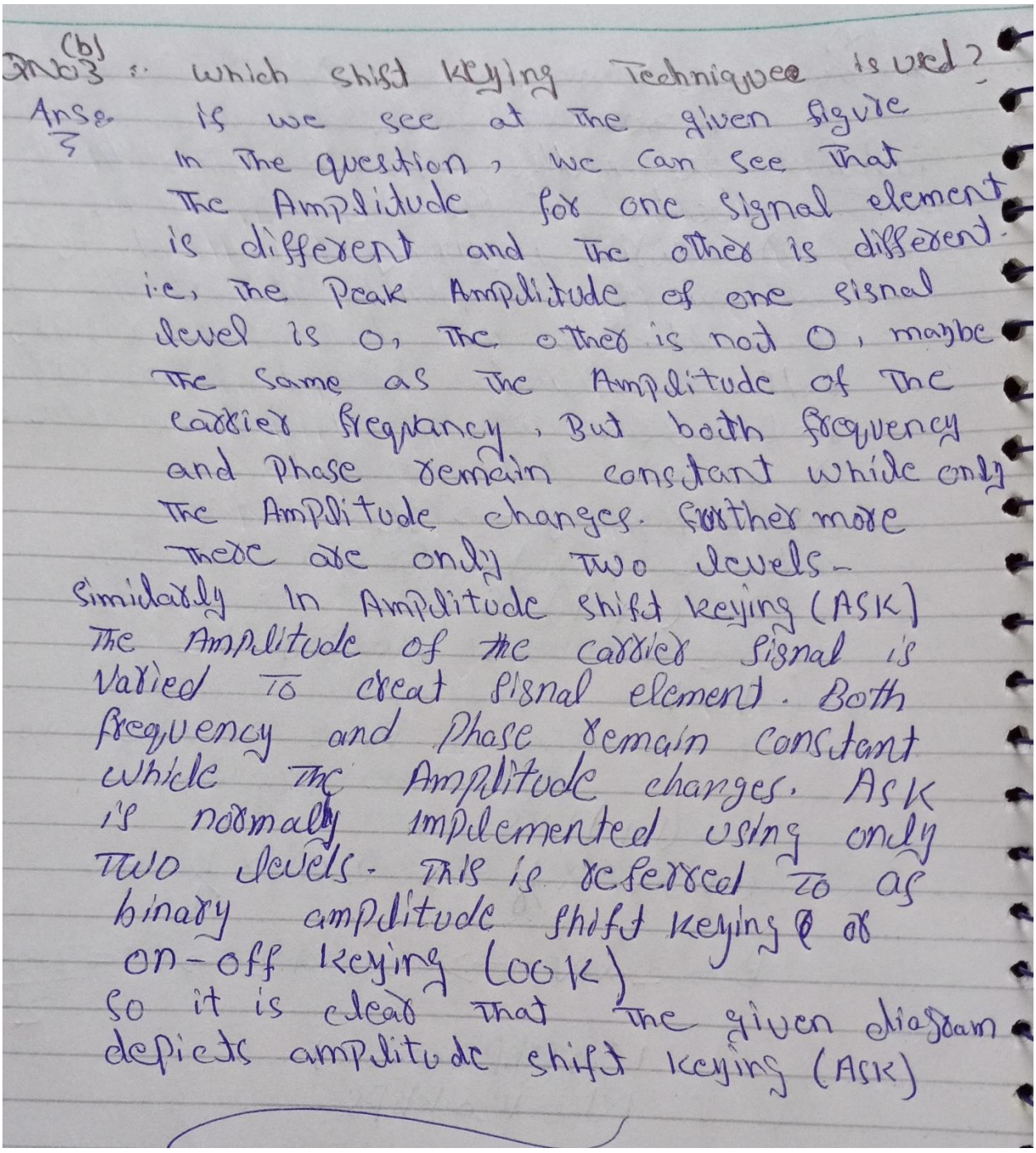
$B = 2 \times N \rightarrow 300$ kHz $\rightarrow N = \frac{300}{2} =$

150 kbps $= N$

$N = 150$ kbps

Q3) Sec b) Which shift keying technique is used in the following diagram? Briefly explain:


Amplitude
Bit rate: 5
1
0
1
1
0
Time
1 signal element
1 signal element
1 signal element
1 signal element
1 signal element
1 s
Baud rate: 5



Q4) Sec a) Briefly explain the FDM Multiplexing and De-Multiplexing Process with the help of diagram and also differentiate between TDM and FDM?

