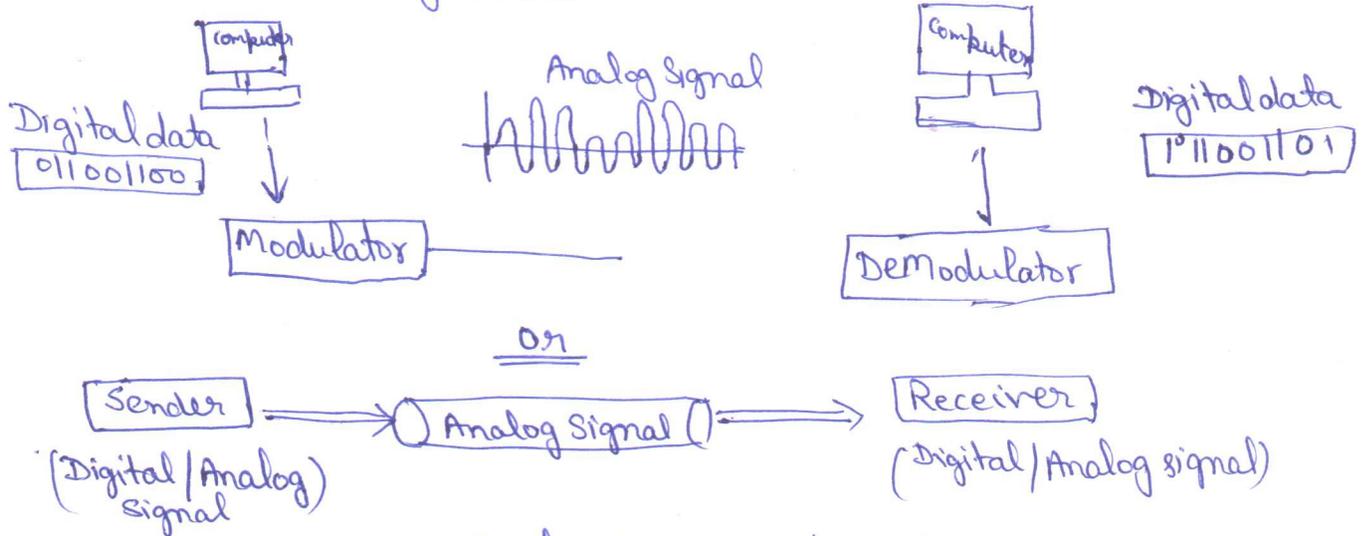


①

# Unit - 3 (Digital & Analog Transmission)

Analog transmission  $\Rightarrow$  It is a method of conveying voice, data, image, video information using a continuous signal which varies in amplitude, phase or some other property in proportion to that of a variable. It could be transfer of an analog source signal, using an analog modulation method such as FM or AM. (frequency modulation or Amplitude modulation)

Digital to Analog Conversion  $\Rightarrow$  It is the process of changing one of the characteristics of the analog signal based on the information in digital data. 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, i.e binary data.

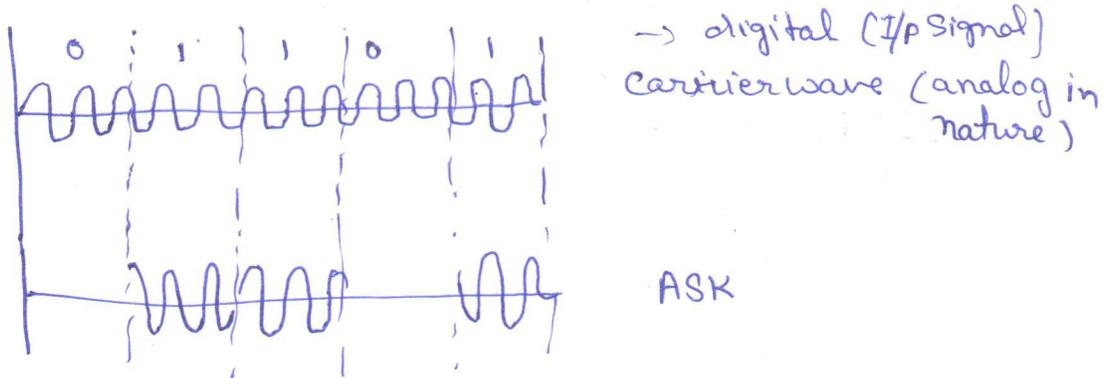


Analog transmission Fig. 1

On the basis of data, there are two types of conversions:  $\Rightarrow$

- (1) Digital to Analog Conversion  
(Amplitude Shift Keying, FSK and PSK)
- (2) Analog to Analog conversion  
(Amplitude modulation, Frequency Modulation, Phase-modulation or AM, FM, PM)

ASK  $\rightarrow$  In ASK, the amplitude of the carrier wave is changed (switched) accordingly to the digital input signal (modulating signal). Therefore, ASK is analogous to AM (analog modulation).



