Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills).
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues may vary and there may be some difference in the candidate's answers and modelanswer.
6) In case of some questions credit may be given by judgement on part of examiner of relevantanswer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

I) A) Answer any three of the following: **12**

i) Draw the basic block diagram of an electronic communication system and state the function of each block.
(2M block diagram, 2M explanation)

Ans.

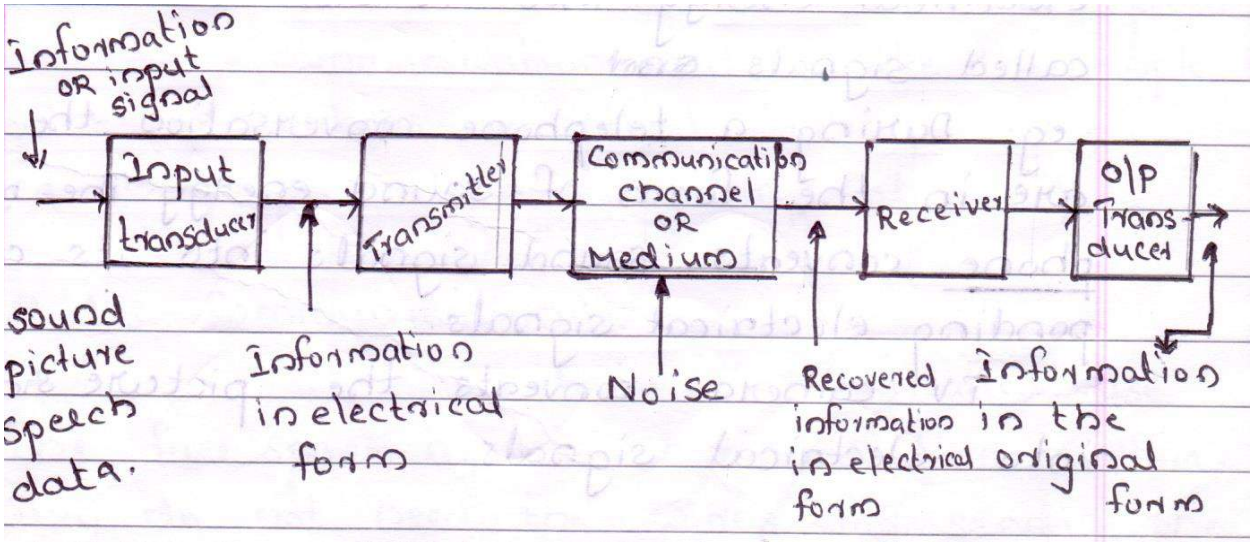


Fig: block diagram of an electronic communication

The main components of a basic communication system are:

1. Information or input signal
2. Input transducer
3. Transmitter
4. Communication channel or medium
5. Noise
6. Receiver
7. Output transducer

1. **Information or input signal:** The information can be in the form of a sound signal like speech or music or it can be in the form of pictures (T. V. signals) or it can be data information coming from a computer.

2. **Input Transducer:** The communication system transmits information in the form of electrical signals. The transducers convert the non-electrical energy into its electrical energy called signals.
   E.g. During a telephone conversation the words are in the form of sound energy. The microphone converts sound signals into its corresponding electrical signals.

   TV camera converts the picture signals into electrical signals.
   E.g. Microphone, TV, Camera.

3. **Transmitter:** It is used to convert the information into a signal suitable for transmission over a given communication medium. It increases the power level of the signal. The power level is increased to cover a large range. The transmitter consists of electronic circuits such as amplifier, mixer oscillator and power amplifier,

4. **Communication channel or medium:** The communication channel is the medium used for transmission of electrical signals from one place to other. The communication medium can be conducting wires cables optical fiber or free space. Depending on the type of communication medium two types of communication systems will exist.
   They are
   1. Wire communication or line communication
   2. Wireless communication or radio communication.

5. **Noise:** Noise is random undesirable electric energy that enters the communication system through the communication medium and interferes with the transmitted signal.

6. **Receiver:** The reception is exactly the opposite process of transmission. The received signal is amplified demodulated converted into a suitable form by the receiver. The receiver consists of electronic circuits like mixer, oscillator, detector amplifier etc.

7. **Output Transducer:** The output transducer converts the electrical signal at the output of the receiver back to the original form is sound or TV pictures etc.
   E.g. Loud speaker: electrical signals ⟶ sound
   Picture tubes: electrical signals ⟶ visual data.

ii) State the principle of baseband transmission and passband transmission. ***(2M for each)***

Ans.

Baseband Transmission

The message signal generated from information source is called baseband signal. If the baseband signal is transmitted directly then it is called baseband transmission. Baseband transmission does not use modulators and demodulators. Baseband transmission is preferred for low frequencies and for short distances.

Passband Transmission

If the modulated signal is transmitted over the channel it is called bandpass transmission. Whenever the modulating signal is impressed upon the carrier the modulated signal is generated. This modulated signal has fixed band of frequencies around carrier frequency. The nature of such a signal is bandpass type. Hence modulated signals are called bandpass type signals. Passband transmission is preferred for high frequencies and for long distances.

iii) Describe the working principle of CDMA. ***(2M diagram, 2M explanation)***

Ans.

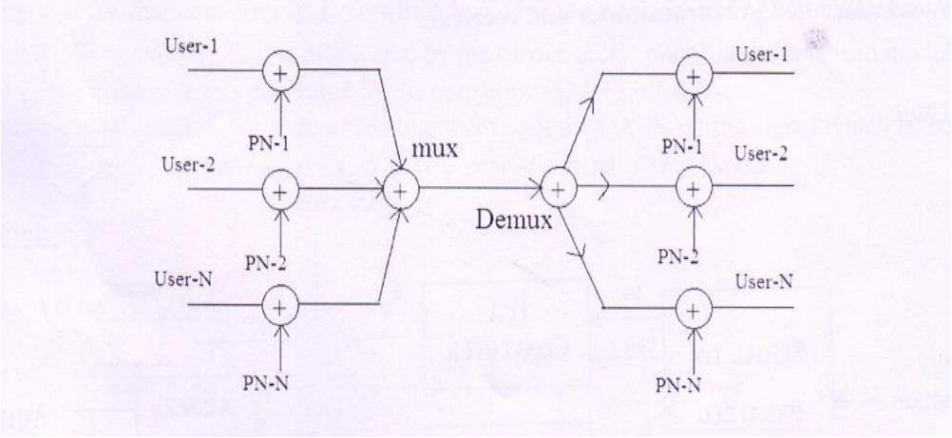


Fig: CDMA

- CDMA system uses same frequency band and transmit simultaneously. They can use the whole available bandwidth for all the time. The transmitted signal is recovered by co-relating the received signal with the PN code used by the transmitter.

