Unit:-11

Baseband Transmission

» Pulse Transmission

In all the digital systems, the pulse are transmitted from the transmitter to receiver. But the channel carrying these pulses never have enough bandwidth required to ensure the preservation of the shape of the pulse. Such channels are called as the band limited channels. Depicts the output of a bandlimited channel when a narrow pulse is applied at its input.

- Bandwidth is equal to $\frac{1}{T}$, i.e., $B = \frac{1}{T}$,

* Maximum bit rate that is supported by this channel is $\boxed{R = 2B}$

Pulse Shaping : Intersymbol Interference (ISI)

When the data is being transmitted in the form of pulses (i.e. bits) the output produced at the receiver due to other bits or symbol interferes with the output produced ~~at the receiver due to~~ by the desired bit. This is known as intersymbol interference (ISI). The intersymbol interference will introduce errors in the detected signal.

EYE PATTERN :~

Eye pattern is a pattern displayed on the screen of cathode ray oscilloscope CRO. The shape of this pattern resembles with the shape of human eye. Hence, it is known as eye pattern. Eye-pattern is a practical way to study the intersymbol interference (ISI) and its effects on a PCM or data communication system. The eye pattern is obtained on the CRO interference by applying the received signal to vertical deflection plates (Y-plates) of the CRO. (1/T_b) to the ~~hozi~~ horizontal deflection plates (X-plates). The resulting oscilloscope display shown in the figure is called eye pattern.

There are three basic signaling schemes used in Passband data transmission:

1.) Amplitude Shift Keying (ASK)

2.) Phase Shift Keying (PSK)

3.) Frequency Shift Keying (FSK)

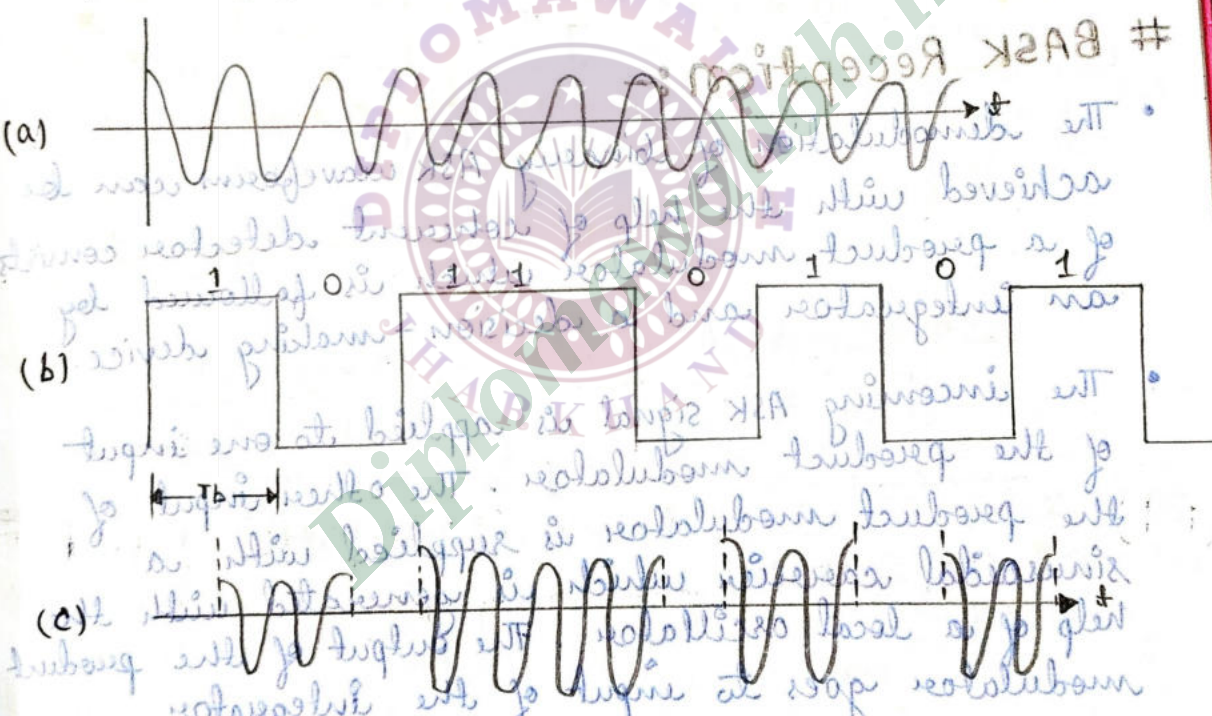
Digital Modulation Technique Types.