We don't transmit any signal when it is zero and when it is 1 then carrier wave is transmitted.

Amplitude of this carrier wave is changed.

It has two types  $\rightarrow$  Binary and Non-binary ASK

Characteristics

ASK  $\rightarrow$  ~~It has~~ frequency

Binary ASK  $\rightarrow$  In the data signals has only two levels then it is known as binary ASK (The amplitude is highest at level one and lowest at level zero.

Also known as on-off (0,1) Keying - ~~OOK~~

Non Binary ASK  $\rightarrow$  There may be more than two levels available in ASK depending on the bandwidth of the signals.

③

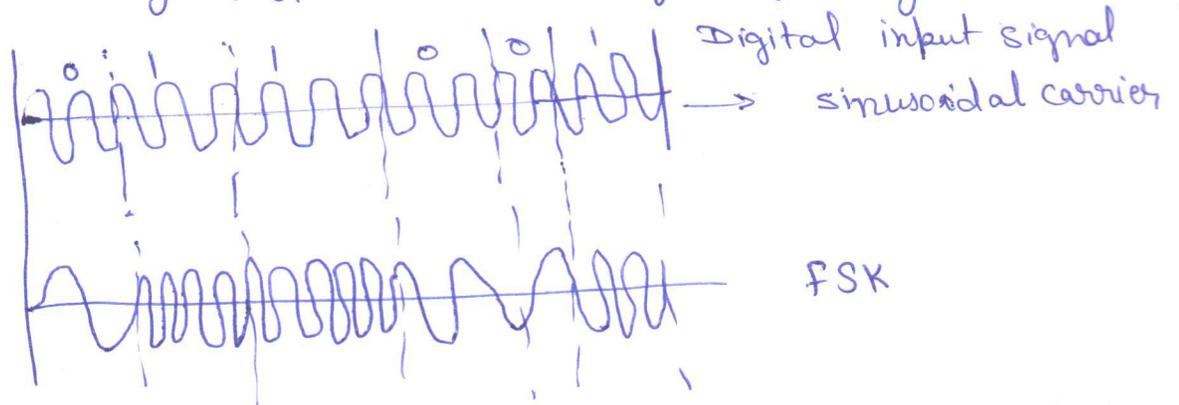
### Characteristics of ASK: $\Rightarrow$

- (1) Frequency is Constant for the data signals
- (2) Phase is Constant for the data signals
- (3) Amplitude changes for the data signals
- 4) Easy to convert
- 5) High Noise Interference
- 6) Inefficient technique.

FSK  $\rightarrow$  Frequency shift keying

If the frequency of sinusoidal carrier wave is varied (switched) depending on the digital input signal, then it is known as the Frequency Shift Keying.

It is analogous to FM (Analog frequency modulation)



When zero is transmitted the wave low and when one is transmitted high frequency. We reduce the frequency when zero is transmitted and increase the frequency (no of cycle) when one.

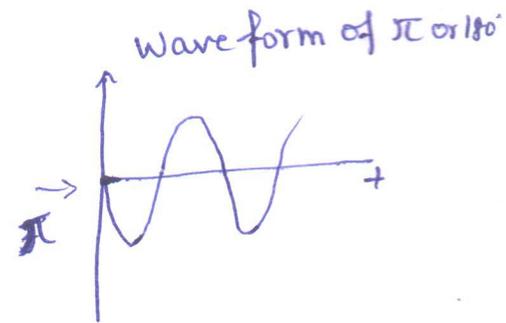
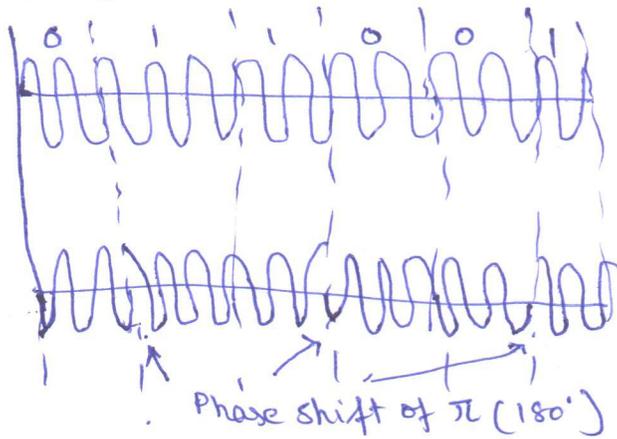
It has also two types



Characteristics of FSK:  $\rightarrow$

- (1) Frequency changes for the data signals
- (2) Phase is constant and Amplitude is constant for the data signals.
- (3) Difficult to convert as compared to ASK
- (4) Less Noise Interference
- (5) Efficient technique.

