Principles Of Communication

Assignment 05

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D10A 01

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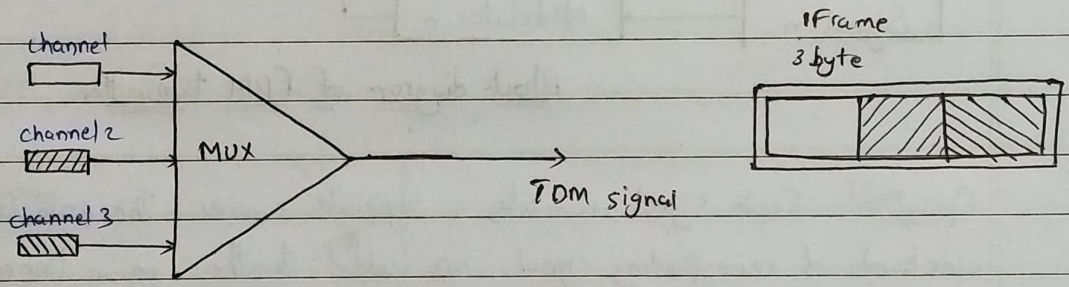
PCOM Assignment 5

1) What is multiplexing in communication system

→ Multiplexing is the process of simultaneously transmitting two or more individual signal over a signal communication channel. Due to multiplexing it is possible to increase the number of communication channel, so that more information can be transmitted.

2) Define TDM. Draw block diagram of TDM system and explain each blocks.

→ TDM is a multiplexing technique in which many signals are sent in a sequential manner but they occupy the same band in the frequency spectrum



Block diagram of TDM system

The data flow of each channel is divided into units. Then one unit from each source is taken and combined to form one frame. The size of each unit such used can be 1 bit or more. For 3 inputs being multiplexed, a frame of TDM will consist of 3 units. Similarly for n number of inputs, each TDM frame will consists of n units.

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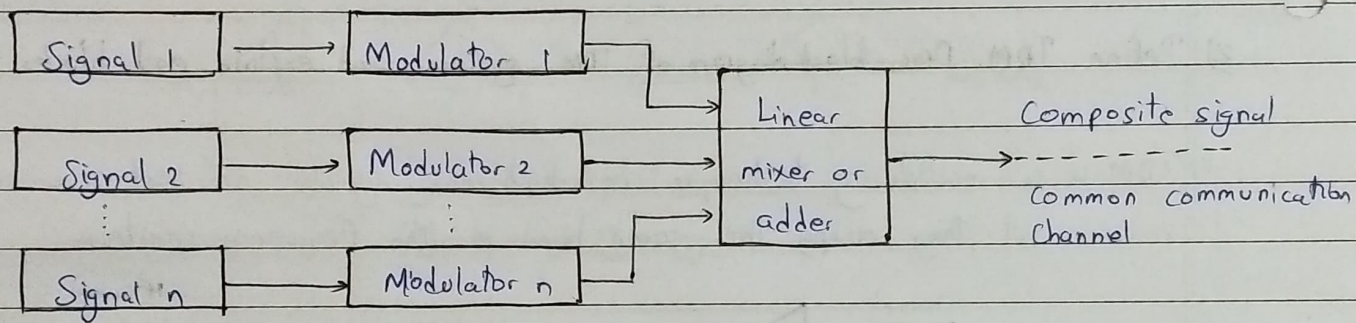
3) Explain concept of FDM, draw and explain block diagram of FDM system Draw spectrum of of FDM signal