2) Generation and Detection of Binary Ask and Binary ASK :-

Coherent Binary Amplitude Shift Keying or ON-OFF Keying :-

* Definition :-

Amplitude shift keying (ASK) or ON-OFF keying (OOK) is the simplest digital modulation technique, In this method, there is only one unit energy carrier and it is switched on or off depending upon the input binary sequence.



Generation of ASK Signal :-

Ask signal may be generated by simple applying the incoming binary data (represented in unipolar form) and the sinusoidal carrier to the two inputs of a product modulator.

The resulting output will be the ASK waveform. This is shown in figure. Modulation causes a shift of the baseband signal spectrum.

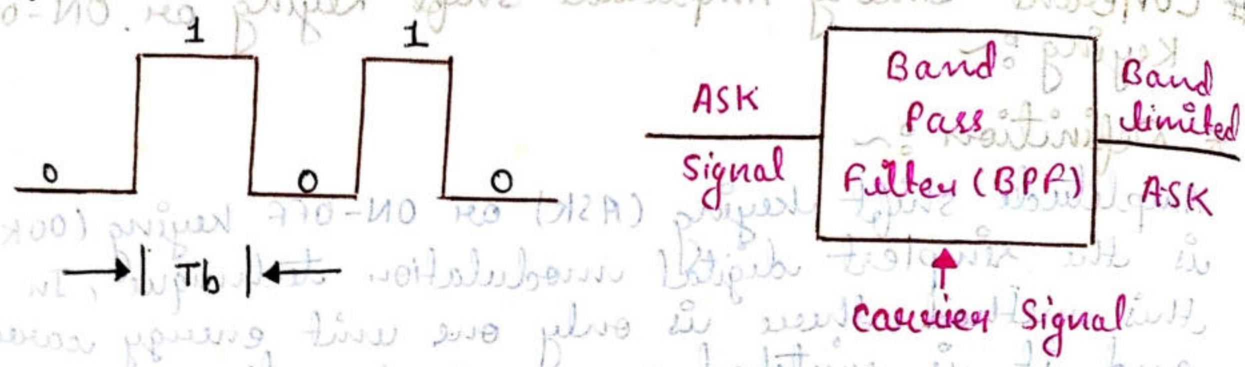
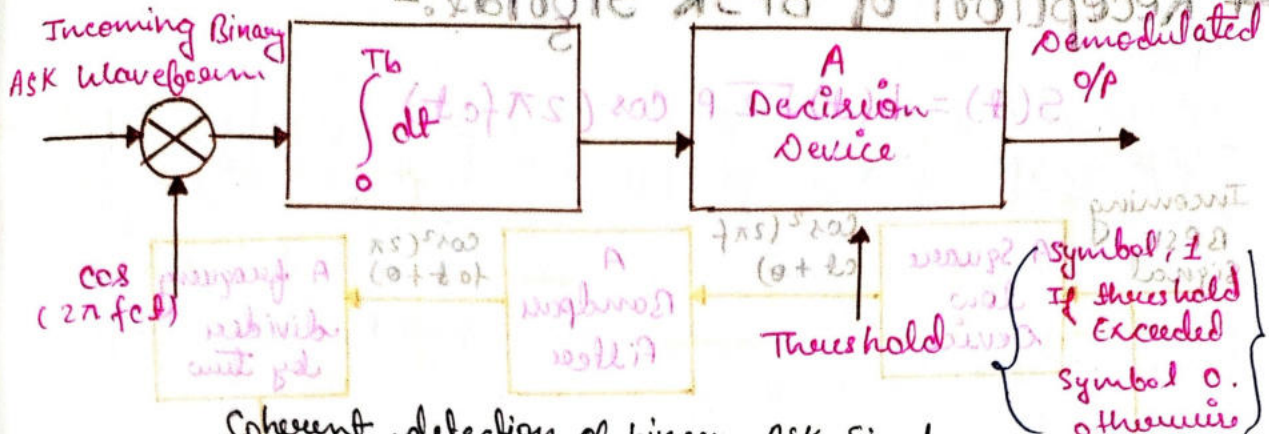


Fig:- Generation of Binary ASK waveform.