Phase Shift Keying (PSK) → In phase shift keying, phase of the carrier wave (analog) is switched as per the input digital signal. This is the analogous to PM (analog phase modulation).



if we have the change in digital signal such as 0 to 1 or 1 to 0 a phase shift of  $\pi$  i.e.  $180^\circ$  <sup>or input</sup>

if there is no changing in signal or bit then no change in frequency

It has also two types



### Characteristics of PSK

- 1) Phase changes of the data signal
- 2) Amplitude and frequency remains constant for data signal.
- 3) Very less noise Interference.
- 4) Very efficient technique.
- 5) Superior quality than ASK and FSK.

# Analog to Analog Conversion: →

6

① AM → Amplitude Modulation → It was developed in the beginning of 20<sup>th</sup> Century. It was the earliest modulation technique. AM is used for audio broadcasting on long medium & short wave band & two way radio. AM is the process in which the amplitude of the carrier signal is varied in accordance with the information signal. If the unmodulated carrier signal is represented by

$$A \sin 2\pi f_c t$$

and the modulating signal is represented by

$$B \sin 2\pi f_a t$$

where

$f_c$  = carrier frequency

$A$  = Maximum value of un-modulating signal

$f_a$  = frequency of the modulating signal

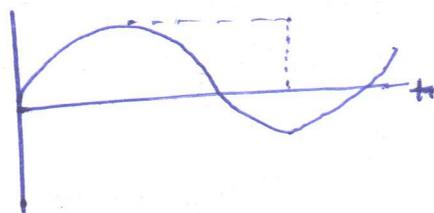
$B$  = Maximum value of un-modulating signal

$P = P_i$

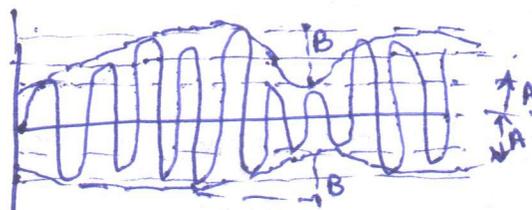
Now - modulated signal can be represented as

$$A + B (\sin 2\pi f_c t) (\sin 2\pi f_a t)$$

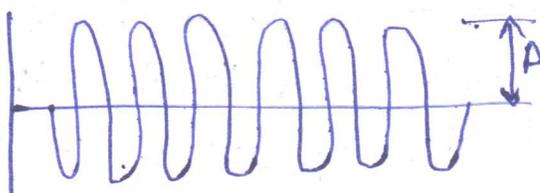
The carrier signal, modulating signal & the modulated signal is as



Audio Signal  
(modulation signal)



AM signal



carrier frequency

When an amplitude modulated signal is created the amplitude of the signal is varied in line with the variations in intensity of the sound wave. In this the overall amplitude or envelop of the carrier is modulated to carry the audio signal. In above fig. the envelop of the carrier can be seen to change in line with the modulating signal.

The bandwidth of AM signal covers a range centered around the carrier frequency & is equal to twice the bandwidth of the modulating signal. Normally the AM stations allow a frequency of 530 KHz to 1.7 MHz. However to avoid interference each stations carrier frequency is kept seperately at either sides by atleast 10 KHz.

AM is simplest form of modulation & it needs less power because no power is used to transmit the carrier or the other side band.

Advantages : → ① It is simple to Implement

② It can be demodulated using a circuit consisting of very few components.

③ AM receivers are very cheap as no. specialised components are needed.

Dis-advantages → ① An AM signal is not efficient in term of its power usage.

② It is not efficient in term of its use of bandwidth, requiring a bandwidth equal to twice that of the highest audio frequency

③ An Amplitude modulation signal is prone to high level of noise because most noise is amplitude based and obviously AM detectors are sensitive to it.

Note:  $\Rightarrow$  However it is still in wide spread use for broad-casting on the long, medium and shortwave bands as well as for a number of mobile or portable communications systems including some aircraft communications.