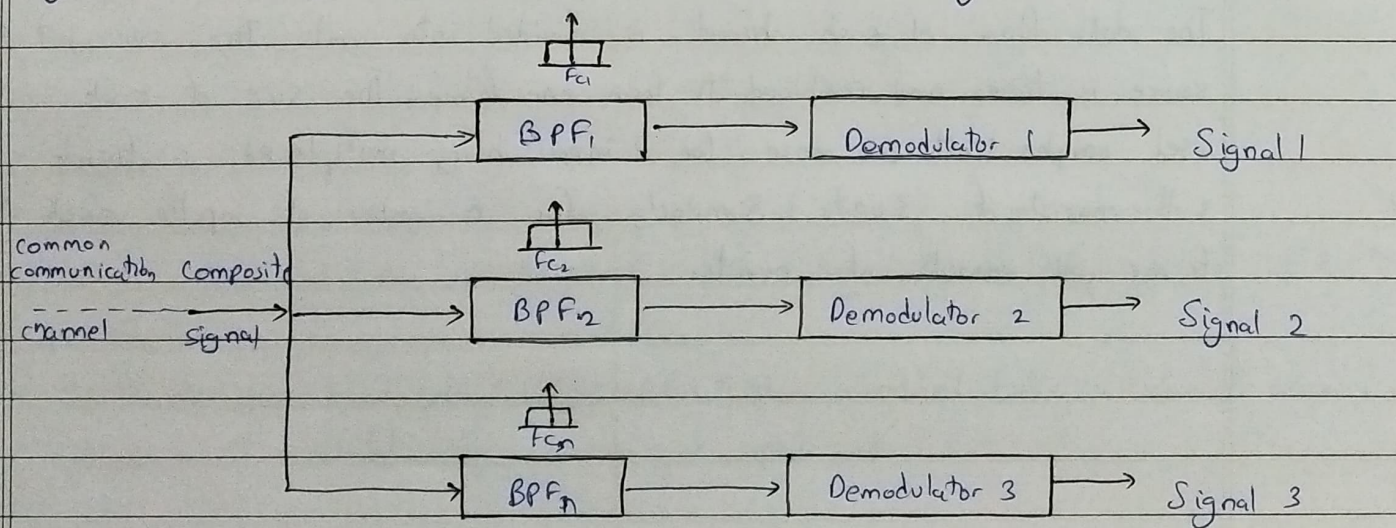
→ FDM is a multiplexing technique in which many signals are sent simultaneously in time domain but are seperated from each other in frequency domain.

FDM transmitter :-



Block diagram of FDM transmitter

Operation :- Each signal modulates a seperate carrier. The modulator putputs, containing side bands of corresponding signal, are added togather in a linnear mixer or adder in which only the algebraic addition of modulated output takes place, the composite signal at the output of mixer is transmitted over the single commonication channel



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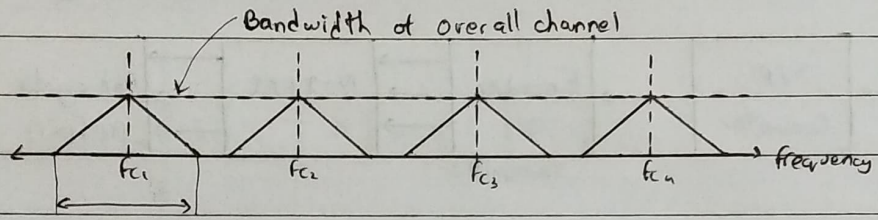
operation:- The composite signal is applied to the group of band pass filter (BPF) each BPF has a center frequency corresponding to one of the carrier The BPFs have an adequate band width to pass all the channel information without any distortion. Each filter will pass through only its channel and reject all others channels. The channel demodulator then removes the carrier and recovers the original signal back



Individual carriers: $f_{c_1}, f_{c_2}, f_{c_3}, f_{c_4}$

Spetrum of FDM signal

4) Compare TDM and FDM

FDM	TDM
i) The signal to be multiplexed are in time domain but occupy diff frequency domain	i) The signal to be multiplexed can occupy entire band width but are isolated in time domain
ii) Prefferred for analog signals	ii) Preferred for digital signals
iii) Synchronisation not required	iii) Synchronisation is required
iv) Requires complex circuitry	iv) Circuitry is not very complex
v) Suffers from problem of crosstalk	v) Problem of crosstalk is not severe
vi) Due to wide band fading, all channels are effected	vi) Due to fading only few channels are affected
vii) Due to slow narrowband fading, only a single channel is affected	vii) Due to slow narroband fading, all channels may get wiped out

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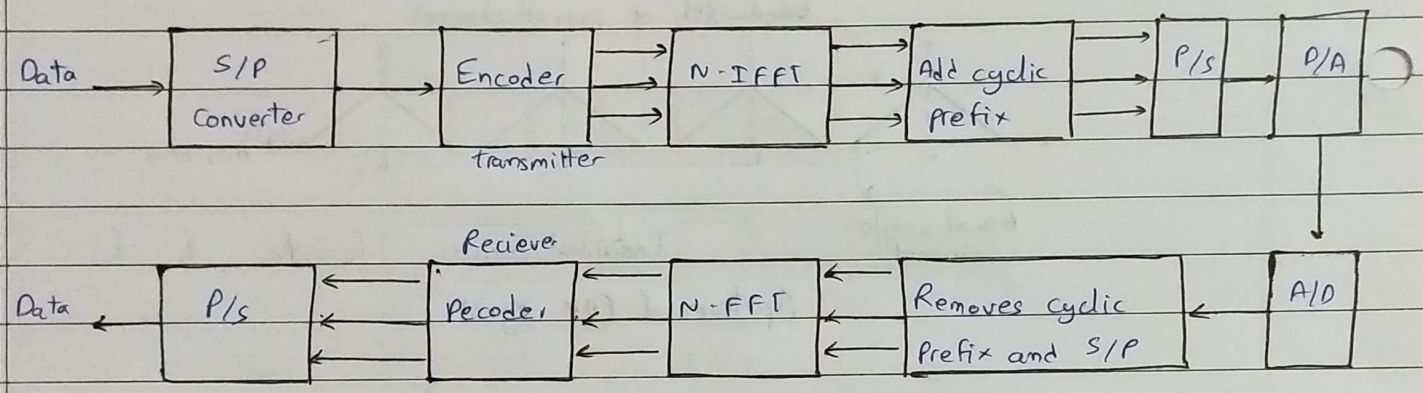
5) Explain the fact of OFDM. Draw block diggram of OFDM transmitter and reciever and explain each blocks.