BASK Reception:-

- The demodulation of binary ASK waveforms can be achieved with the help of coherent detector consist of a product modulator which is followed by an integrator and a decision-making device.
- The incoming ASK signal is applied to one input of the product modulator. The other input of the product modulator is supplied with a sinusoidal carrier which is generated with the help of a local oscillator. The output of the product modulator goes to input of the integrator
- The integrator operates on the output of the multiplier for successive bit intervals and essentially performs a low-pass filtering action. The output of the integrator goes to the input of a decision-making device. Makes a decision in favour of symbol 1 when the threshold is exceeded and in favour of symbol 0 otherwise.



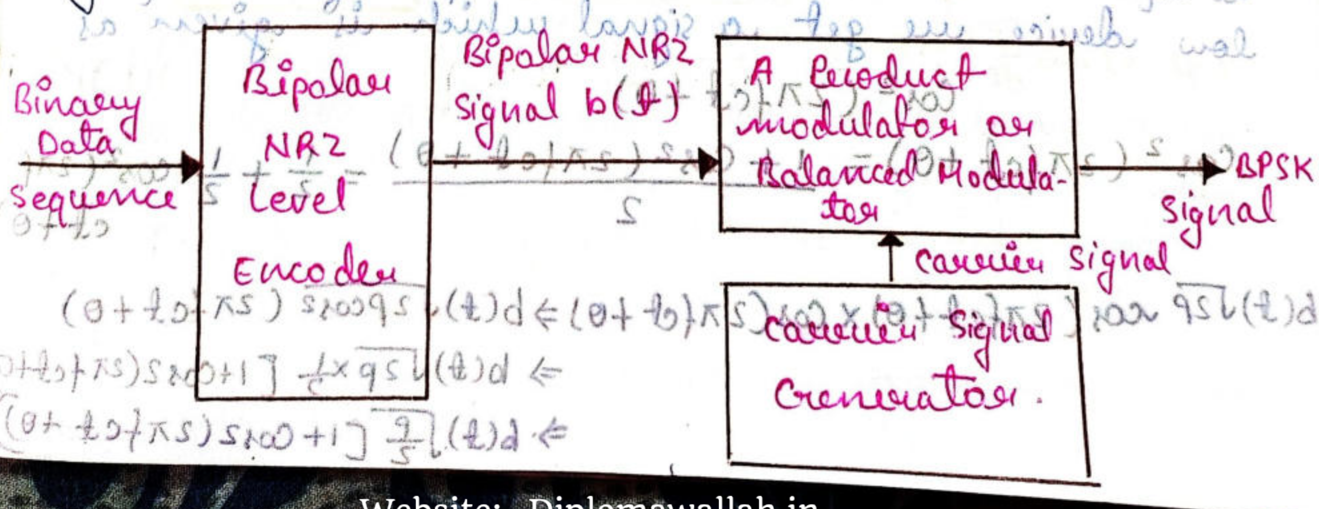
Coherent detection of binary ASK Signals

Binary Phase Shift Keying (BPSK :-

Binary phase shift Keying (BPSK) is the efficient of the three digital modulation i.e ASK, FSK and PSK. Hence binary phase shift keying (BPSK) is used for high bit rate. In BPSK phase of the sinusoidal carrier is changed according to the data bit to be transmitted.