- CDMA allows all the users to occupy all channels at the same time. Transmitted signal is spread over the whole band and each voice or data call is assigned a unique code to differentiate it from other calls carried over the space spectrum.
- All the users in CDMA use same carrier and may transmit simultaneously. Each user has its own pseudorandom code word which is unique for each channel. For detection of message signal the receiver needs to know the code word use by transmitter. Each user operates independently with no knowledge of other users.

iv) The carrier input to AM modulator is a 500 KHz$_0$ with 20 V amplitude. The modulating input is a 10 KHz signal with 7.5V amplitude.
Determine:
a) Upper and lower side frequencies
b) Modulation index and percentage modulation.
(1M each)

Ans. a) Upper and lower side frequencies:

$f_c = 500KHz$

$V_c = 20V$

$f_m = 10KHz$

$V_m = 7.5V$

$\boldsymbol{f_{USB} = f_c + f_m}$

= $500KHz + 10KHz$

=$\boldsymbol{510KHz}$……..(1M)

$\boldsymbol{f_{LSB} = f_c - f_m}$

= $500KHz - 10KHz$

= $\boldsymbol{490KHz}$……(1M)

b) Modulation index and percentage modulation:

$m_a = \frac{V_m}{V_c} = \frac{7.5}{20} = \mathbf{0.375}$……(1M)

% Modulation = $\frac{V_m}{V_c} X\ 100 = \frac{7.5}{20} X\ 100 =$ **37.5%**.....(1M)

I) B) Answer any one: 6

i) Draw the block diagram of AM superheterodyne receiver and state the function of each block.

(2M diagram, 4M explanation)

Ans.

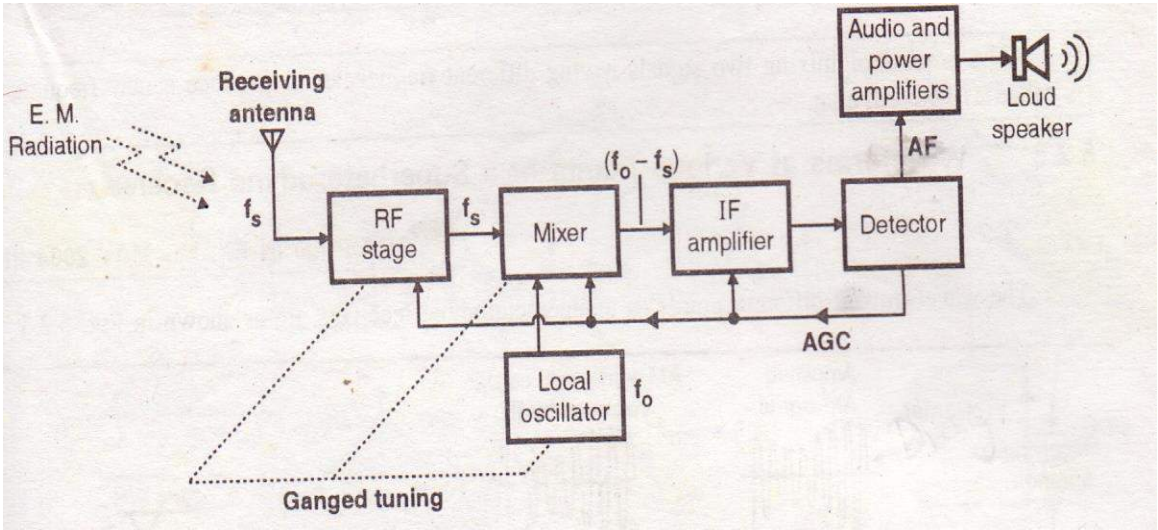


Fig: superheterodyne receiver

Working:

The AM signal transmitted by the transmitter travels through the air and reaches the Receiving antenna. The signal is in the form of electromagnetic waves. It induces a very small voltage into the receiving antenna.

RF amplifier: The RF amplifier is used to select the wanted signal and rejects the unwanted signals present at the antenna. It reduces the effect of noise. At the output of RF amplifier we get the desired signal at frequency f_s.

Mixer: The mixer receives the signal from the RF amplifier at frequency (f_s) and from the local oscillator at frequency (f_0) such that $f_0 > f_s$.

Intermediate frequency (IF): The mixer is a non-linear circuit. It will mix the signals having frequency f_0 and f_s to produce signals having frequencies f_s, f_0, $f_0 - f_s$, $f_0 + f_s$. Out of these the difference of frequency component i.e. $f_0 - f_s$ is selected and all other are rejected. This frequency is called intermediate frequency (IF).

$IF = (f_0 - f_s)$	IF = 455 KHz For AM

Ganged Tuning: In order to maintain a constant difference between the local oscillator frequency and the incoming signal frequency ganged tuning is used, This is simultaneous tuning of RF amplifier mixer and local oscillator. This is obtained by using ganged tuning capacitors.

IF amplifier: The IF signal is amplifier by one or more IF amplifier stage. IF amplifiers provide most of the gain and Bandwidth requirement of the receiver.

Detector: The amplifier IF signal is detected by the detection to obtain the original modulating signal. Normally practical diode detectors are used as detector.

Audio and Power Amplifier: The recovered modulating signal is amplified to the \ adequate power level by using the Audio and Power Amplifier and given to the Loud speaker.

Loud Speaker converts the electrical signals into sound signals.

AGC (Automatic Gain Control): This circuit controls the gain of RF and IF amplifiers to maintain a constant output voltage level even when the signal level at the receiver input is fluctuating. This is done by feeding a controlling D.C. voltage to the RF and IF amplifiers. The amplitude of this dc voltage is proportional to the detector output.

ii) Draw the block diagram to generate ASK. Describe its working. Draw the related waveforms.
(2M block diagram, 2M explanation, 2M waveforms)
Note: Any other correct block diagram and waveform shall be considered)

Ans.