→ OFDM stands for orthogonal frequency division modulation. It is technique in which bandwidth is divided into several orthogonal sub frequencies. It can be used for high speed video and audio communication without any inter symbol interfearance (ISI)



Block diagram of OFDM transmitter and reciever

Serial to parallel conversion: The input data is made compatible for transmission by converting it into suitable word size and then transmitting it parallely using carrier for each word.

Modulator:- Each carrier to be used is alloted with data whose amplitude and phase are chosen according to the modulation scheme used.

IFFT:- IFFT on transmitter and FFT on reciever's side are used to modulate and demodulation respectively

Cyclic prefix: Since the bandwidth is broken into N sub-carriers, the symbol rate is N times lower than normal. This makes OFDM naturaly resistant to ISI caused by multipath propogation cyclic prefix makes signal periodic and discards the gaurd interval at the reciever.

The reciever basically does the reverse operation to retrieve the information signal

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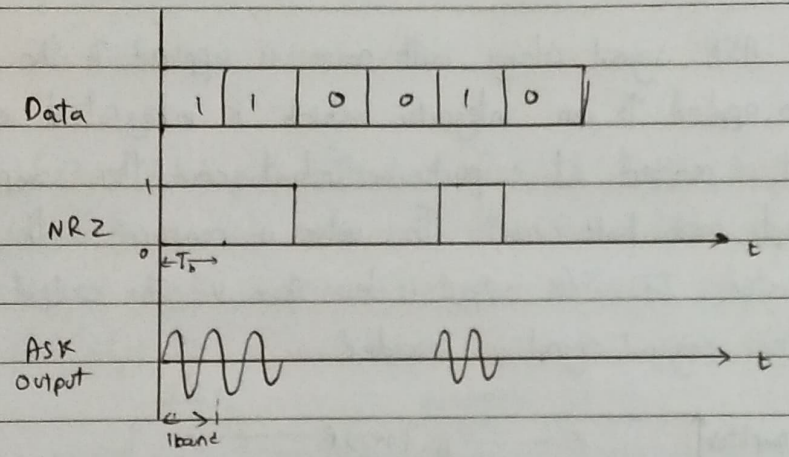
6) What is ASK ? Explain with help of suitable waveforms.

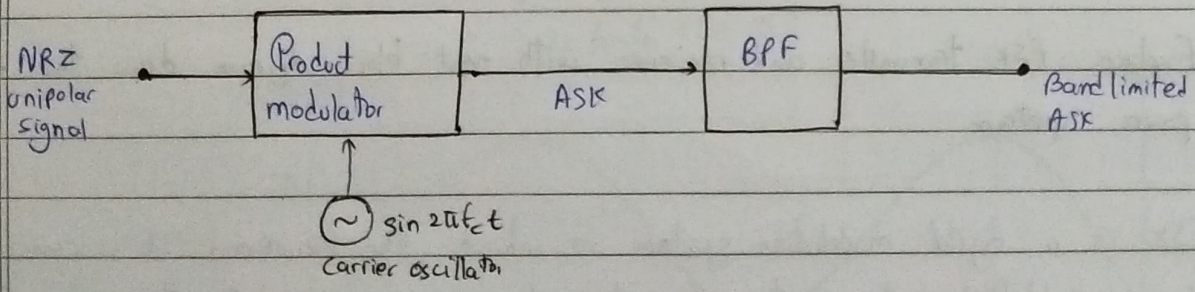
→ ASK or Amplitude Shift Keying is the digital carrier modulation in which the amplitude of the sinusoidal carrier will take one of the two pre determined values in response to 0 or 1 value of digital input signal. ASK is the simplest type of CW modulation



ASK waveform

7) Explain ASK transmitter and reciever with neat block diagram. Draw the frequency spectru

