

# # Asynchronous data

Combines the features of an asynch. & synch. system  
System sends the block of data asynchronously.  
(stream at random intervals)

Each transmission begins with a start packet.

Used when data must be delivered with some time constraint (video stream).

No error correction mechanism, as ~~the~~ if not found  
it can't be resent due to time constraint.

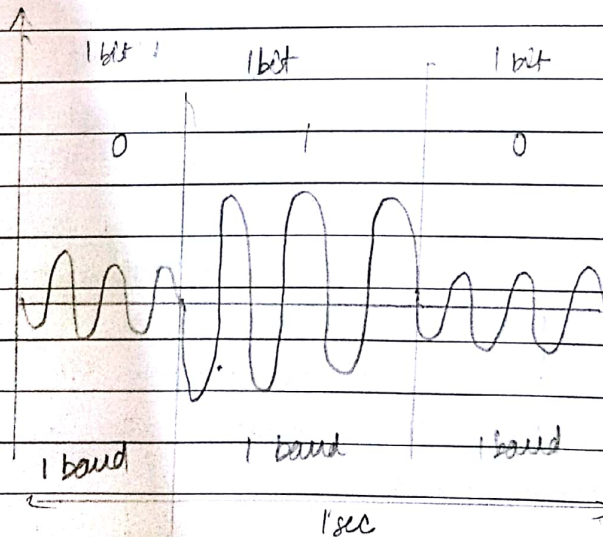
ASK

FSK

PSK

--- Quadrature amplitude modulation (QAM)

