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Subject: Data communication and networks

Question 1 sec A:

To multiplex 10 voice channels,

we need nine guard bands.

The required bandwidth is

then B = (4 KHz) × 10 + (500 Hz) × 9 = 44.5 KHz

Question 1 sec B:

In this case

R = 4

S = 3000

N is unknown.

We can find the value of N from

S=N*1/r or N=S*r= 3000*4

N=12000bps.

Question 1 sec C:

Let us distinguish between a **data element** and a **signal element.**

In data communications, our goal is to send data elements.

A data element is the smallest entity that can represent a piece of information: This is the bit.

In digital data communications, a signal element carries data elements.

A signal element is the shortest unit (time wise) of a digital signal.

In other words, data elements are what we need to send; signal elements are what we can send.

Data elements are being carried; signal elements are the carriers.

Question 1 sec D:
In multiplexing, the word **link** refers to the physical path.

The word **channel** refers to the portion of a link that carries a transmission between a given pair of lines.

One link can have many (n) channels.

Question 1 sec E:
Three different techniques in serial transmission are:

1) Synchronous
2) Asynchronous
3) Isochronous

In both **synchronous and asynchronous transmissions**, a bit stream is divided into independent frames.

In **synchronous transmission**, the bytes inside each frame are synchronized.

In **asynchronous transmission**, the bytes inside each frame are independent.

In **isochronous transmission**, there is no in-dependency at all. All bits in the whole stream must be synchronized.

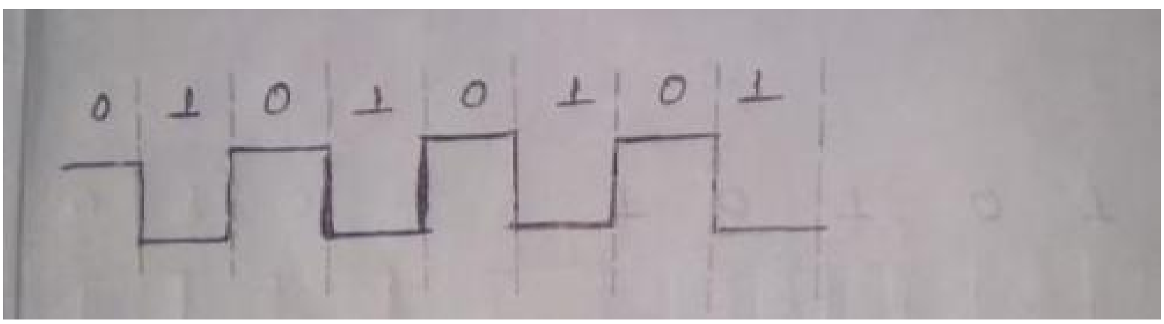
Question 2 sec A:

Differential Manchester = 11000100

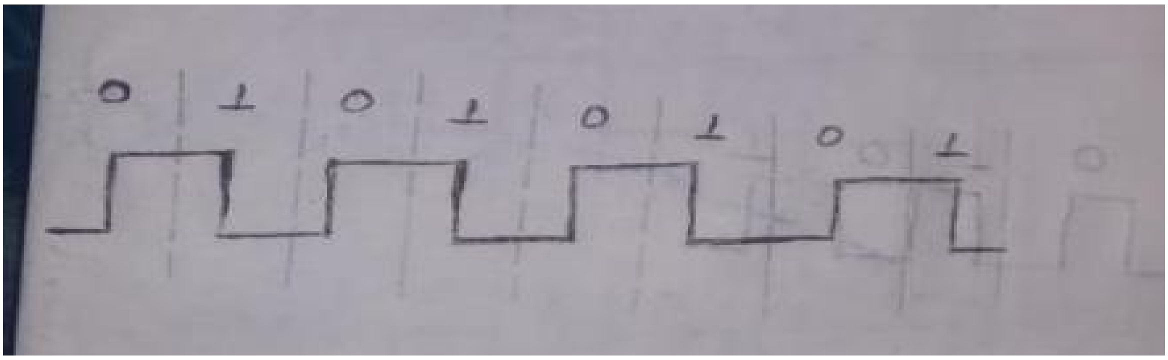
Question 2 sec B:

a)01010101

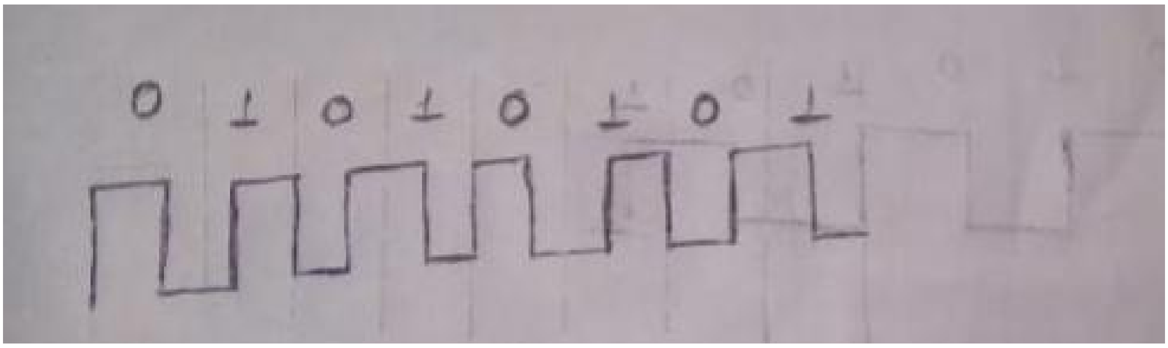
NRZ-L (Non-return-to-zero-level) graph:



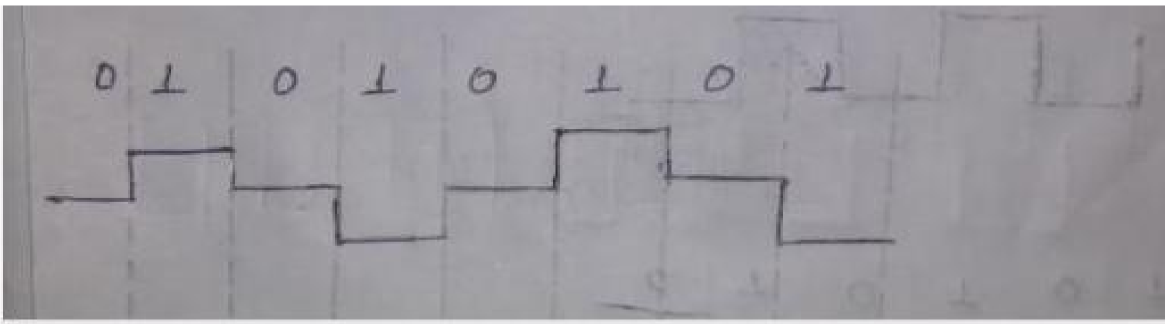
Manchester graph:



Differential Manchester graph:

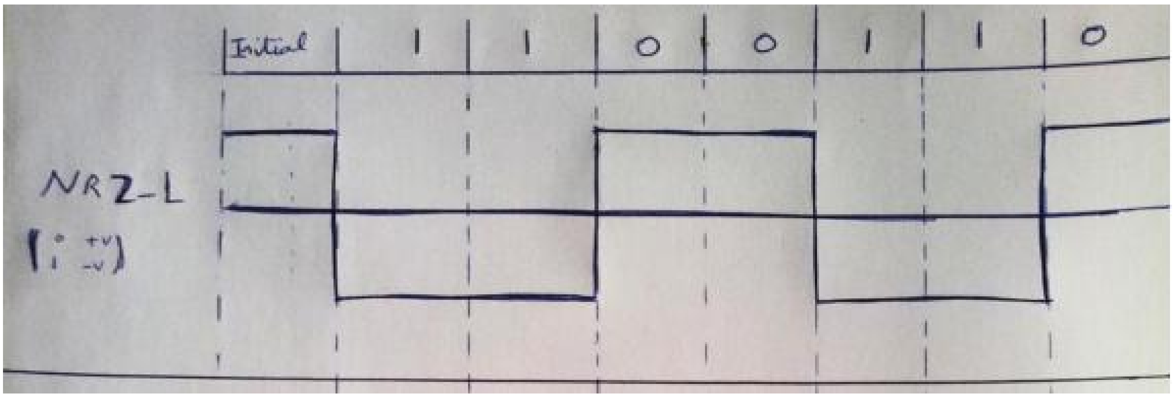


AMI scheme (Alternate Mark Inversion) graph:

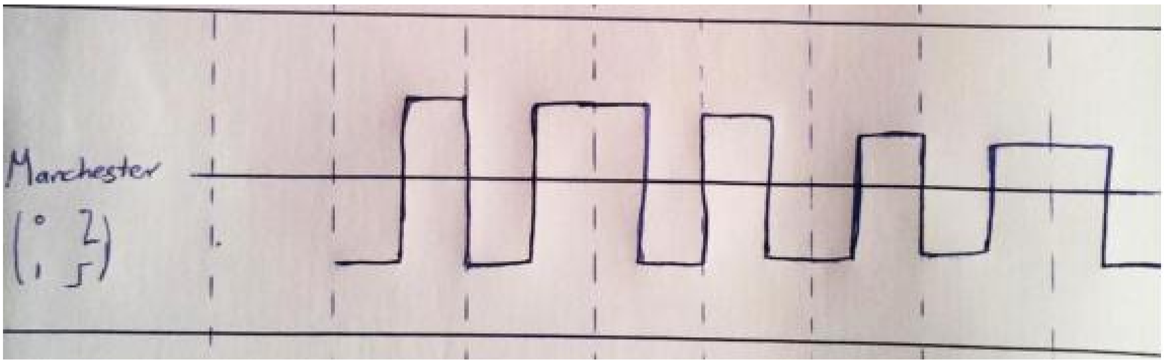


b) 11001100

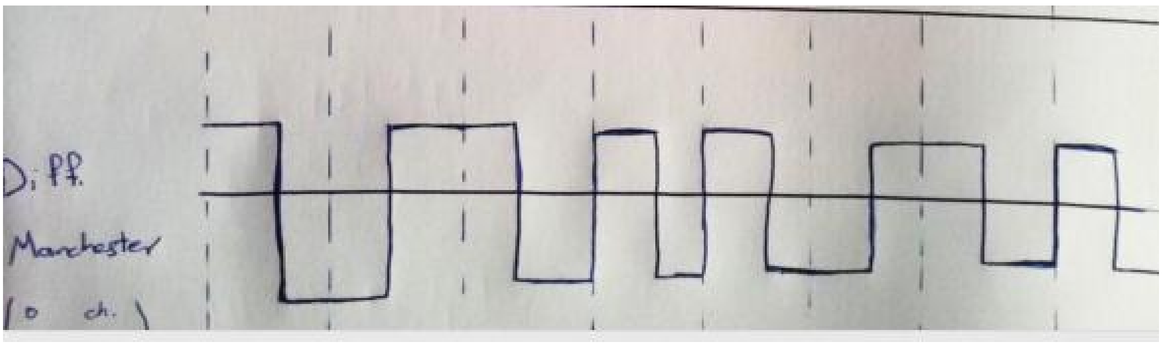
NRZ-L (Non-return-to-zero-level) graph:



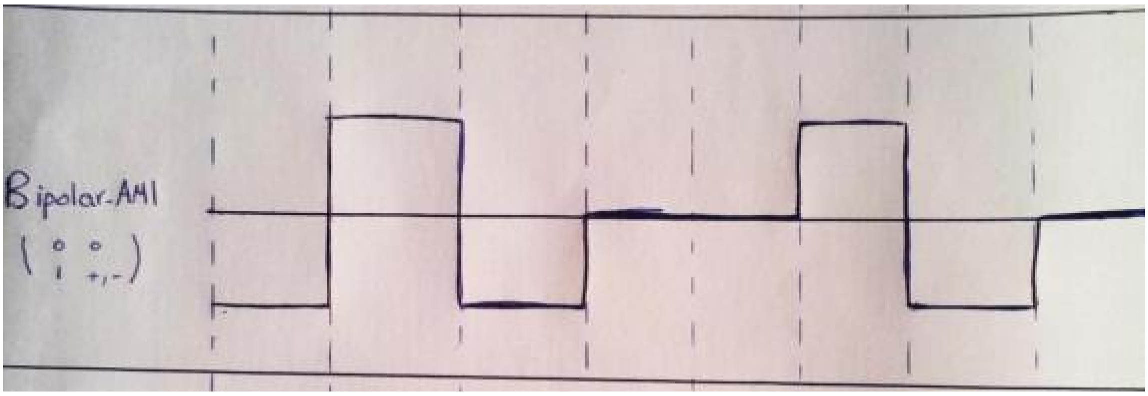
Manchester graph:



Differential Manchester graph:



AMI scheme (Alternate Mark Inversion) graph:



Question 2 sec C:

Bandwidth = Highest frequency - Lowest frequency

950KHz = x - 450KHz

x = 950 + 450 = 1400KHz

Nyquist Sampling Rate => should be at least twice the maximum frequency

Hence,
Nyquist Sampling Rate = 2*1400 Khz = 2800 KHz

Question 3 sec A:
The middle of the bandwidth is located at 650 kHz

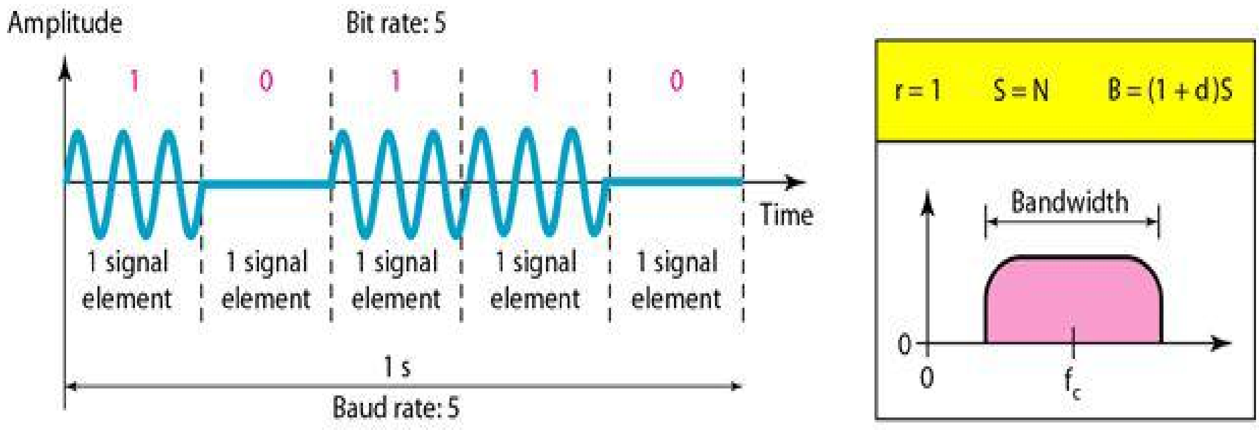
As (500 + 800)/ 2 = 650

This means that our carrier frequency can be at fc = 650 kHz

We can use the formula for bandwidth to find the bit rate
(with d = 1 and r = 1)

B = (1 + d) * S = 2 * N * (1 / r)
= 2 * N
=> 2 * N = 650 kHz.
=> N = 325 Kbps.

Question 3 sec B:
Amplitude Shift Keying technique is used in the following diagram.



Question 4 sec A:

FDM: Frequency Division Multiplexing
In analog multiplexing, the most used technique is Frequency Division Multiplexing (FDM). This technique uses various frequencies to combine streams of data, for sending them on a communication medium, as a single signal.

Example − A traditional television transmitter, which sends a number of channels through a single cable uses FDM.

De-multiplexers: De-multiplexers are used to connect a single source to multiple destinations. This process is the reverse process of multiplexing. As mentioned previously, it is used mostly at the receivers. DEMUX has many applications. It is used in receivers in the communication systems. It is used in arithmetic and logical unit in computers to supply power and to pass on communication, etc.
De-multiplexers are used as serial to parallel converters. The serial data is given as input to DEMUX at regular interval and a counter is attached to it to control the output of the de-multiplexer.
Both the multiplexers and de-multiplexers play an important role in communication systems, both at the transmitter and the receiver sections.

