NAME:- KRUNAL RANK

ADM. NO:- U18CO081

B TECH 3RD YEAR

U18CO081

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Computer Networks
Tutorial 4

Ans 1: Analog transmission refers to the transmission of analog message signals using a band pass channel. Baseband digital or analog signals are converted to a complex analog signal with a range of frequencies suitable for a channel.

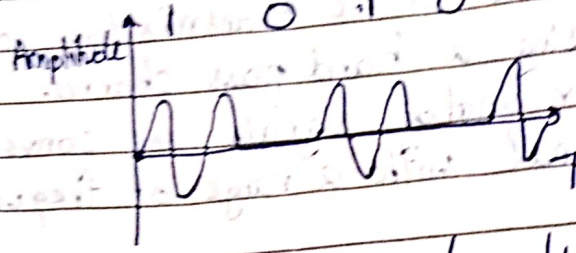
In analog transmission, the sending device produces a high frequency signal that acts as a base for the information signal. This base signal is called carrier signal or carrier frequency.
It is a constant frequency signal.
The role of carrier signal is:-

- to provide message signal with a higher base frequency to prevent attenuation of message signal during transmission that would prevent its reconstruction.
- to increase the strength of message signal and increase its range of transmission.

Ans 2: When data from one computer is sent to another via some analog carrier, it is first converted into analog signals. Analog signals are modified to reflect digital data.

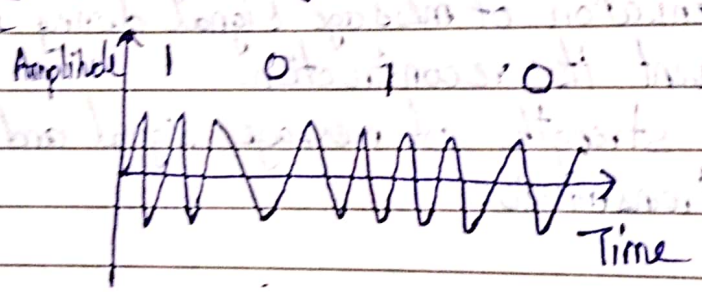
An analog signal is characterised by its amplitude, frequency and phase. There are three kinds of digital to analog conversions:-

- Amplitude Shift Keying:
In this conversion technique, the amplitude of analog carrier is modified to reflect binary data.



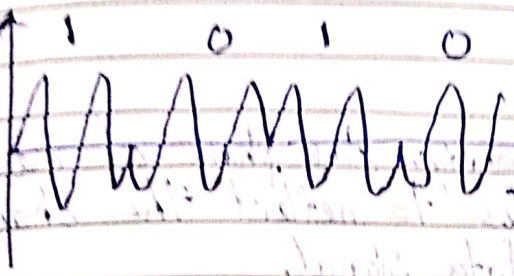
When binary data represents digit 1, the amplitude is held. Otherwise, it is set to 0. Both frequency and phase remain same as in the original carrier signal.

- Frequency Shift Keying:
In this conversion technique, the frequency of the analog carrier signal is modified to reflect binary data.



This technique uses two frequencies, f1 and f2. One of them, for example f1, is chosen to represent binary digit 1 and the other represents binary digit 0.

- Phase Shift Keying:
In this conversion, 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.

- Quadrature Phase Shift Keying:-
QPSK alters the phase to reflect two binary digits at once. This is done in two different phases. The main stream of binary data is divided equally into two sub-streams. The serial data is converted in to parallel in both sub streams and each stream is converted to digital signal using NRZ technique. Later, both the digital signals are merged together.

Ans 3. Analog signals are modified to represent analog data. This conversion is also known as Analog modulation. Analog modulation is required when bandpass is used. Analog to analog conversion can be done in three ways:

- Amplitude Modulation:-
In this modulation, the amplitude of the carrier signal is modified to reflect the analog data.

- Frequency Modulation:-
In the modulation, the frequency of carrier signal is modified according to the amplitude of message signal.

- Phase Modulation:-
In the modulation technique, the phase of carrier is modulated in order to reflect the change in voltage of analog data signal.

Ans 4:

1. $S = \frac{N}{r} = \frac{2000}{1} = 2000$ baud

2. $S = \frac{N}{r} = \frac{4000}{1} = 4000$ baud

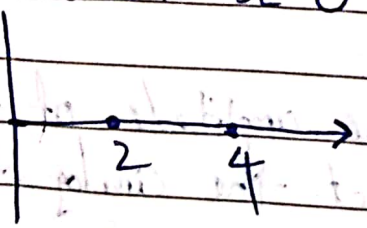
3. $S = \frac{N}{r} = \frac{6000}{2} = 3000$ baud

4. $S = \frac{N}{r}$ here $r = \log_2 64 = 6$

$S = \frac{36000}{6} = 6000$ baud.