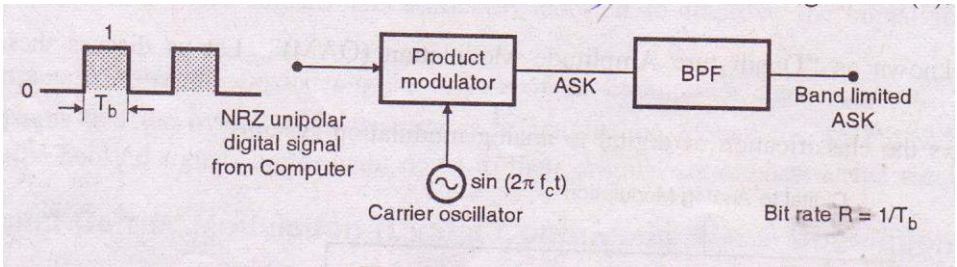


Fig: ASK generator

- The carrier is a sinewave of frequencyf_c. We can represent the carrier signal mathematically as follows:

$$e_c = sin(2\pi f_c t)$$

- The digital signal from the computer is a unipolar NRZ signal which acts as the modulating signal. The ASK modulator is nothing but a multiplier followed by a band pass filter.
- Due to the multiplication, the ASK output will be present only when a binary "1" is to be transmitted.
- The ASK output corresponding to a binary "0" is zero.
- The carrier is transmitted when a binary 1 is to be sent and no carrier is transmitted when a binary 0 is to be sent.

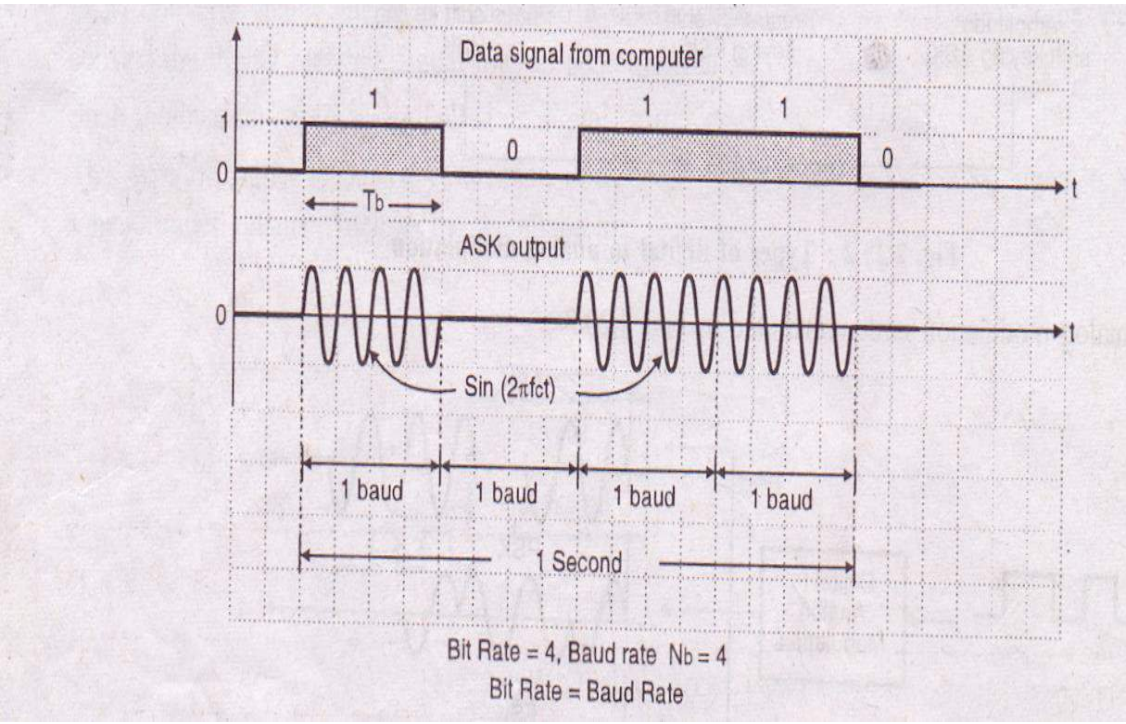


Fig: ASK waveforms

II. Answer any four: 16

a) With the help of block diagram, describe a method to generate PAM wave. Draw the waveforms of modulating signal, Pulse and PAM on the same time scale.
(2M block diagram, 1M explanation, 1M waveforms)

Ans.

