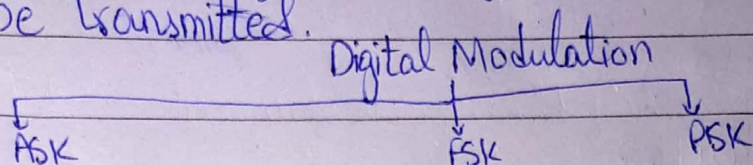
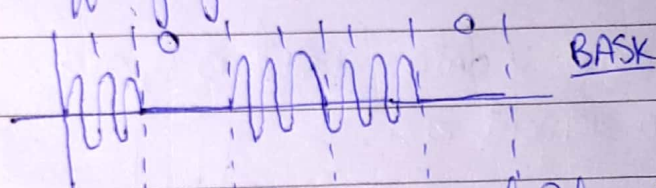


Modulation: It is process of varying one or more properties of periodic waveform called carrier signal with a modulating signal that typically contains information to be transmitted.



1). Amplitude Shift Keying: [Signal $\rightarrow 1$, No-Signal $\rightarrow 0$
Used in Optical Fibre.

BASK: It is simplest modulation technique, and also called On-off keying.

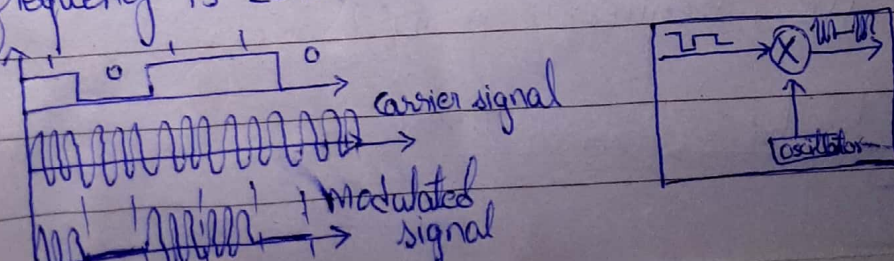


Bit Rate = 5, Band Rate = 5

$$S = N, B = (1+d)S$$

Implementation of BASK:

If digital data are represented as unipolar NRZ, digital signal with high voltage of 1 and low voltage of 0V, implementation can be achieved by multiplying NRZ digital signal by carrier signal coming from oscillator. When amplitude of NRZ signal is 1, amplitude of carrier frequency is held, if amp. is 0, then amp. of carrier frequency is zero.

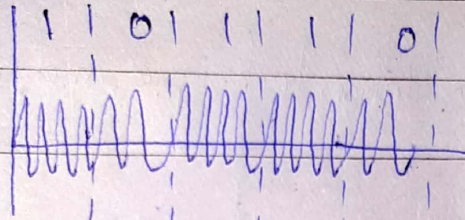


Adv 1). Easy to generate and detect.

Disad : 1). Sensitive to noise
2). It use very low bits

2). Frequency Shift Keying :

BFSK :



1 →

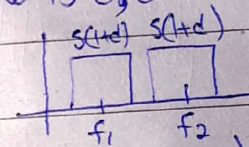
0 →

We use first carrier if data element is 0, and second carrier if data element is 1.

$$S = N, \delta = 1$$

$$B = (1+d) \times S + 2\Delta f$$

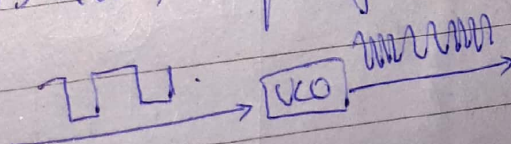
$$\text{or } B = (1+d) \times S + 2\Delta f$$



$$B = S(1+d) + 2\Delta f$$

Implementation :