## ASK



## Bandwidth for ASK

Amplitude

Bit rate : B

Band rate : 3

min bandwidth

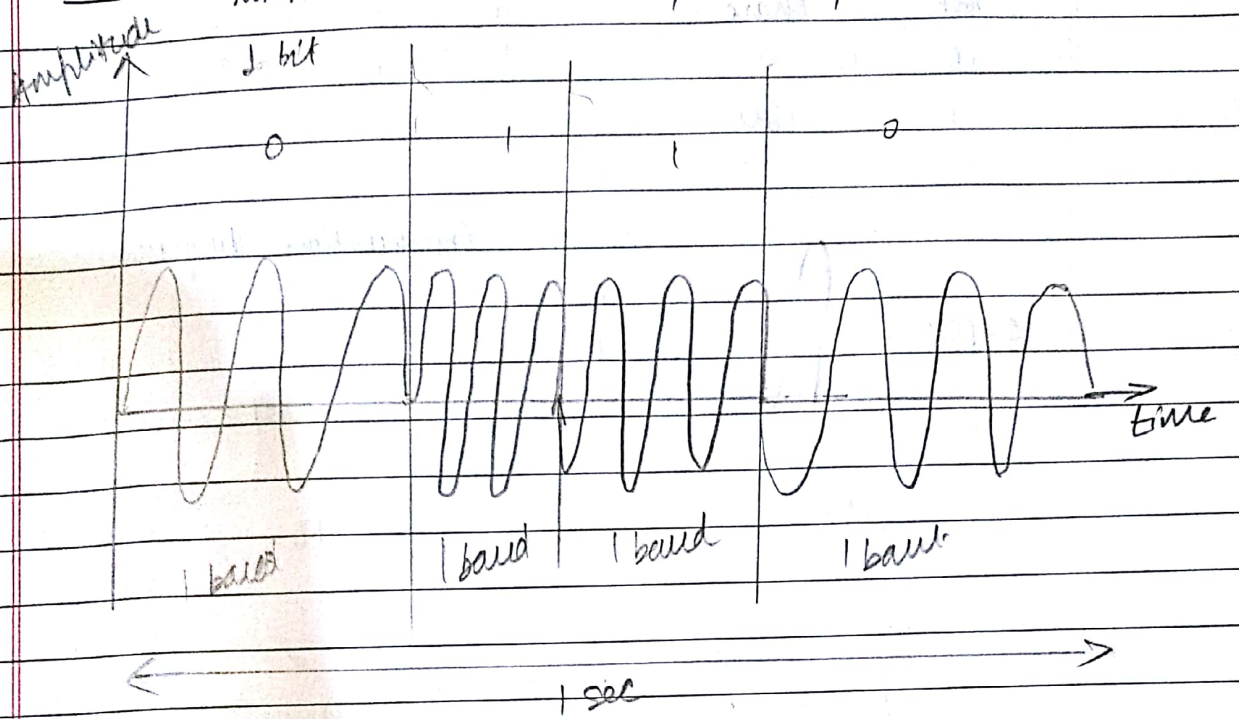
$$f_c - \frac{N_{band}}{2}$$

$$f_c$$

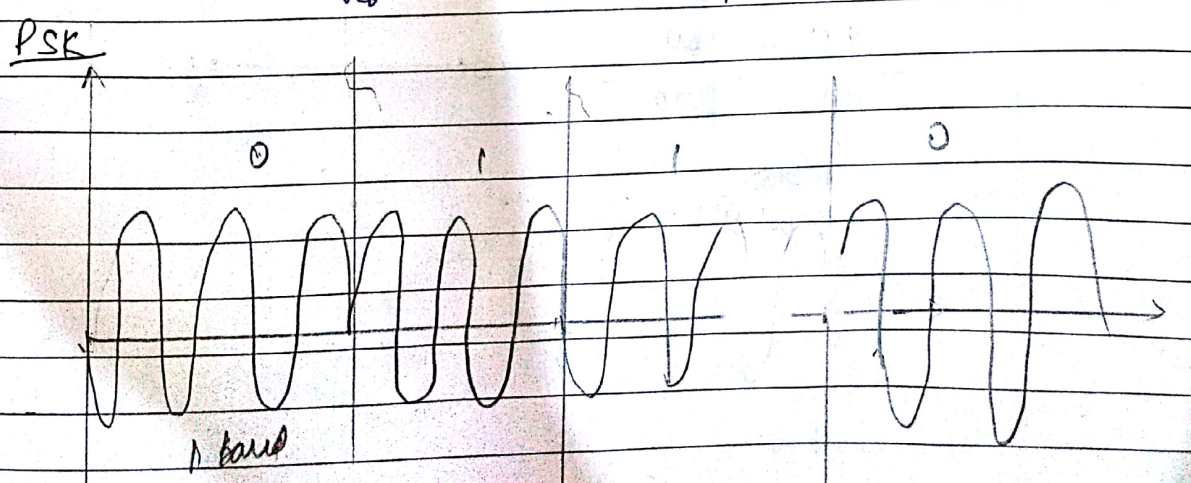
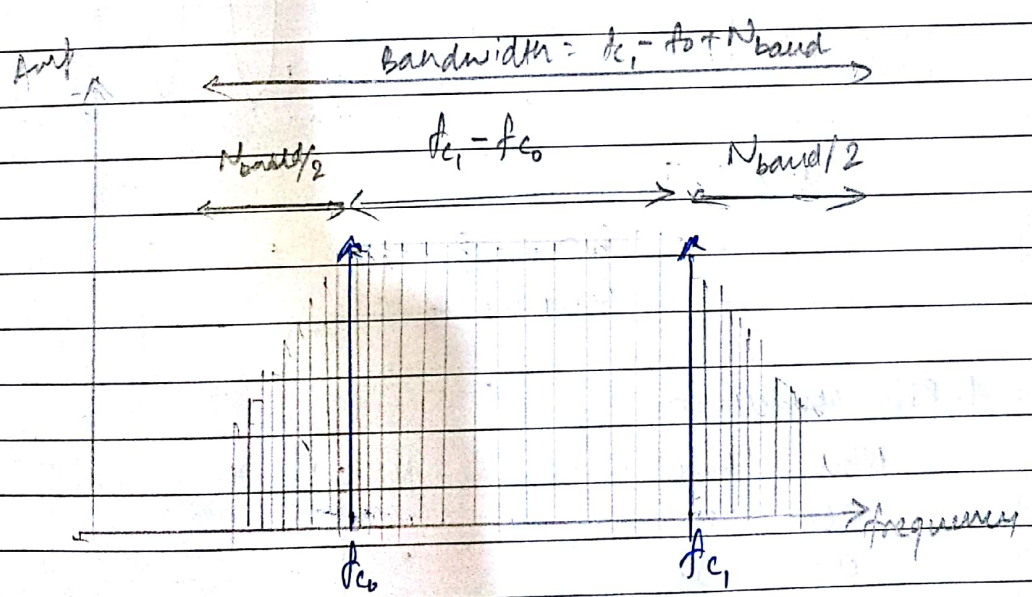
$$f_c + \frac{N_{band}}{2}$$

Frequency

FSK - susceptible to noise. Can't carry more info.