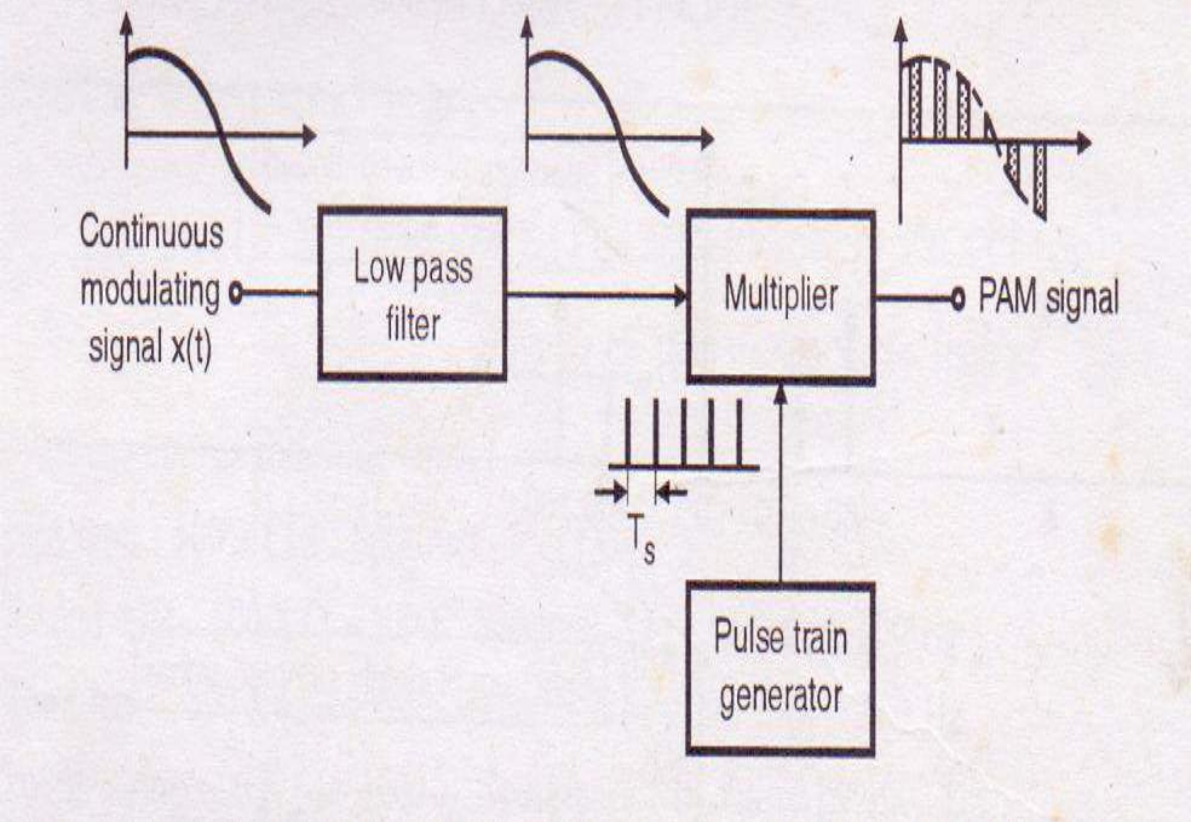


Fig: Generation of PAM

- The continuous modulating singal$x(t)$ is passed through the low pass filter. The low pass filter will bandlimit signal to f_m. All the frequency components higher than $f_m$are removed.
- The pulse train generator generates a pulse train at a frequency$f$.
- The modulating signal $x(t)$ and the sampling signal are multiplied in the sampled to produce pulse amplitude modulated (PAM) signal.
- The PAM signal is a train of pulse of width t whose amplitudes are varying.

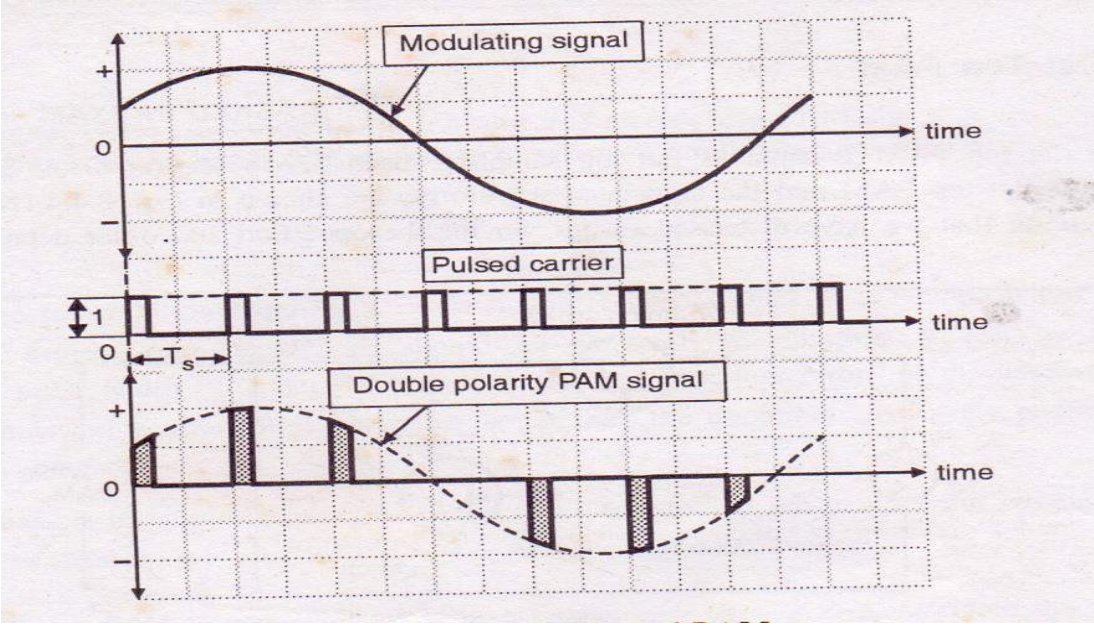
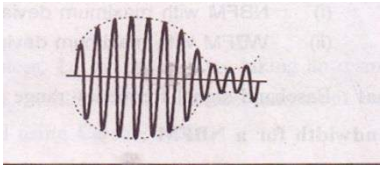
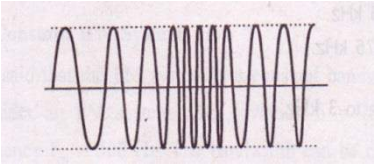


Fig: Waveform of PAM

b) Compare AM and FM on the basis of
i) Definition
ii) Waveforms
iii) Bandwidth requirement
iv) Modulation index.
(1M for each)

Ans.

Compare	AM	FM
Definition	Amplitude modulation (AM) is the process of changing the amplitude of a high frequency carrier signal in proportion with the instantaneous value of the modulating signal keeping frequency &Phase constant.	Frequency modulation (FM) is the process of changing the frequency of carrier signal in proportion with the instantaneous value of the modulating signal keeping Amplitude &Phase constant.

Waveforms	AM wave: 	FM wave: 
Bandwidth requirement	BW = $2f_m$ (f_m → frequency of modulating signal)	Bandwidth = $2[\delta + f_m]$ (δ → frequency deviation f_m→frequency of modulating signal
Modulation index	$m_a = \frac{V_m}{V_c}$ V_m →Amplitude of modulating signal V_c →Amplitude of carrier signal	$m_f = \frac{\delta}{f_m}$ (δ → frequency deviation f_m→frequency of modulating signal

c) Draw the waveforms of QPSK with a suitable example.
(4M, Give marks for the consideration of any data)

Ans.