→ ASK transmitter It is nothing but multiplier followed by a band pass filter



Block diagram of ASK Transmitter

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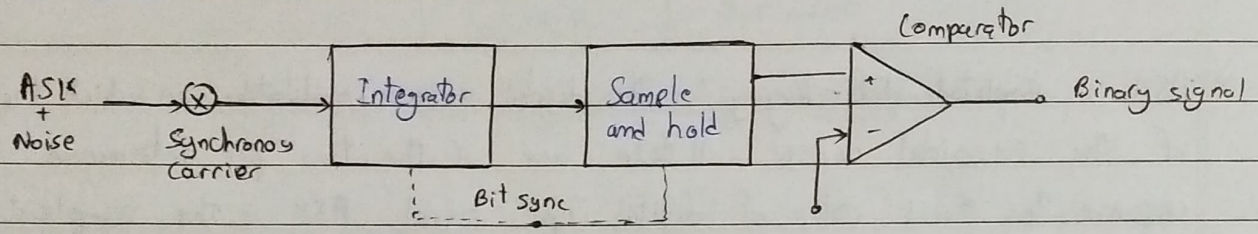
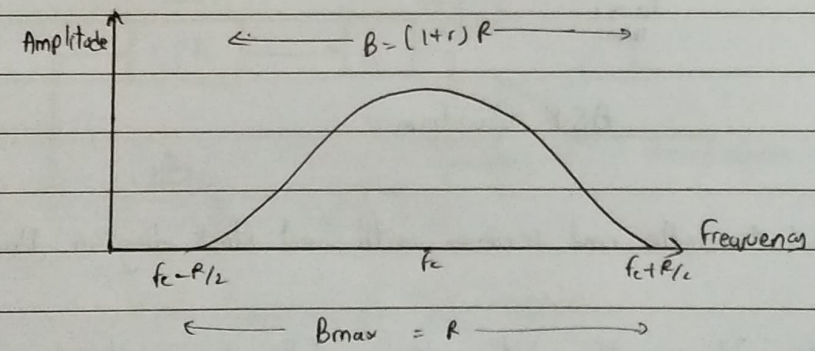
ASK Reciever



Block diagram of ASK reciever

Operation: The ASK signal along with noise is applied to the multiplier, whose output is then applied to an integrator which is integrated over one bit duration T_b. Its output is sampled at a particular instant and this sampled value is held by the sample and hold circuit. This value is compared with reference voltage V by a comparator. If S/H output is less than V the output is 0, otherwise it is 1. Thus original signal is recorded



8) Explain FSK transmitter and reciever with neat block digram, draw the frequency/ power spetrum

→ FSK is a digital modulation system in which the frequency of a sinusoidal carrier is shifted between two discrete values in responses to the value of digital input signal

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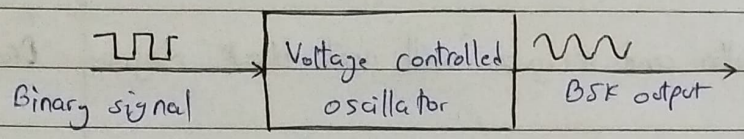
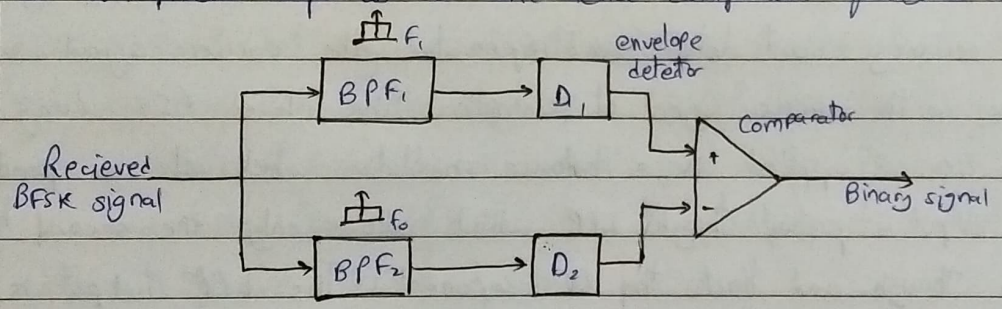