Diagram:

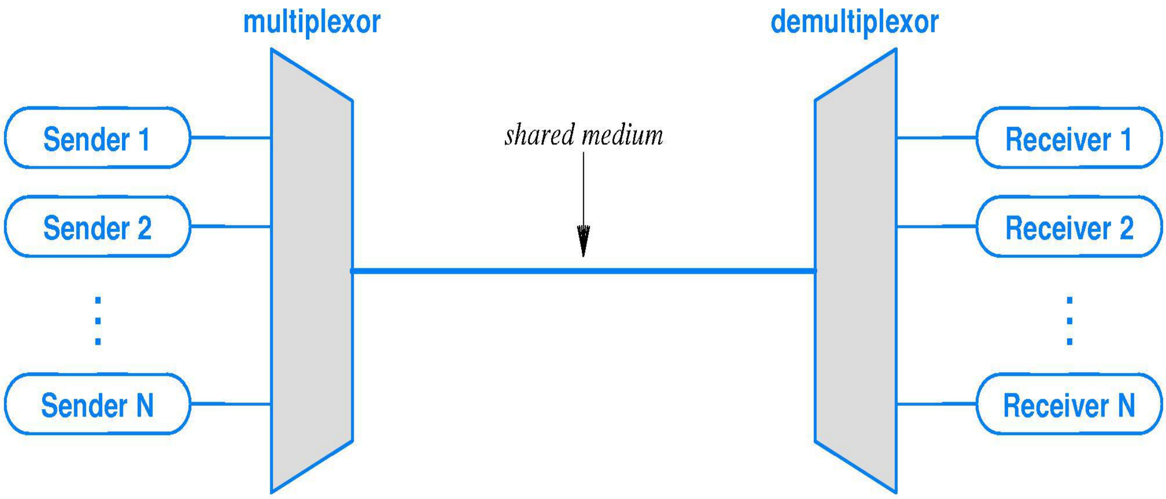


Figure 11.1 The concept of multiplexing in which independent pairs of senders and receivers share a transmission medium.

Difference between TDM and FDM:

S.NO	TDM	FDM
1.	TDM stands for Time division multiplexing.	FDM stands for Frequency division multiplexing.
2.	TDM works with digital signals as well as analog signals.	While FDM works with only analog signals.
3.	TDM has low conflict.	While it has high conflict.
4.	Wiring or chip of TDM is simple.	While it's wiring or chip is complex rather than simple.
5.	TDM is efficient.	While it is inefficient.
6.	In TDM, time sharing takes place.	While in this, frequency sharing takes place.
7.	In TDM, synchronization pulse is necessary.	While in it Guard band is necessary.

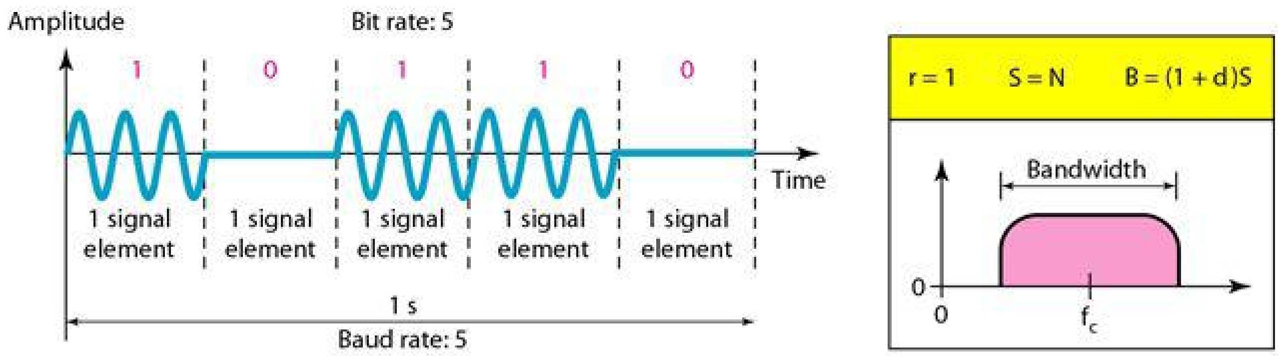
Question 4 sec B:

1) Amplitude Shift Keying:

In amplitude shift keying, the amplitude of the carrier signal is varied to create signal elements. Both frequency and phase remain constant while the amplitude changes.

Binary ASK (BASK)

ASK is normally implemented using only two levels. This is referred to as binary amplitude shift keying or on-off keying (OOK). The peak amplitude of one signal level is 0; the other is the same as the amplitude of the carrier frequency. The following figure gives a conceptual view of binary ASKS.