Symbol	Phase
00	0
01	90
10	180
11	270

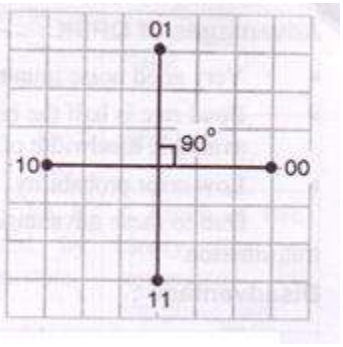


Fig: Constellation diagram of QPSK

- 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 then we have to transmit a carrier at 0^0 phase shift. If 01 is to be transmitted, then the same carrier is transmitted with a phase shift of 90^0

- Similarly the message 10 and 11 are transmitted by transmitting the carrier at 180^0 and 270^0 respectively.

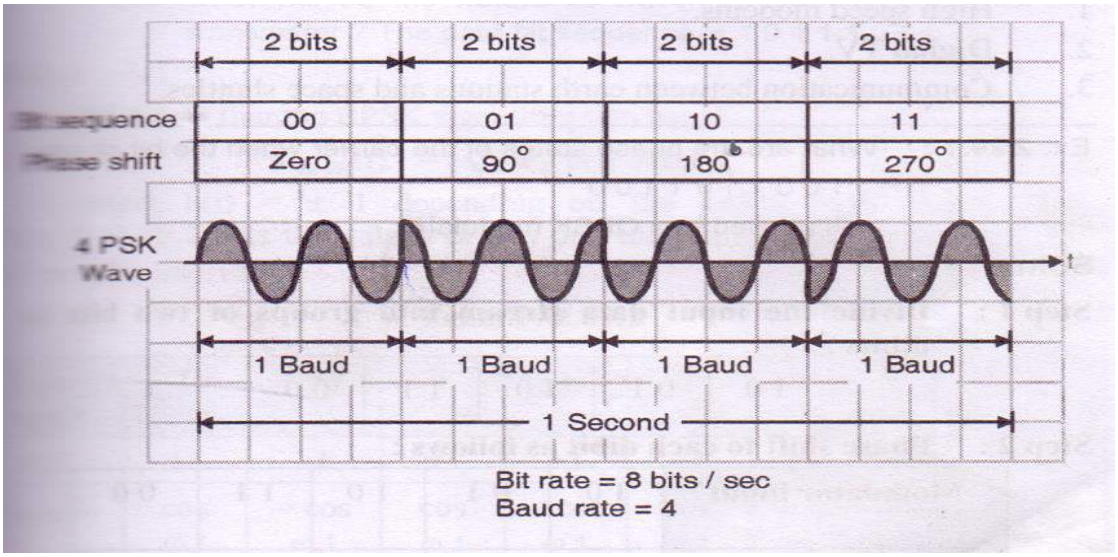
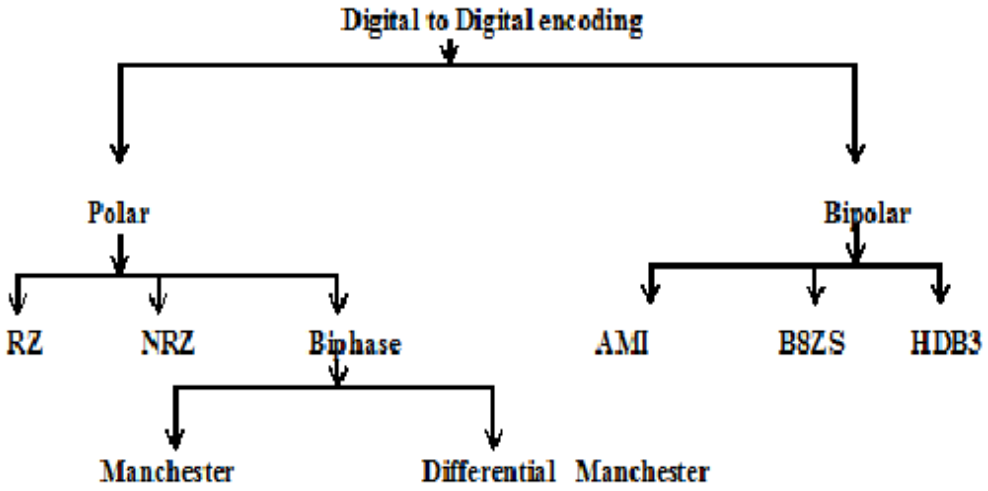