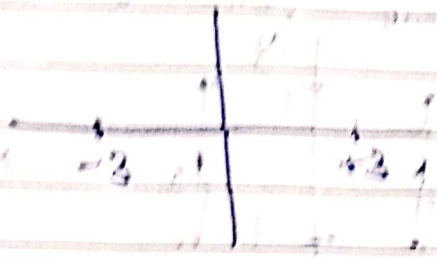
Ans 5:

a) We have 2 signal elements with peak amplitudes 2 and 4. The phase of both signal elements are the same which we assume to be 0 degrees.

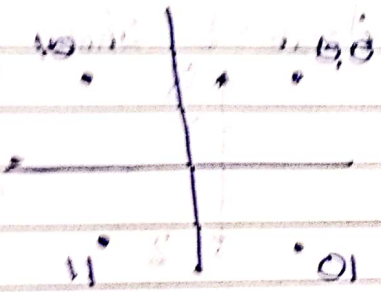


Mid Tutorial

b) There must be 180 degrees difference b/w two phases.

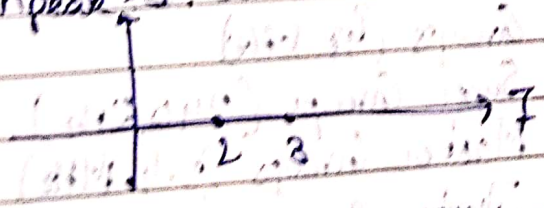


c) 90° phase difference b/w each phase.

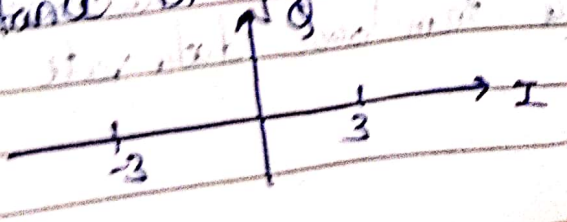


Ans:

a) (2,0) and (3,0)
This is ASK. There are two peak amplitudes both with same phase (0°). The peak amplitude values are $A_1 = 2$ and $A_2 = 3$. Hence, $A_{peak} = 3$.

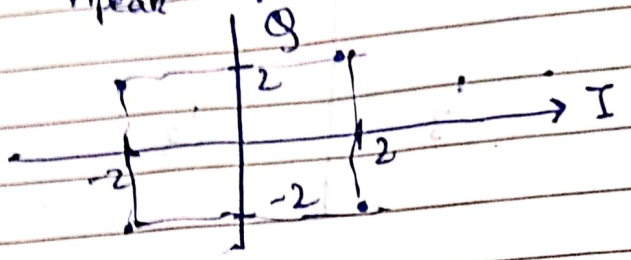


b) (3,0) & (-3,0)
This is BPSK. There is only one peak amplitude $A_{peak} = 3$, which is distance b/w point & origin. There are two phases

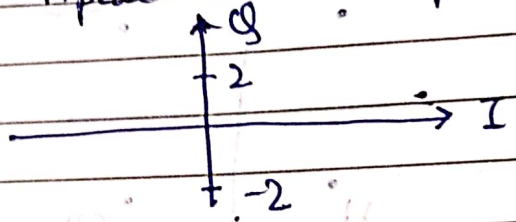


c) (2,2), (-2,2), (-2,-2) & (2,-2).
This is QPSK as 4QAM. Both types have only one amplitude but 4 phases. Amplitude is

$A_{peak} = \sqrt{2^2+2^2} = 8$



d) (0,2) and (0,-2)
This is BPSK. Apeak = 2, where phases are 90° and



Ans 7: To maximize the efficiency of their infrastructure telephone companies have traditionally multiplexed analog signals from lower BW lines to higher

Hierarchy: Voice channels (4 KHz)
Groups (48 kHz)
Super Groups (240 KHz)
Master Groups (2.4 MHz)
Jumbo Groups (15.12 MHz)

To maximize the efficiency of their infrastructure, telephone companies have traditionally multiplexed digital signals from lower data rate lines into higher hierarchy.

DS-0 (64 kbps)
DS-1 (1.544 Mbps)
DS-2 (6.312 Mbps)
DS-3 (44.376 Mbps)
DS-4 (274.176 Mbps)

Ans 8:
a) Time division multiplexing (TDM)
b) Space division multiplexing (SDM)
c) Wavelength division multiplexing (WDM)
. These are common multiplexing techniques in fibre optics and requirement of such thing is variation of network speeds that we obtain.

Ans 9: To multiplex 10 voice channels we need nine guard bands. The required bandwidth is:-

$$B = (4\ kHz \times 10) + (300\ Hz \times 9)$$
$$= 44.5\ kHz$$

Ans 10: Allocate the frame carriers four bits from each of the first two channels and three from each of other two channels.

i) Frame size = $(4\times2) + (3\times2) = 14$ bits
ii) Frame rate = $2000.00/4 = 150000/3$
$= 50000$ FPS.

iii) Frame duration = 20μs
iv) Data rate = $50000 \times 14 = 700$ kbps