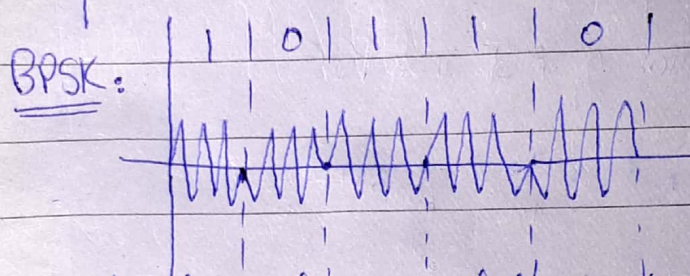
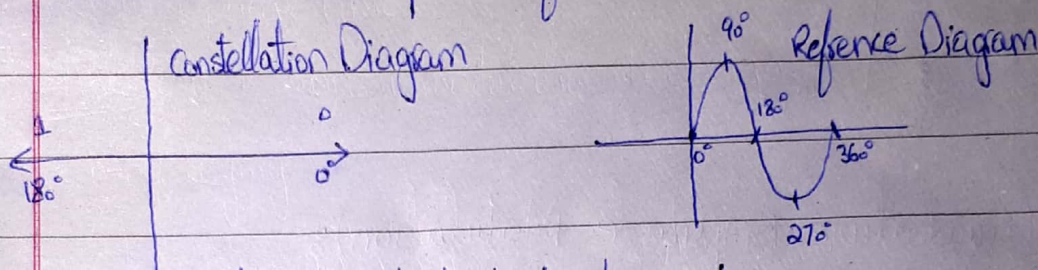
Coherent BFSK can be implemented by using one VCO (Voltage controlled oscillator) that changes its frequency according to input voltage. The input of oscillator is unipolar NRZ signal. When amplitude of NRZ is zero, oscillator keeps its regular frequency, when amplitude is +ve, frequency is increased.



MFSK: $B = (1+d) \times S + (L-1) 2\Delta f$
 $B = L \times S$

3). Phase Shift Keying:

BPSK: The simplest is BPSK, in which we have only two signal elements, one with phase of 0° and other with phase of 180° .



Adv: 1) Modulated signal can travel longer distance when transmitted from base station.

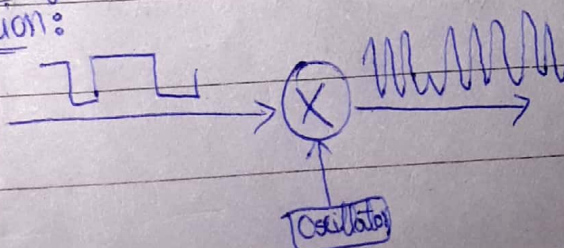
2). Very simple

3). Power efficient.

Disad: It is not bandwidth efficient modulation technique.

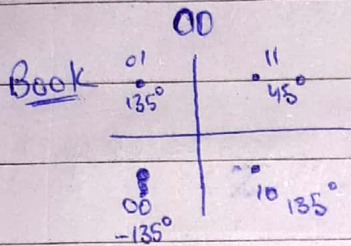
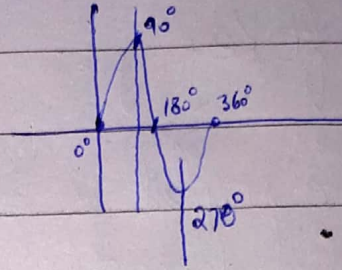
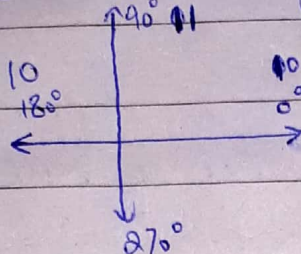
Use: Used by most of cellular towers for long distance comm. of data.

Implementation:



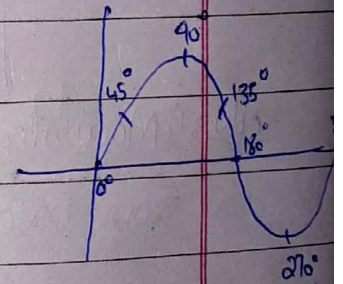
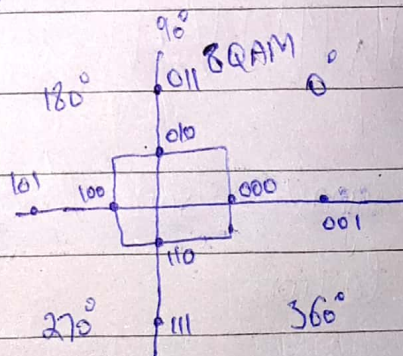
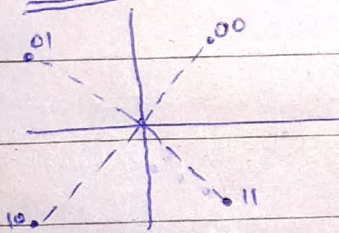
QPSK : (Quadrature PSK)
 2^k