(9)

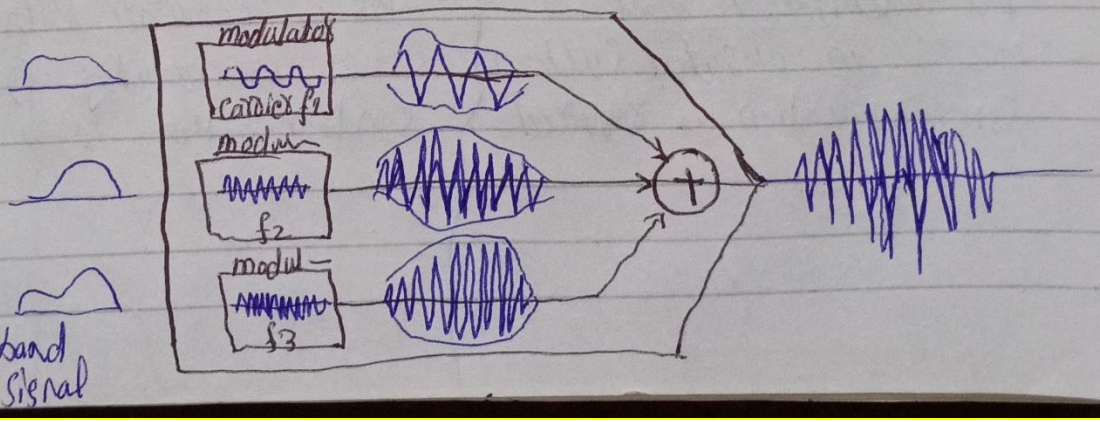
Q.No 4: Briefly explain the FDM multiplexing ....?

Ans: FDM is an analog technique that can be applied when the bandwidth of a link is greater then the combined bandwidth of the signals to be transmitted. In FDM, signals generated by each sending device modulate different carrier frequencis. These modulated signals are then combined into a single composite signal that can be transported by the link. channels can be separated by strips of unused bandwidth - guard bands - to prevent signals from overlapping.

FDM multiplexing Process:

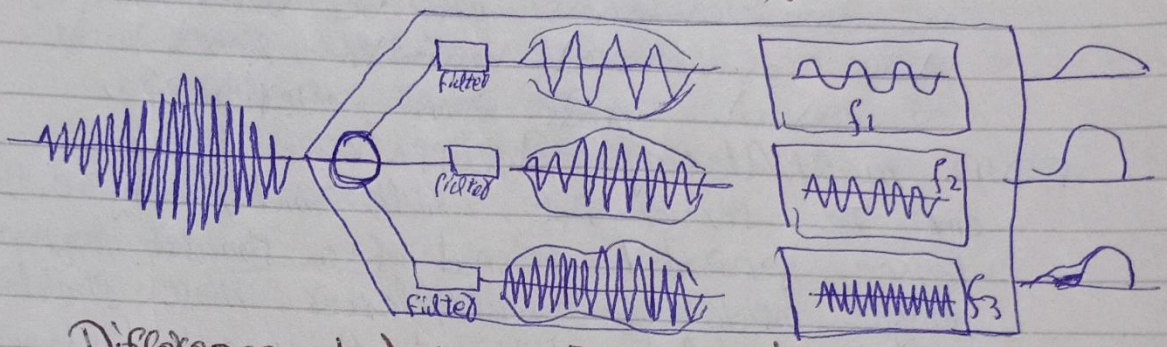
one the sender side, while multiplexing, each source generated a signal of a similer frequancy range. Inside the multiplexer, these similar signal modulate, different frequencies (f_1, f_2 and f_3) The resulting modulated signals are then combined into a signal composite signal that is sent out over a media link that has enough bandwidth to accommodate it.

The below illustration is showing the FDM multiplexing process.