Block diagram of FSK transmitter

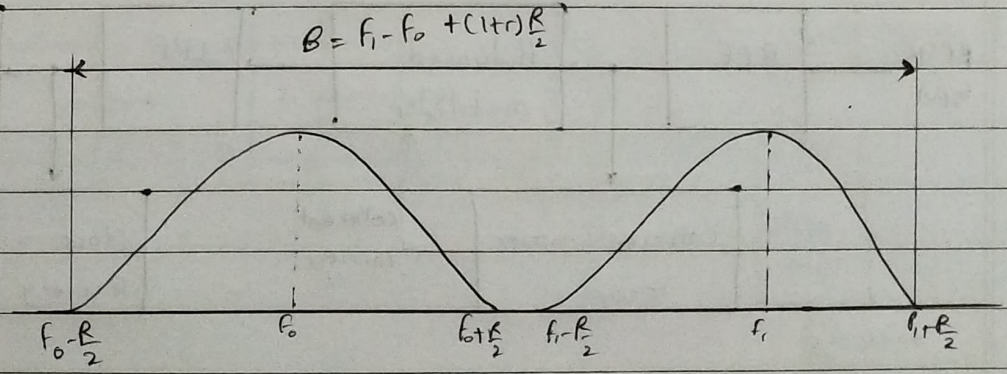
An FSK generator is basically a voltage controlled oscillator, which produce sine waves at frequency f_1 and f_0 respectively. Corresponding to binary 0 input, the VCO produces a sinewave of frequency of f_1. Thus we obtain the binary FSK at output VCO

FSK Recievers

It consists of two band pass filter, one for each of the frequency f_0 and f_1. The envelope detectorss which rectify and filter their inputs, to generate a DC voltage proportional to AC input. Suppose Binary 1 is recieved. D_1 will pass a signal and D_2 will produce output as 0 and hence comparator produces 1



Block diagram of FSK recievers



Frequency spectrum of FSK signal

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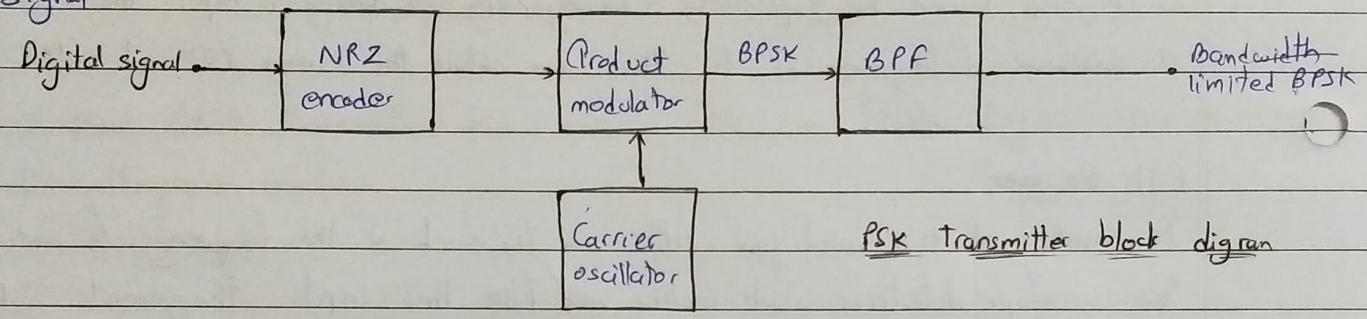
9) Explain PSK transmitter and reciever. with neat block diagram. Draw the power spectrum

PSK transmitter

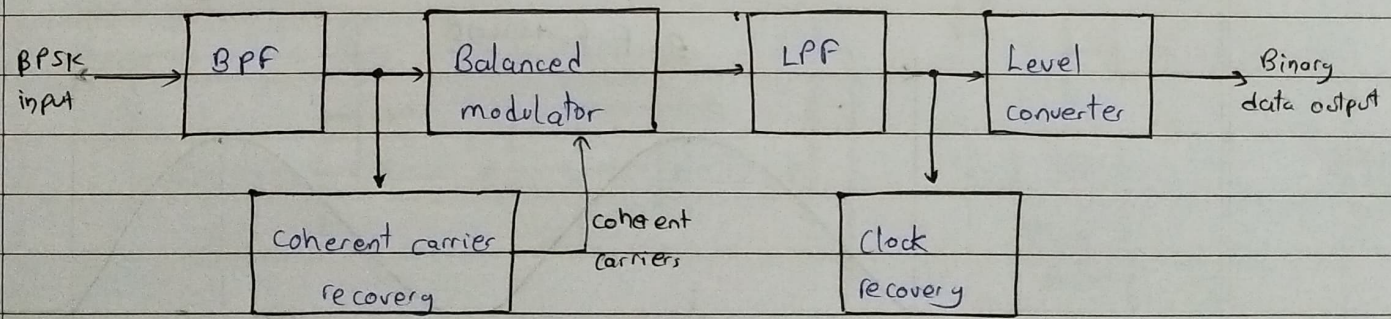
The binary data signal is converted into a NRZ bipolar signal by an NRZ encoder, which is then applied to a multiplier. The other input to the multiplier is carrier signal