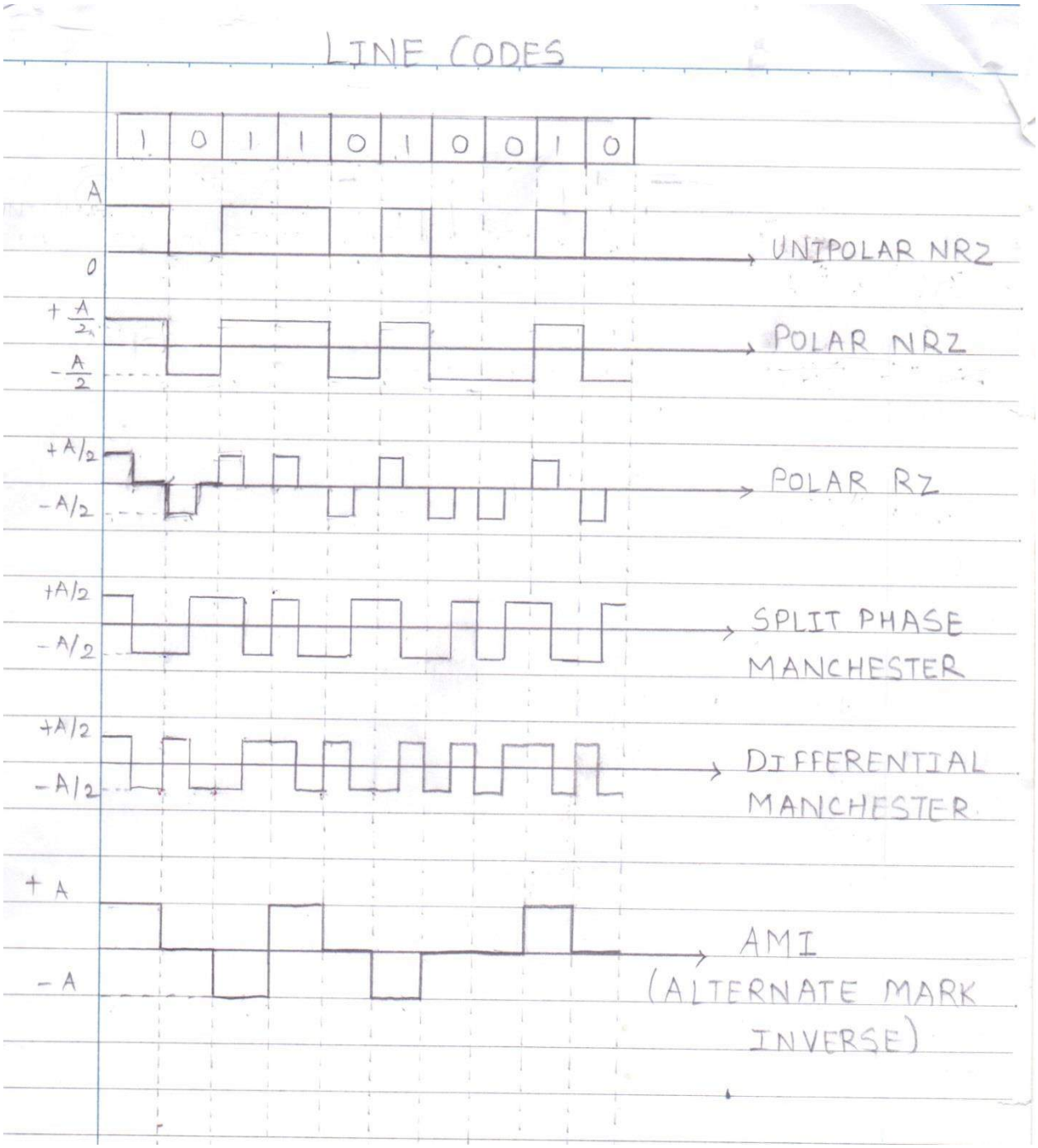
Fig: Waveforms of QPSK

d) Classify the various methods of digital-digital encoding. With a suitable example, encode using any two methods.
(2M classification, 1M each for each method, Give marks for the consideration of any other data also)

Ans.



Example


LINE CODES
1 0 1 1 0 1 0 0 1 0
A
0
UNIPOLAR NRZ
+ A/2
- A/2
POLAR NRZ
+A/2
-A/2
POLAR RZ
+A/2
-A/2
SPLIT PHASE
MANCHESTER
+A/2
-A/2
DIFFERENTIAL
MANCHESTER
+ A
- A
AMI
(ALTERNATE MARK
INVERSE)

e) Draw the basic block diagram of a Satellite Communication and describe its working principle.
(2M block diagram, 2M working principle)

Ans.

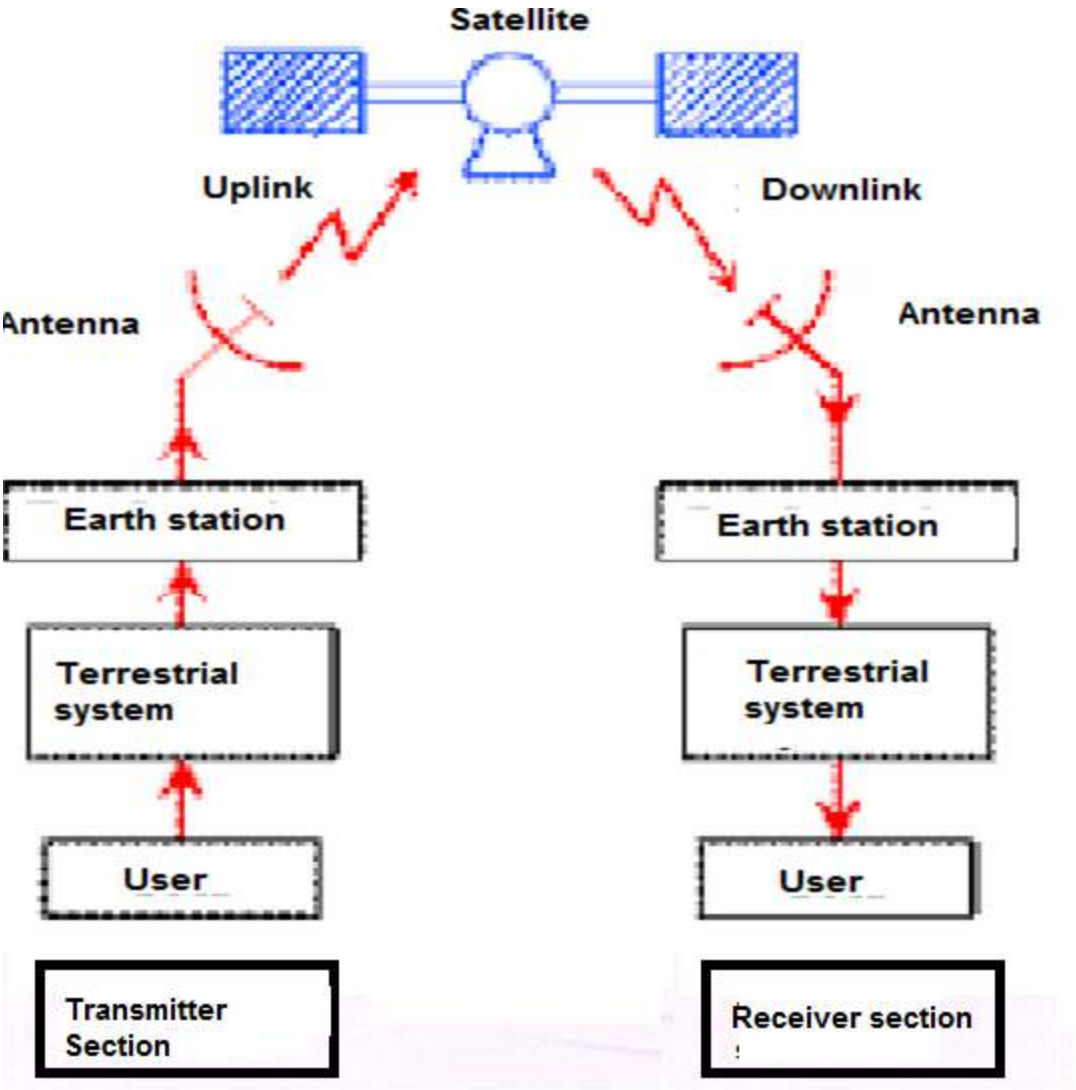


Fig: Satellite Communication

Working principle of satellite communication:

- Users are the ones who generate baseband signals, which is processed at the earth station and then transmitted to the satellite through dish antennas.