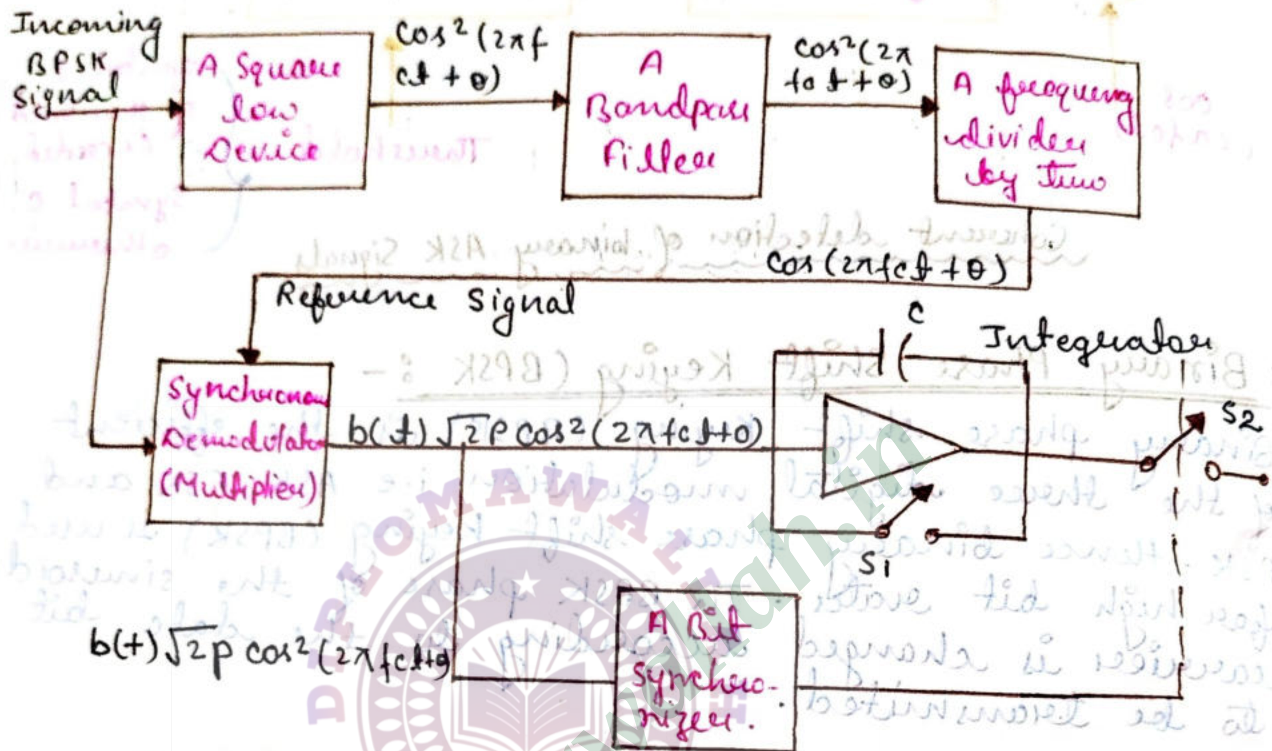
Generation of BPSK signal :-

BPSK signal may be generated by applying carrier signal to a balanced modulator. The binary data signal (0s and 1s) is converted into a NRZ bipolar signal by an NRZ encoder. Here the bipolar signal b(t) is applied as a modulating signal to the balanced modulator.



Reception of BPSK Signal:-

$$S(t) = b(t)\sqrt{2P}\cos(2\pi f_c t)$$



Reception of Baseband signal in BPSK Signal

Let us consider that this phase shift is θ. Because of this the signal at the input of the receiver can be written as

$$S(t) = b(t)\sqrt{2P}\cos(2\pi f_c t + \theta)$$

The receiver signal is allowed to pass through a square low device. At the output of the square low device we get a signal which is given as

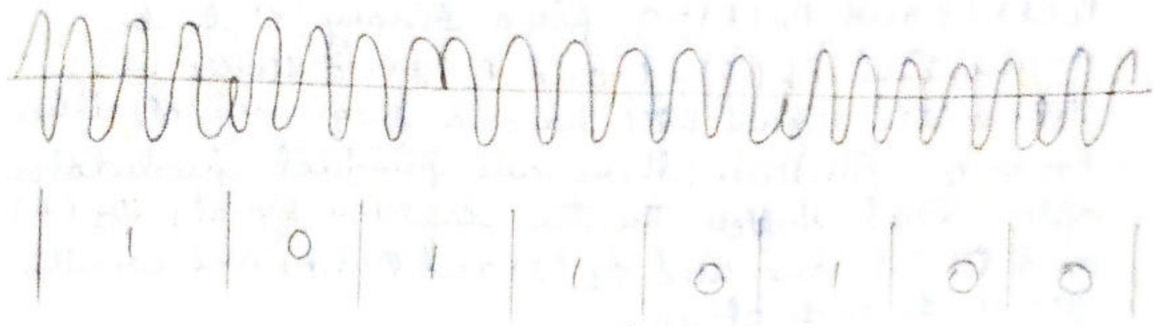
$$\cos^2(2\pi f_c t + \theta)$$

$$\cos^2(2\pi f_c t + \theta) = \frac{1 + \cos^2(2\pi f_c t + \theta)}{2} = \frac{1}{2} + \frac{1}{2}\cos^2(2\pi f_c t + \theta)$$