FDM Demultiplexing Process:-

on the receiver side, demultiplexer is used to demultiplex the signal. The de-multiplexer uses a series of filters to decompose the multiplexed signal into its constituent component signals. The individual signals are then passed to a demodulator that separates them from their carries and passes them to the output line. The below illustration is showing the FDM Demultiplexing



Difference between TDM and FDM

TDM	FDM
→ TDM Total available time is divided into several users	→ Total frequency bands are divided into several users.
→ Transmission of two or more signal on the same path but at different times	→ A multiplex system for transmitting two or more signals over a common path.
→ use in digital system synchronization is required	→ use in analog system synchronization is not required

Q4) Sec b) Briefly explain Analog to Analog conversion techniques with the help of diagrams?

Sec(b)

Q.No 4. Briefly Explain Analog to Analog conversion.

Ans. Analog to Analog conversion, or Analog modulation is the representation of Analog Information by an analog signal. it is usually needed when the medium is bandpass in nature or if only a bandpass channel is available to us. An example is radio transmission.

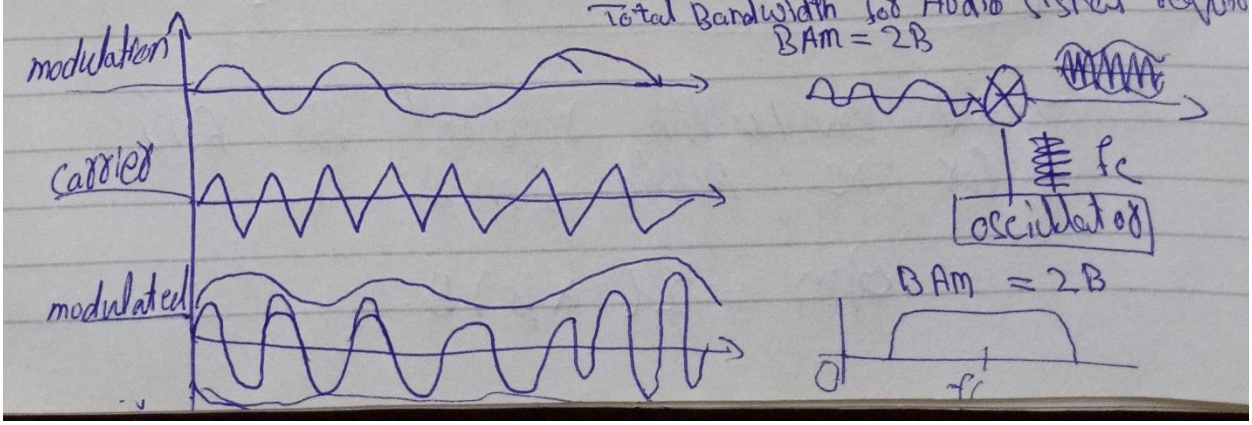
Analog to Analog conversion can be accomplished in three ways. Amplitude modulation (AM) frequency modulation (FM) and Phase modulation (PM)

Amplitude Modulation :-

In AM transmission, the carrier signal is modulated so that the Amplitude varies with the changing amplitude of the modulating signal.

The frequency and Phase of the carrier remain the same, only the Amplitude changes to follow variation in the Informati The modulating signal is the envelope of the carrier.

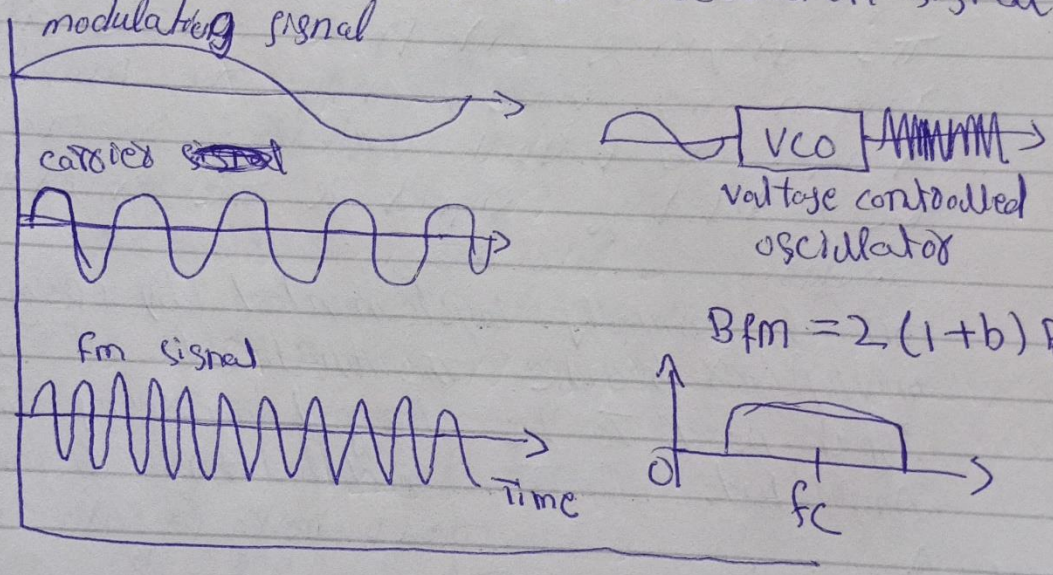
Am is normally implemented by using a simpl multiplier because the Amplitude of the carrie signal needs to be changed according to the Amplitude of the modulating signal.