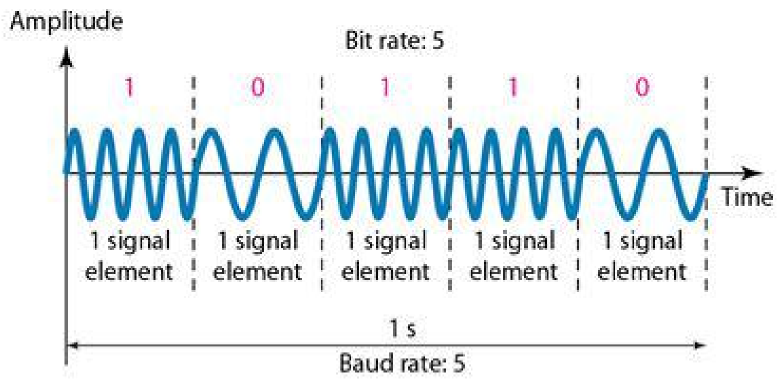


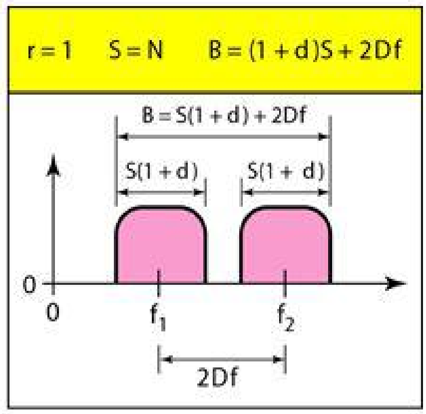
2) Frequency Shift Keying:

In frequency shift keying, the frequency of the carrier signal is varied to represent data. The frequency of the modulated signal is constant for the duration of one signal element, but changes for the next signal element if the data element changes. Both peak amplitude and phase remain constant for all signal elements.

Binary FSK (BFSK):

One way to think about binary FSK (or BFSK) is to consider two carrier frequencies. In the following Figure, we have selected two carrier frequencies f1 and f2. We use the first carrier if the data element is 0; we use the second if the data element is 1.





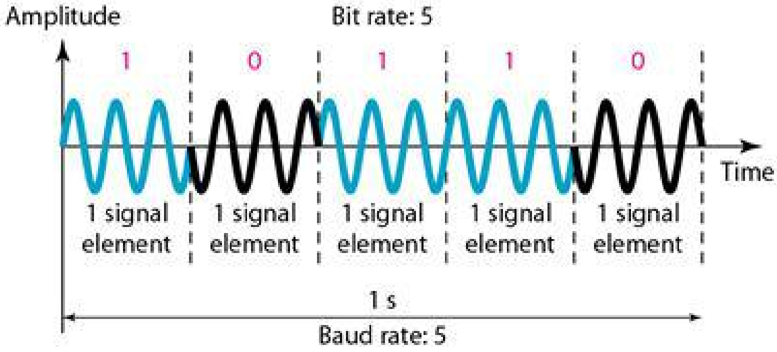
The above figure shows, the middle of one bandwidth is f1 and the middle of the other is f2. Both f1 and f2 are Δf apart from the midpoint between the two bands. The difference between the two frequencies is 2Δf.

3) Phase Shift Keying:

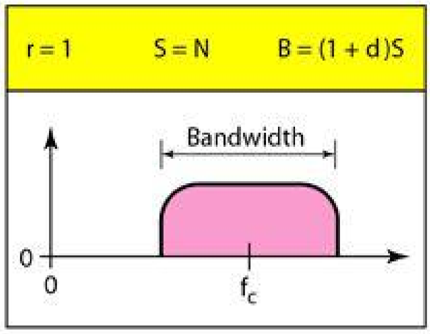
In phase shift keying, the phase of the carrier is varied to represent two or more different signal elements. Both peak amplitude and frequency remain constant as the phase changes.

Binary PSK (BPSK):

The simplest PSK is binary PSK, in which we have only two signal elements, one with a phase of 0°, and the other with a phase of 180°. The following figure gives a conceptual view of PSK. Binary PSK is as simple as binary ASK with one big advantage-it is less susceptible to noise. In ASK, the criterion for bit detection is the amplitude of the signal. But in PSK, it is the phase. Noise can change the amplitude easier than it can change the phase. In other words, PSK is less susceptible to noise than ASK. PSK is superior to FSK because we do not need two carrier signals.



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



r = 1
S = N
B = (1 + d)S
Bandwidth
0
0
fc