$$b(t)\sqrt{2P}\cos(2\pi f_c t + \theta) \times \cos(2\pi f_c t + \theta) \Rightarrow b(t)\sqrt{2P}\cos^2(2\pi f_c t + \theta)$$

$$\Rightarrow b(t)\sqrt{2P} \times \frac{1}{2}\left[1 + \cos 2(2\pi f_c t + \theta)\right]$$

$$\Rightarrow b(t)\sqrt{\frac{P}{2}}\left[1 + \cos 2(2\pi f_c t + \theta)\right]$$

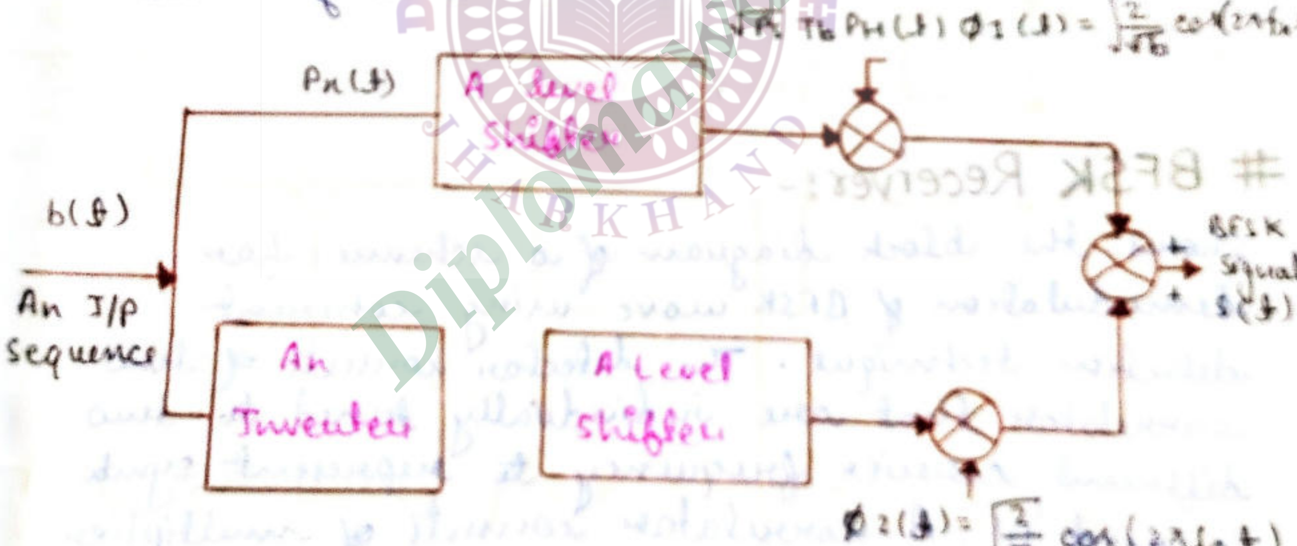


The BPSK waveform

≫ Coherent Binary Frequency Shift Keying (BFSK)

A binary frequency shift keying (BFSK) the frequency of a sinusoidal carrier is shifted according to the binary symbol.

$P_H(t)$ is same as $b(t)$ and also $P_L(t)$ is inverted version of $b(t)$.



We know that input sequence $b(t)$ is same as $P_H(t)$. An Inverter is added after $b(t)$ to get $P_L(t)$. The level shifter $P_H(t)$ and $P_L(t)$ are unipolar signals.

The level shifter converts the '+1' level to $\sqrt{P_s T_b}$, zero level is unaffected; Thus the output of the level shifters will be either $\sqrt{P_s T_b}$ (if '+1') or zero (if I/p is zero)

In other when a binary '0' is to be transmitted $P_L(t) = 1$ and $P_H(t) = 0$ for a binary '1' to be transmitted $P_H(t) = 1$ and $P_L(t) = 0$ Hence the transmitted signal will have a frequency of either f_H or f_L. Further, there are product modulator after level shifter. The two carrier signals $\phi_1(t)$ and $\phi_2(t)$ are used $\phi_1(t)$ and $\phi_2(t)$ are or-thogonal to each other.