PSK Transmitter block digram

PSK reciever

The coherent recovery circuit detects and regenerated the carrier signal, which has same frequency as the carrier signal at transmitter. The filtered PSK along with regenerated carrier is applied to a balance modulator, which acts as product detector. Its output is passed through LPF, which allows only the second harmonic term to pass through and blocks the DC component. The LPF output is applied to the level detector and clock recovery circuit. The output of level detector is $+V/2$ (0 or 1) Thus the binary signal is obtained at output



Block diagram of BPSK reciever

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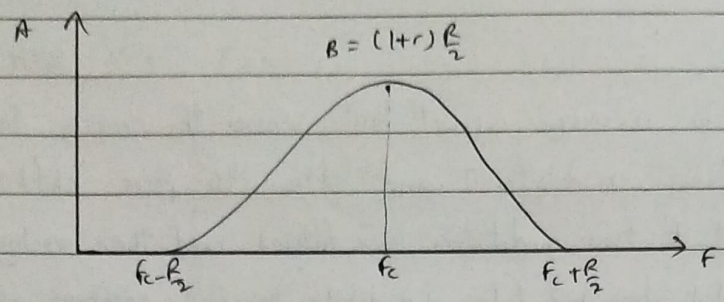
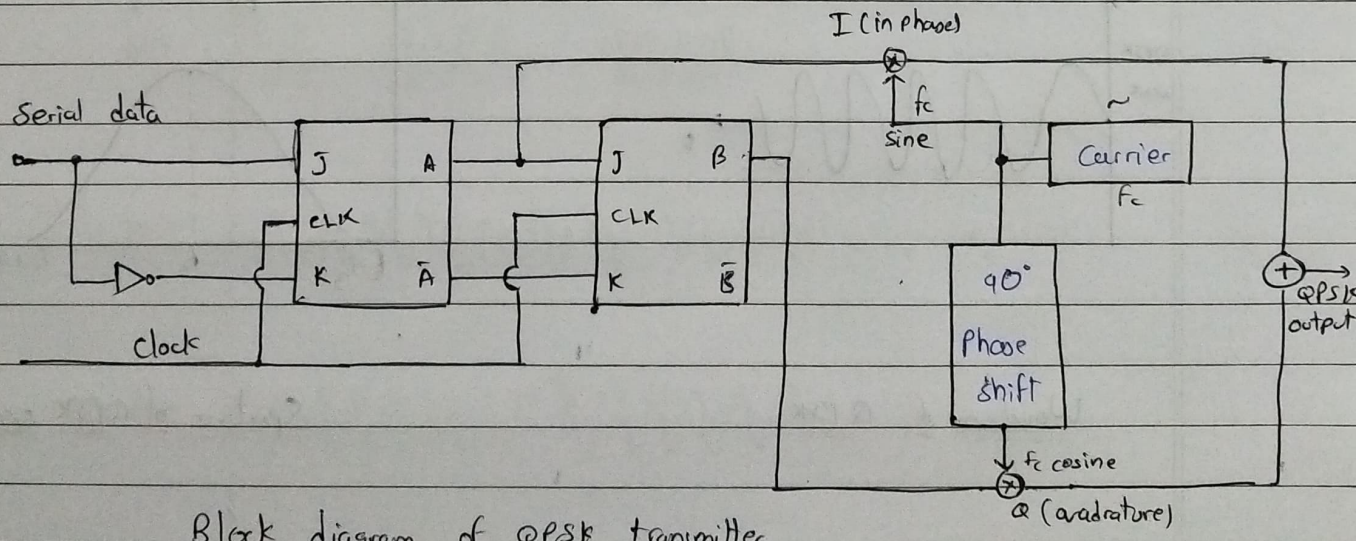


Spectrum of PSK/BPSK signal

10) Explain QPSK Transmitter and reciever with neat block digram and waveform. Draw the power spectrum.

QPSK transmitter

The input seial dat stream is sampled as an entire character by 2 bit shift register and converted to a parallel output signal by a clock pulse. The ostpt of most significant bit register of bit splitter is channel to I modulator. The least significant bit of the registe is directed to Q modulator. The output of each modulated (I and Q) is a BSK signal where there is no phase shift to '0' and 180° Phase shift for '1'. The output of modulators are linearly added to produce QPSK signal.