- Now the user is connected to the earth station via some telephone switch or some dedicated link.
- The satellite receives the uplink frequency and the transponder present inside the satellite does the processing function and frequency down conversion in order to transmit the downlink signal at different frequency.
- The earth station then receives the signal from the satellite through parabolic dish antenna and processes it to get back the baseband signal.
- This baseband signal is then transmitted to the respective user via dedicated link or other terrestrial system.
- A satellite communication system operates and works in the millimeter and microwave wave frequency bands from 1GHz to 50 GHz.

f) State four applications of Satellite Communication System.
(1M each for any four points)

Ans..

1. Major application of satellite is **surveillance or observation**
2. It is used in **Navigation (Global Positioning system).**
3. It is used in **TV distribution(TV signal is transmitted through satellite)**
4. **Satellite telephone**
5. **Entertainment** - Broadcasting via satellite offers a variety of programming to the avid viewer including local and foreign programs.
6. **Do serve civilian in rural area** where terrestrial communication network does not exist by providing telephony service.
7. **In military sector**, providing robust and sophisticated secure communications network.
8. **To provide communication when the terrestrial systems fail due to disaster** such as earthquake, volcanic eruption floods, drought, cyclones, landslides and epidemics.
9. **Tele-medicine.**

III. Answer any four: 16

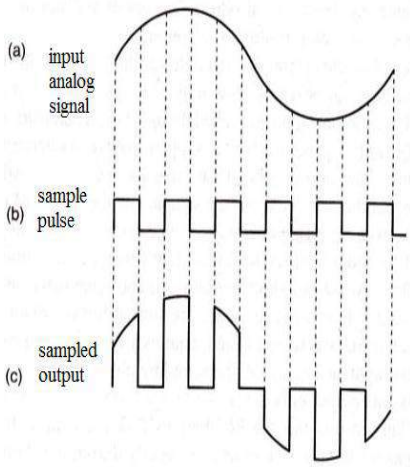
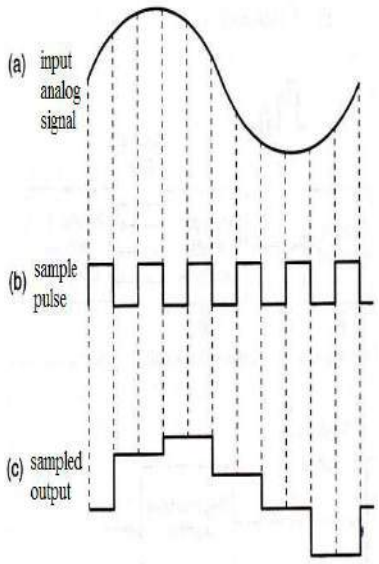
a) Define sampling theorem. Compare Natural sampling and Flat top sampling (2 points).
(Definition-2M & Comparision-2M (Any 2 Points))

Ans:

Sampling theorem:A continues time signal x (t) can be completely represented in its sampled form and recovered back from its sampled format the receiver with minimumdistortion if the sampling frequency fs**≥2w**

Where fs=Sampling Frequency

w=Maximum modulating frequency

Criteria	Natural sampling	Flat top sampling
Circuit used for generation	chopper circuit	Sample and hold circuit
Signal power	Increases with increase in pulse width	Increases with increase in pulse width
Impact of noise	Increases with decrease in width	Increases with decrease in width
Sampled signal	Sampled signals do not have Flat top. Pulses retain natural shape	Sampled signals have Flat top.
waveform		

b) Draw the block diagram of Delta modulator and describe its working with suitable waveforms
(Diagram-2M & Explanation-2M)

Ans:

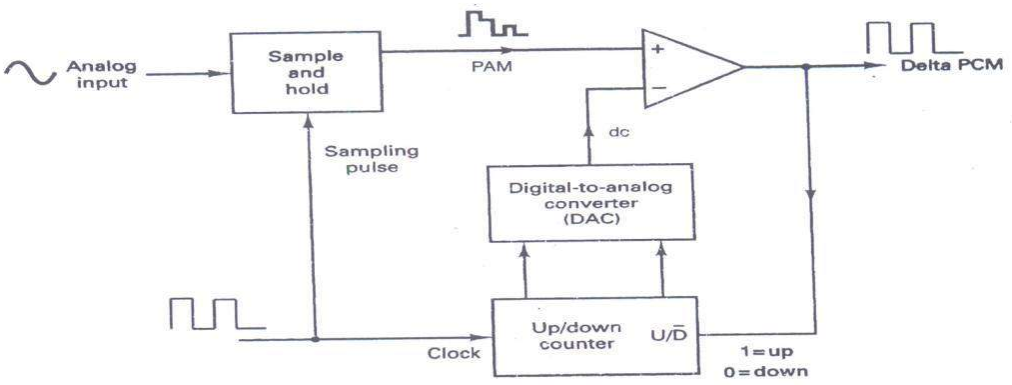
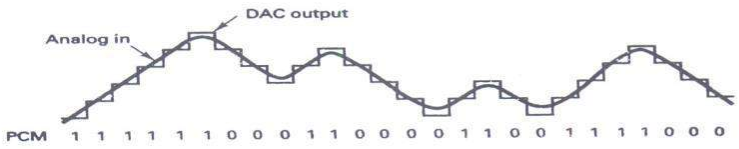