The BFSK Signal

BFSK Receiver:-

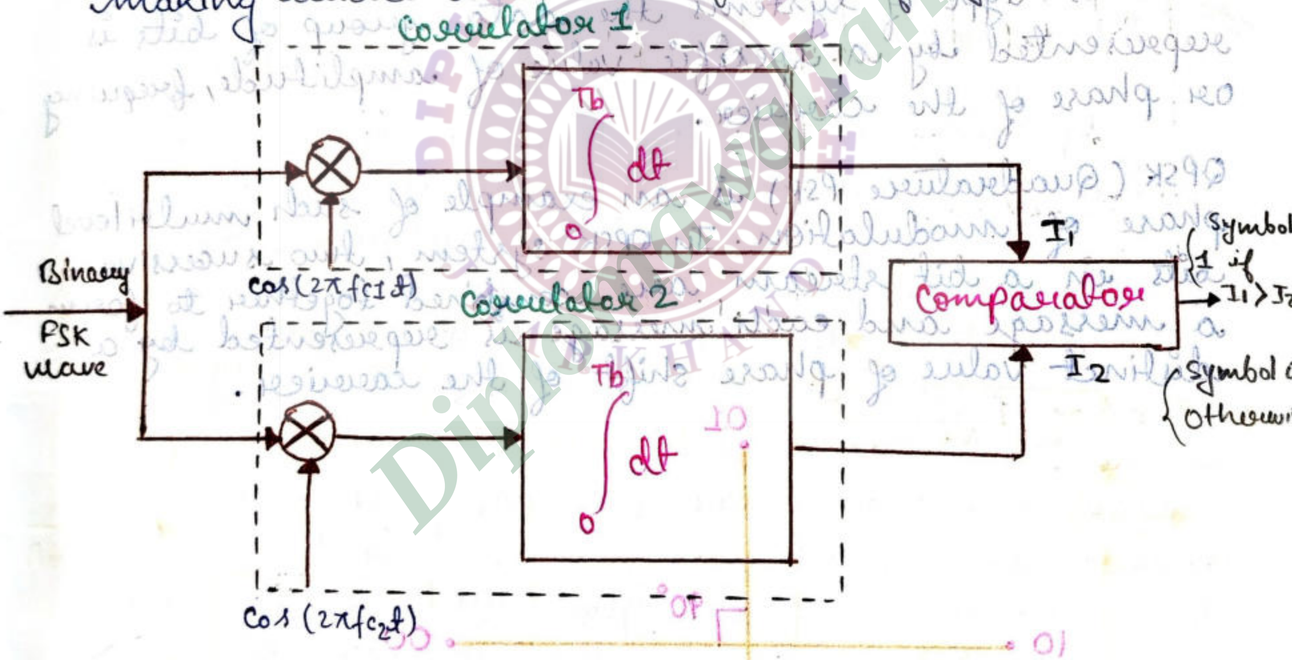
Shows the block diagram of a scheme for demodulation of BFSK wave using coherent detection technique. The detector consists of two correlator that are individually tuned to two different carrier frequency to represent symbols '1' and '0'. A correlator consists of multiplier followed by an integrator. Then the received binary FSK signal is applied to the multipliers of both the correlators.

To the other input of the multipliers carries with frequency. f_{c1} and f_{c2} are applied as shown.

The multiplied output of each multiplier is subsequently passed through integrators generating output I_1 and I_2 in the two paths.

The output of the two integrators are then fed to the decision making device. The decision making device is essentially a comparator which compares the output I_1 and output I_2 (in the lower path).