Constellation Diagram



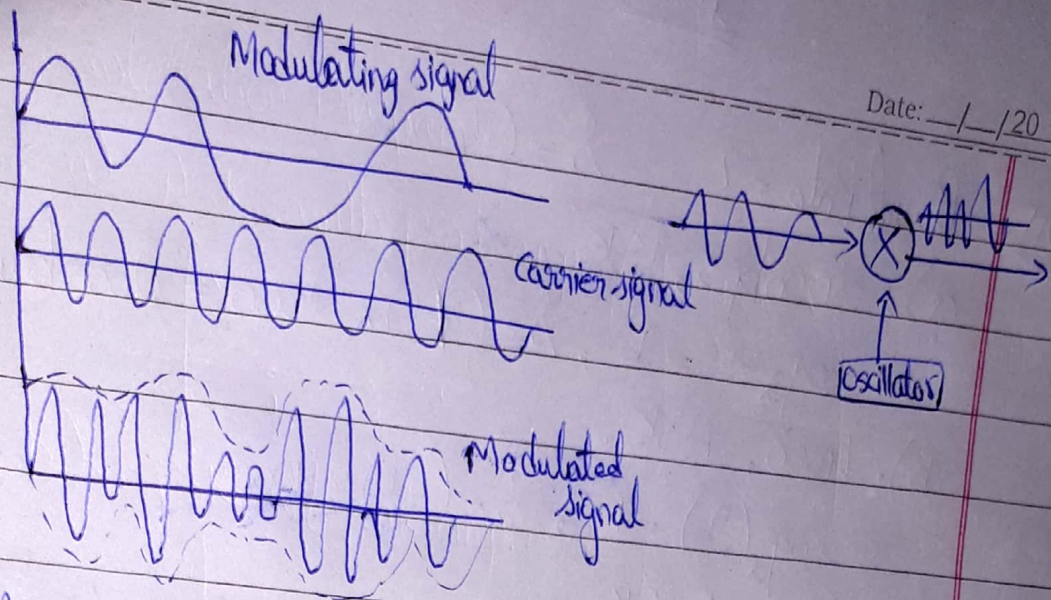
QAM (Quadrature Amplitude Modulation):
It is combination of ASK and PSK

4QAM:



Analogy to Analog Conversion:

- 1) AM : In AM transmission, carrier signal is modulated so that its amplitude varies with changing amplitudes of modulating signal.
The total bandwidth required for AM can be determined from bandwidth of audio signal : $B_{AM} = 2B$.

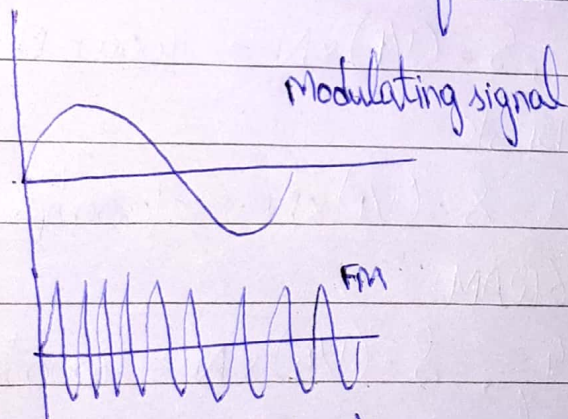


2) FM: In FM transmission, frequency of carrier signal is modulated to follow the changing voltage level of modulating signal.

It is implemented by using voltage controlled oscillator (VCO)

$$B = 2 \times (1 + \beta) B$$

where β is factor that depends on modulation technique with common value of 4.



3) PM (Phase Modulation):

In PM transmission, phase of carrier signal is modulated to follow changing voltage level of modulating signal

It is normally implemented by using VCO along with derivative of input voltage.

$$B = 2(1 + \beta)B$$