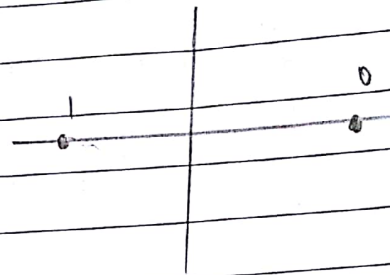
Bit rate: 4      Baud rate: 4





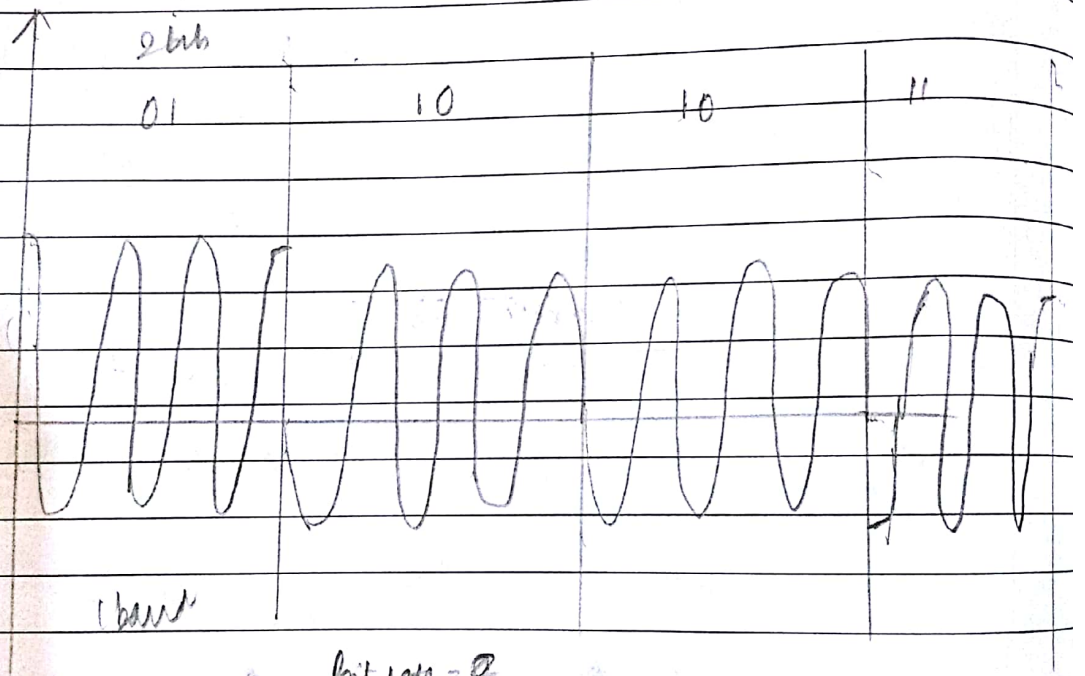
## PSK constellation

Bit	Phase
0	0
1	180



Constellation diagram

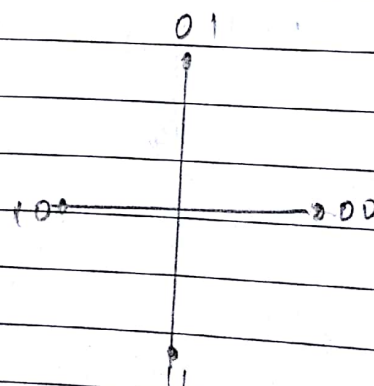
## 4-PSK



Bit rate = 8  
Baud rate = 4

## 4-PSK constellation

Dibit	Phase
00	0
01	90
10	180
11	270

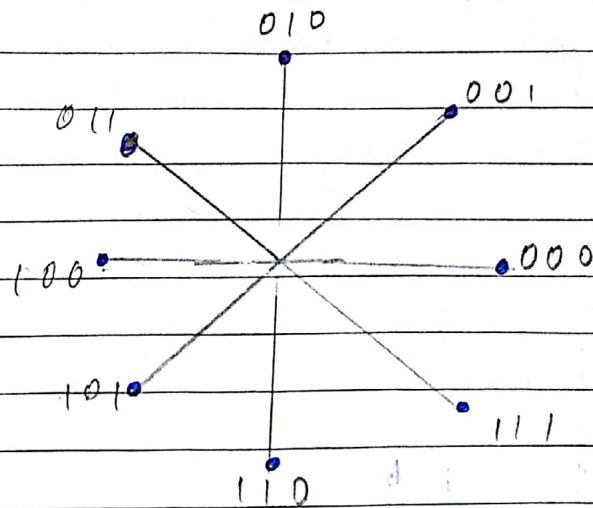


Dibit  
(2 bits)