Block digram of QPSK transmitter

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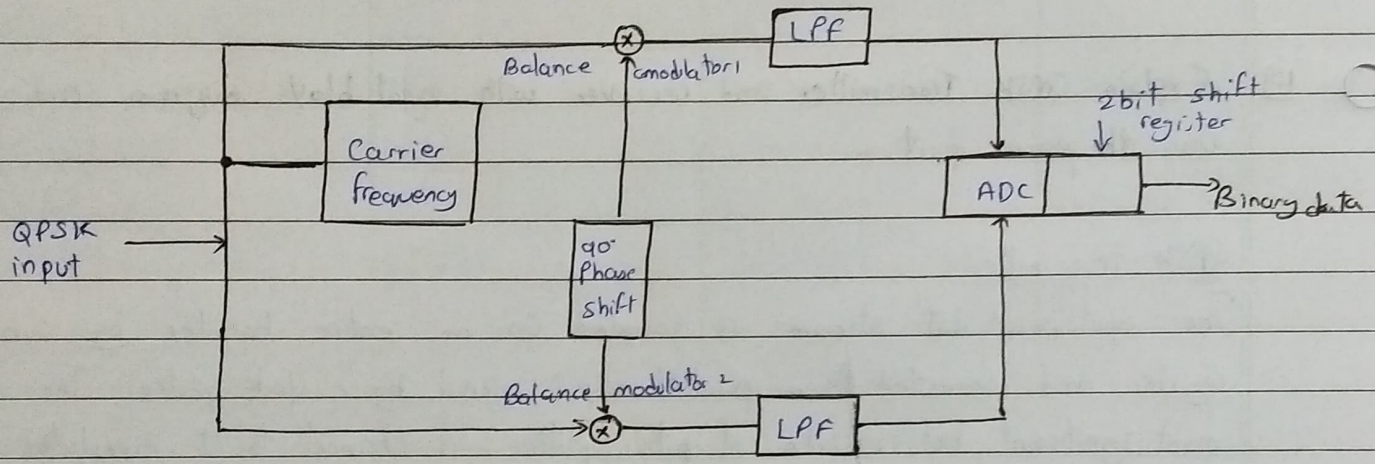
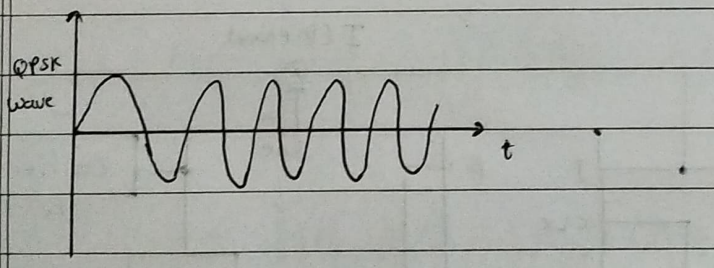
QPSK reciever

It consists of carrier recovery circuit that senses the carrier frequency and suppresses it to balance modulator I and after 90° phase shift to the other balance modulator. The output of two modulators are filtered and then analog information is converted into digital two bit data i.e dibit. The dibit combine in a shift register and shifted out to produce the orginal data