Frequency Modulation:

In FM transmission, the frequency of the carrier signal is modulated to follow the changing voltage levels of the modulation signal. The peak amplitude and phase of the carrier signal remain constant, but as the amplitude of the information signal changes, the frequency of the carrier changes correspondingly.

FM is normally implemented by using a voltage-controlled oscillator as with FSK. The frequency of the oscillator changes according to the input voltage which is the amplitude of the modulation signal.



Total bandwidth required for FM for the audio signal

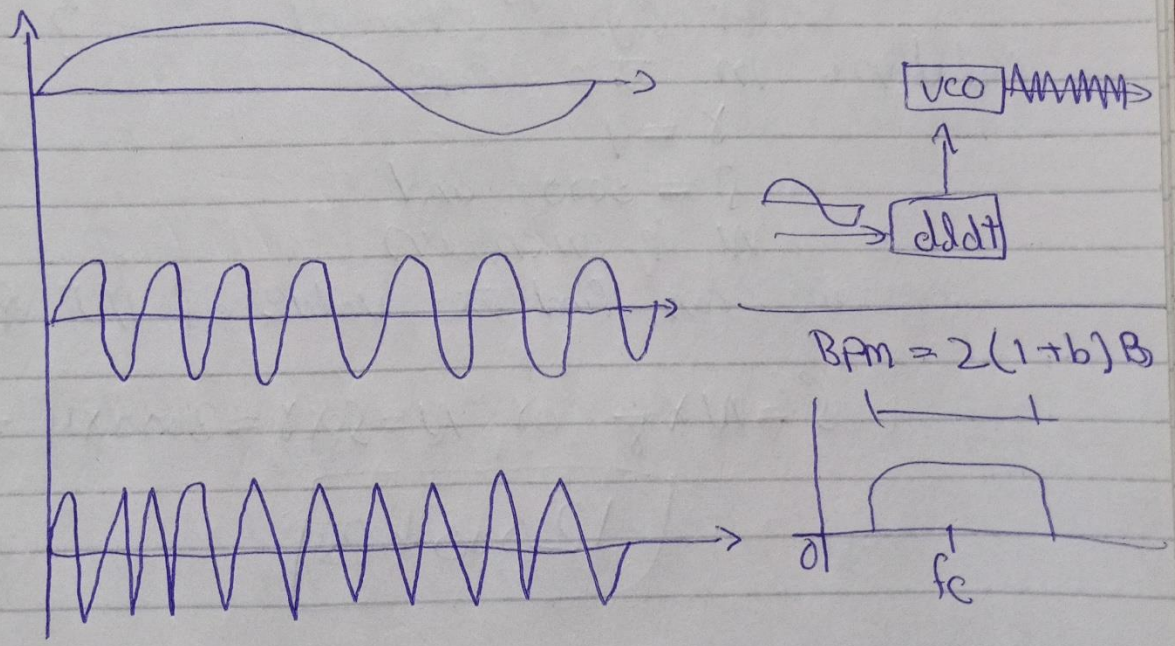
$$B_{FM} = 2(1 \times B)B.$$

Phase Modulation :-

In PM Transmission, the Phase of the carrier signal is modulated to follow the changing voltage level of the modulating signal.

The Peak Amplitude and frequency of the carrier signal remain constant but as the amplitude of the information signal changes, the Phase of the carrier changes correspondingly.

figure show the relationships of the modulation signal, the carrier signal and the resultant PM signal.-



Total Required Bandwidth for FM

$$B_{FM} = 2(1 \times B)\, B.$$