## 8-FSK constellation

000	0
001	45
010	90
011	135
100	180
101	225
110	270
111	315

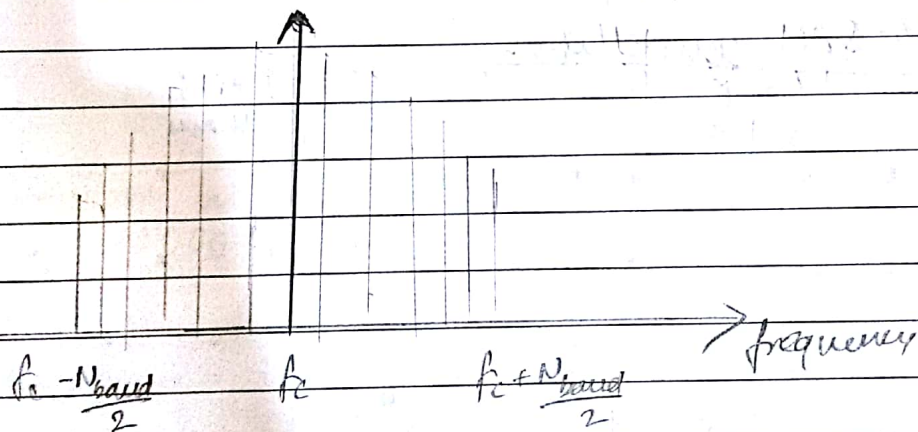
bits



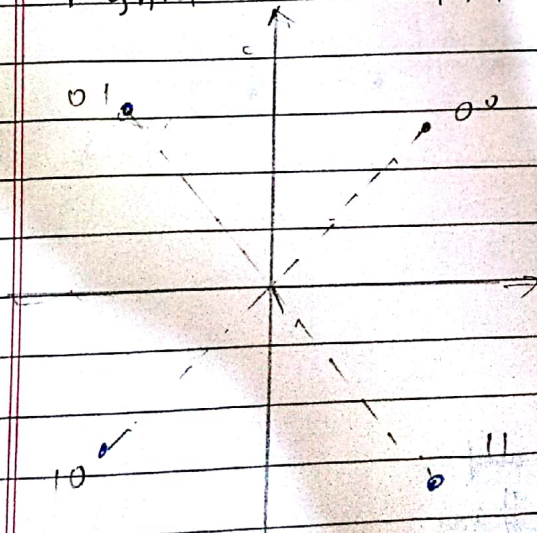
Constellation diagram

Amplitude

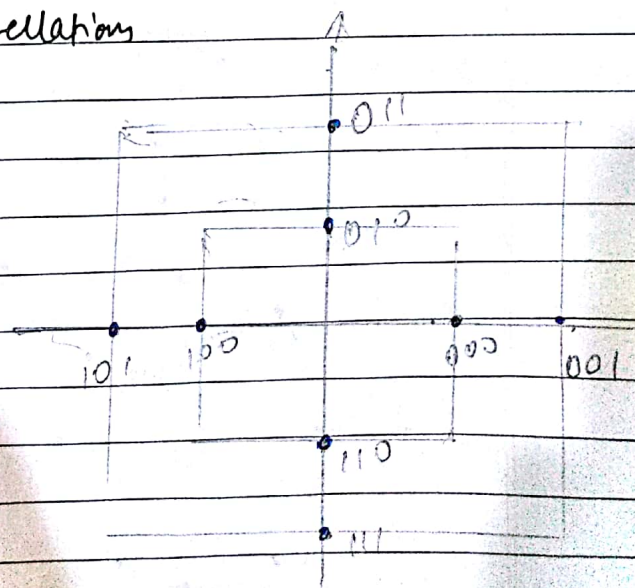
Min. bandwidth =  $N_{\text{band}}$



## 4-QAM and 8-QAM constellations



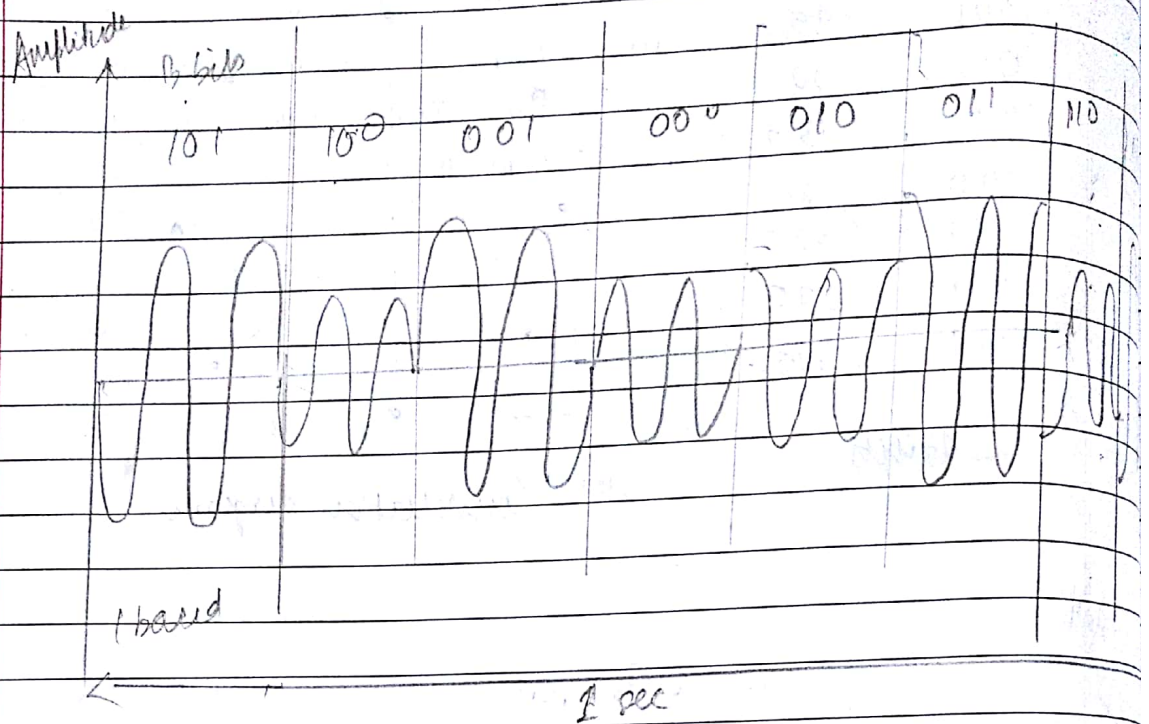
4-QAM  
1 amp, 4 phases



8-QAM  
2 amplitudes, 4 phases