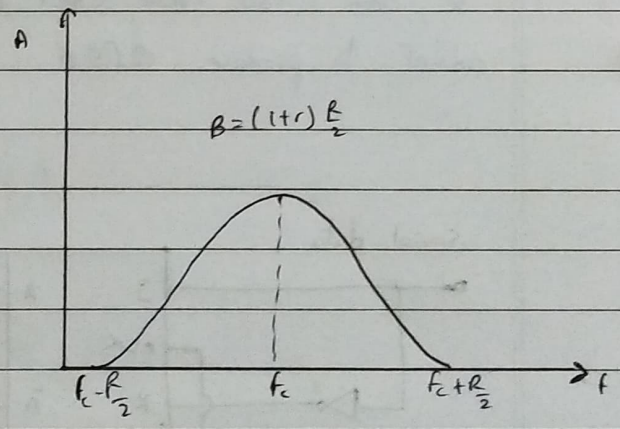


Block diagram of QPSK reciever

00	01	10
0°	90°	180°



Waveform of QPSK



Spectrum of QPSK signal

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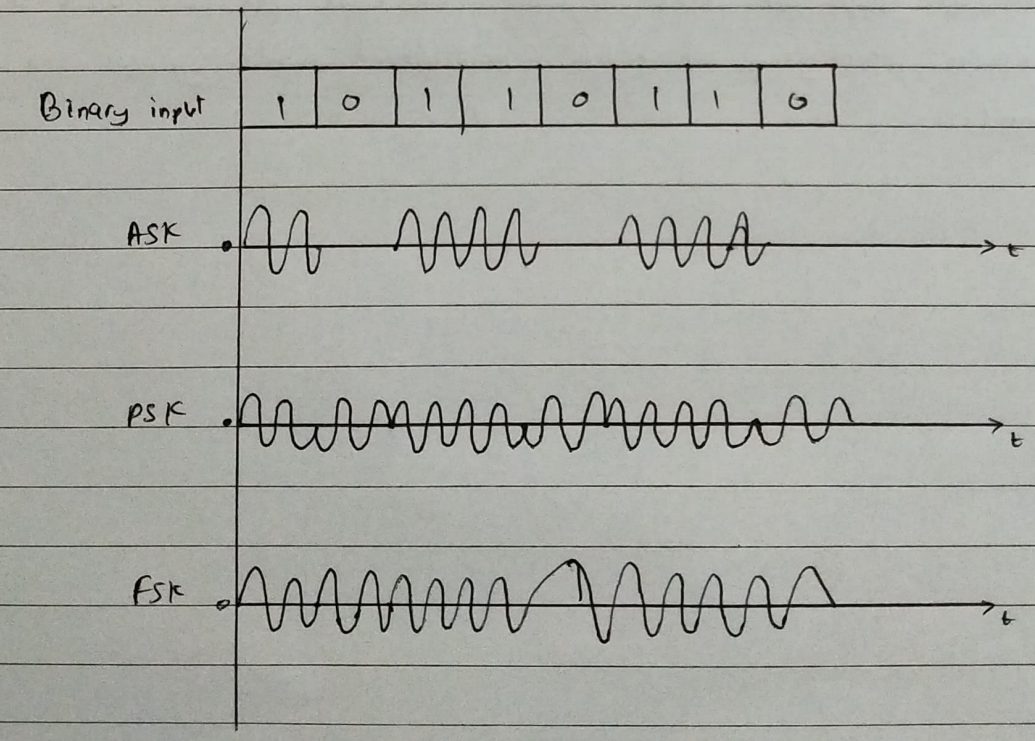
11) Compare ASK, PSK, FSK

Parmeters	ASK	FSK	PSK
i) Variable characteristics	Amplitude	frequency	Phase
ii) Bandwidth (Hz)	2R	$(f_1 - f_0) + (1+r)R$	$(1+r)R$
iii) Noise immunity	low	High	High
iv) Error probability	High	Low	Low
v) Complexity	simple	moderately complex	very complex
vi) Bit rate	upto 100 bits/sec	upto 1200 bits/sec	Very high bit rates
vii) Detection method	Envelope	Envelope	coherent

12) Draw ASK, PSK, FSK waveform for digital data 10110110



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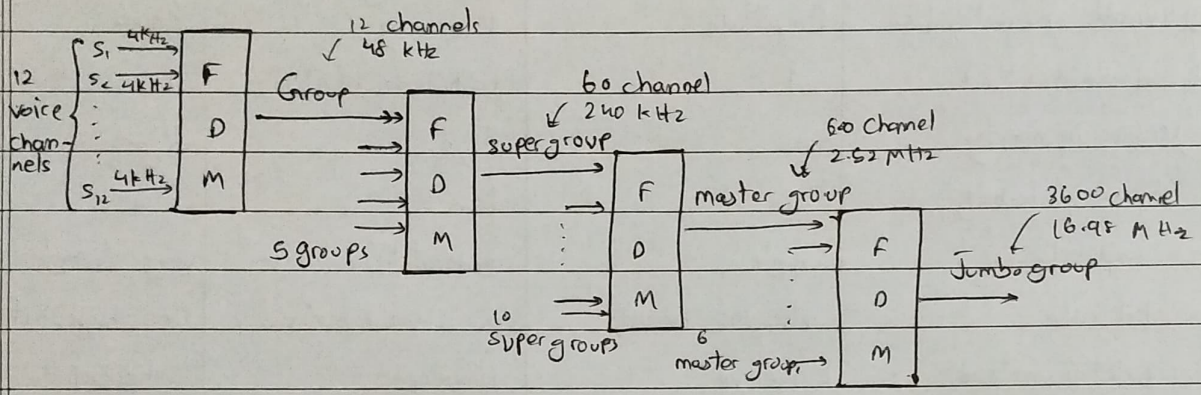
13) Describe the multiplexing heirarchy for FDM system

The FDM Hierarchy is different level of the multiplexer are shown in combined manner. The various levels are shown below



Level 1 denotes the basic group in which 12 voice channels are multiplexed together and as each group in which 5 basic groups are multiplexed altogether, and as each has 12 channels, hence we have 60 voice channels. Level 3 is the master group in which 10 super groups are mixed together and have upto 600 voice channels Level 4 denotes jimbo group, which has 6 multiplexed master groups and upto 3600 voice channels.

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