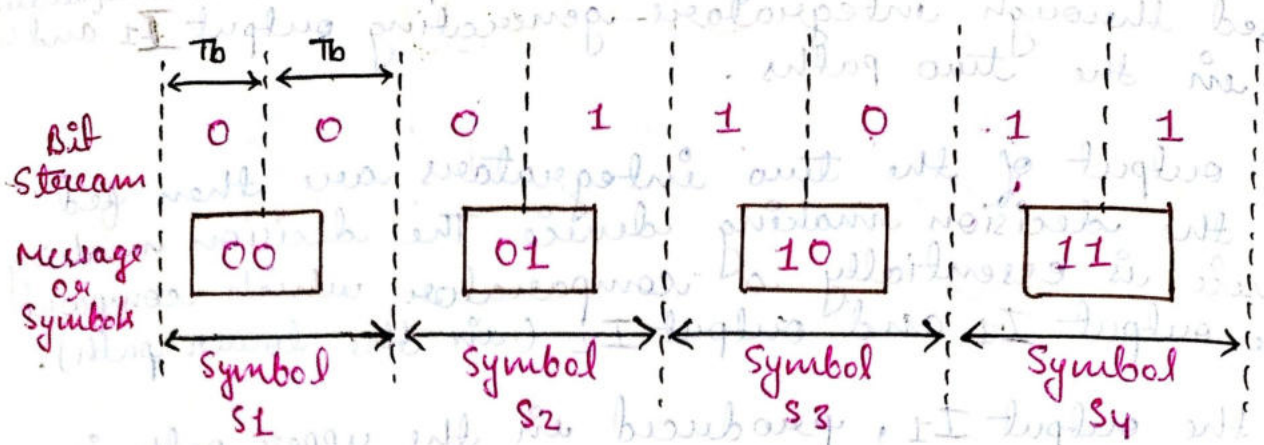
If the output I_1, produced in the upper path is greater than the output I_2 produced in the lower path detector makes a decision in favour of symbol 1. If the output I_1 is less than I_2, then the decision making device decides in favour of symbol 0.



Quadrature phase shift Keying:- (QPSK)

The modulation schemes discussed so far are all two level modulation (ASK and BPSK). Because they can represent only two states of the digital data (0 or 1).

Hence the bit rate and the baud rate are same for these systems.



Note that every symbol consist of two bits.

Fig :- Grouping of bits in QPSK

In this type of systems the data group of bits is represented by a specific value of amplitude, frequency or phase of the carrier.

QPSK (Quadrature PSK) is an example of such multilevel phase of modulation. In QPSK system, two sucessive bits in a bit stream are combined together to form a message and each message is represented by a distinct value of phase shift of the carrier.

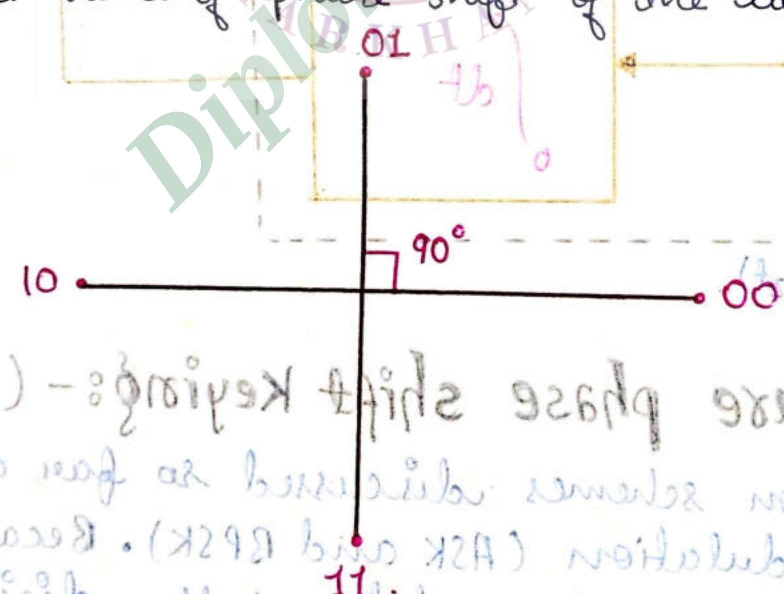


Fig :- Constellation diagram of QPSK.

There symbols are transmitted by transmitting the same carrier at four different phase shifts as shown in since, there are four phase shifts involved this system is called as quadrature PSK or 4-PSK system.

If the symbol 00 is to be transmitted, we have to transmit a carrier at 0° phase shift.

If 01 is to be transmitted, then the same carrier is transmitted with a phase shift of 90°. The message 10 and 11 are transmitted by transmitting the carrier at 180° and 270° respectively.