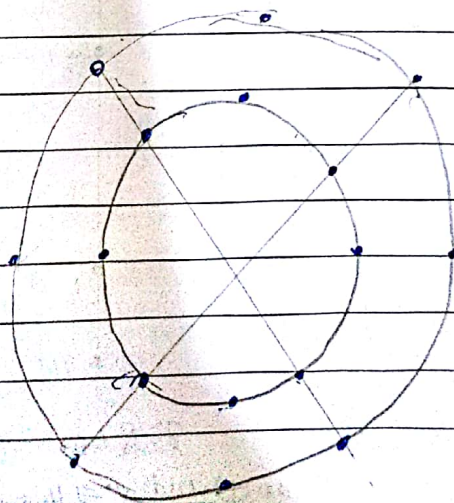
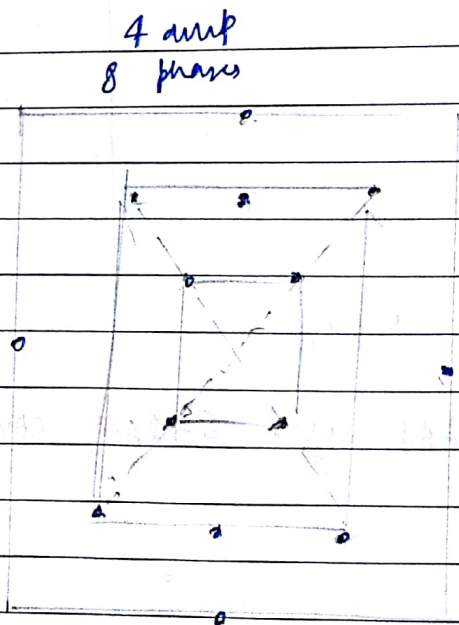
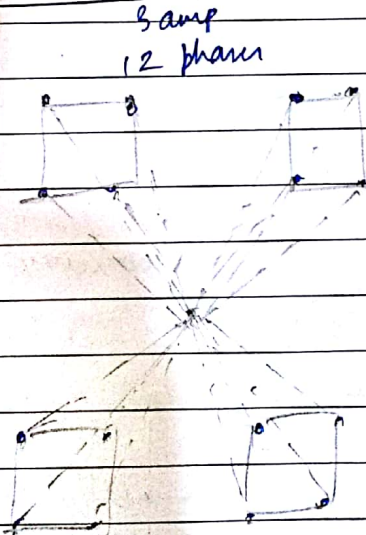


## 8 QAM signal



Bit rate = 24    Baud rate = 8

## 16-QAM constellation

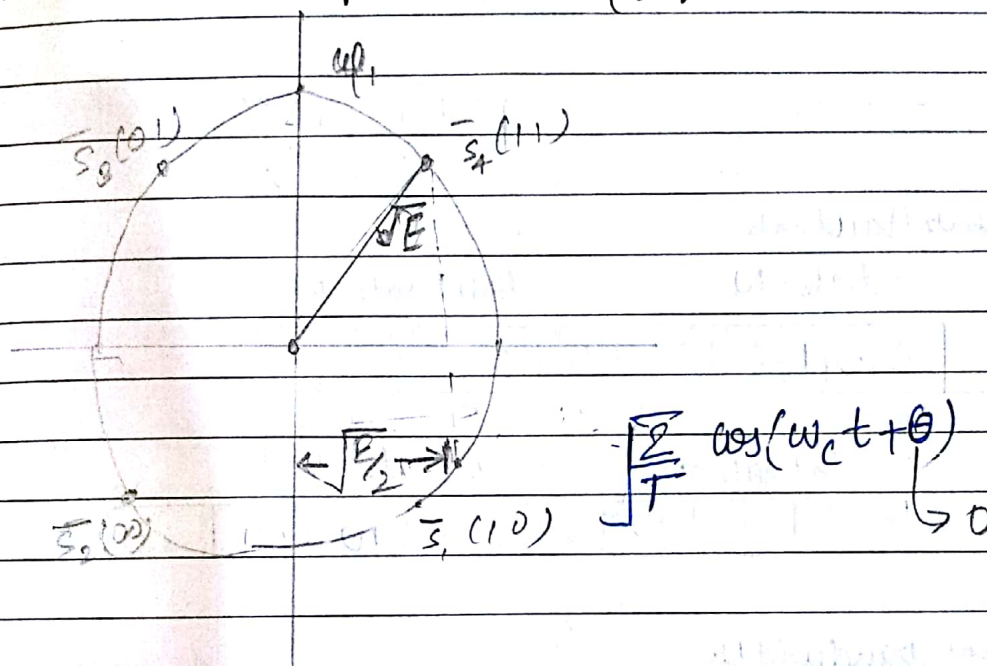


2 amp  
8 phases

Quadrature Phase Shift Keying (QPSK) or

- QPSK is a digital modulation technique
- It is bandwidth efficient as each signal point represents two bits.
- QPSK uses two separate BPSK modulations; one is in-phase other is quadrature (out of phase).

Signal constellation for QPSK ( $\theta$  is considered to be zero)



Take a random bit sequence  
10111011000110

Odd bit sequence = (1111001) } Can be done  
Even bit sequence = (0101010) } using 1 to 2 Demux

Modulating symbol sequence =  $\{s_1(11), s_2(10), s_3(00), s_0(01), s_1(11), s_2(10), s_3(00), s_0(01)\}$