FIGURE 10-20 Delta modulation transmitter



Ideal operation of a delta modulation encoder

The above diagram shows a block diagram of a delta modulation transmitter. The analog input is sampled and converted to a PAM signal, which is compared with the output of the DAC. The output of DAC is a voltage equal to the regenerated magnitude of the previous sample, which was stored in the up-down counter as a binary number. The up-down counter is incremented or decremented depending on whether the previous sample is larger or smaller than the current sample. The up-down counter is clocked at a rate equal to sample rate. Therefore, the up-down counter is updated after each comparison. Initially, the up-down counter is zeroed, and the DAC is outputting 0V. The first sample is taken, converted to PAM signal, and compare with zero volts. The output of the comparator is a logic 1 condition (+V), indicating that the current sample is larger in amplitude than the previous sample. On the next clock pulse, the up-down counter is incremented to a count of 1. The DAC now outputs a voltage equal to the magnitude of the minimum step size (resolution). The steps change value at a rate equal to the clock frequency (sample rate). Consequently, with the input signal shown, the up-down counter follows the input analog signal up until the output of the DAC exceeds the analog sample; then the up-down counter will begin counting down until the output of the DAC drop below the sample amplitude. In the idealized situation, The DAC output follows the input signal. Each time the up-down counter is incremented, logic 1 is transmitted, and each time the up-down counter is decremented, logic 0 is transmitted.

c) State two advantages of FSK over ASK and PSK.
(Any two advantages of FSK over ASK-2M, FSK over PSK- 2M Each)

Ans: Advantages of FSK over ASK:

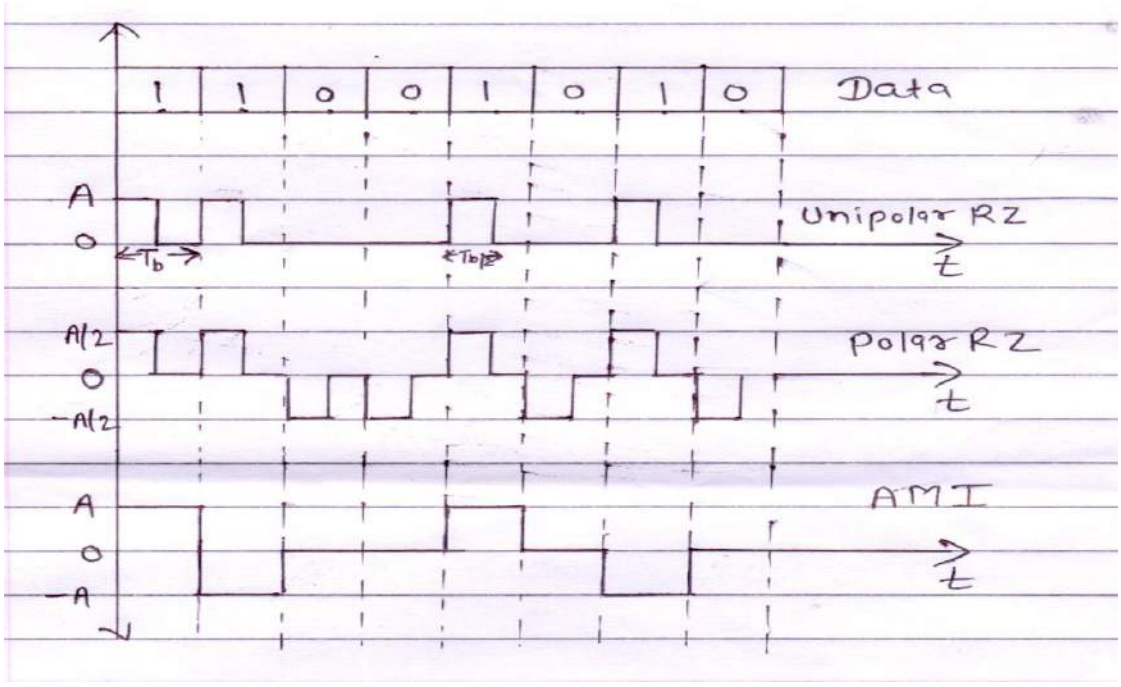
1. Low noise, since amplitude is constant
2. Power requirement is constant
3. Operates in virtually any wires available
4. High data rate
5. Used in long distance communication
6. Easy to decode
7. Good sensitivity
8. It has high security
9. Efficiency is high.

Advantages of FSK over PSK:

1. Low Bandwidth
2. High noise Immunity

d) For the bit stream 11001010, encode using RZ and AMI encoding methods.
(RZ (unipolar or polar) and AMI 2M each)

Ans:



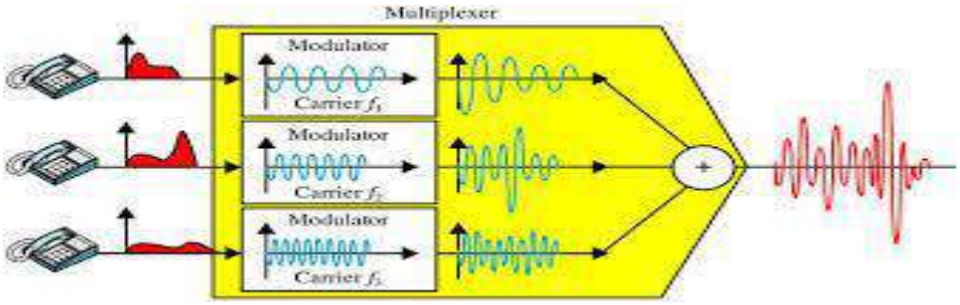
e) Define multiplexing w.r.to communication. Describe FDM with a neat block diagram.

(Definition of multiplexing-1M & FDM Diagram-1M & Explanation-2M)

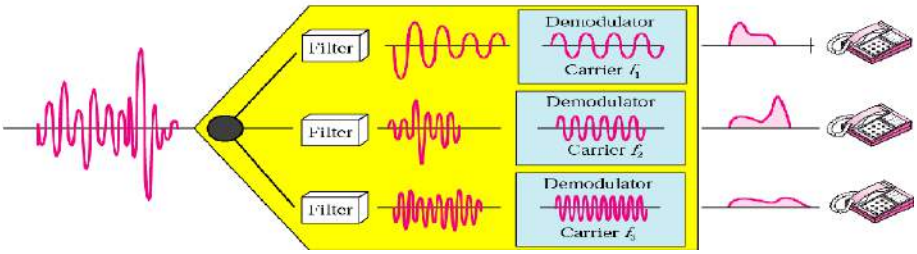
Ans:

Multiplexing (also known as Muxing) is a method by which multiple analog message signals or digital data streams are combined into one signal over a shared medium.

Modulation:



Demodulation:



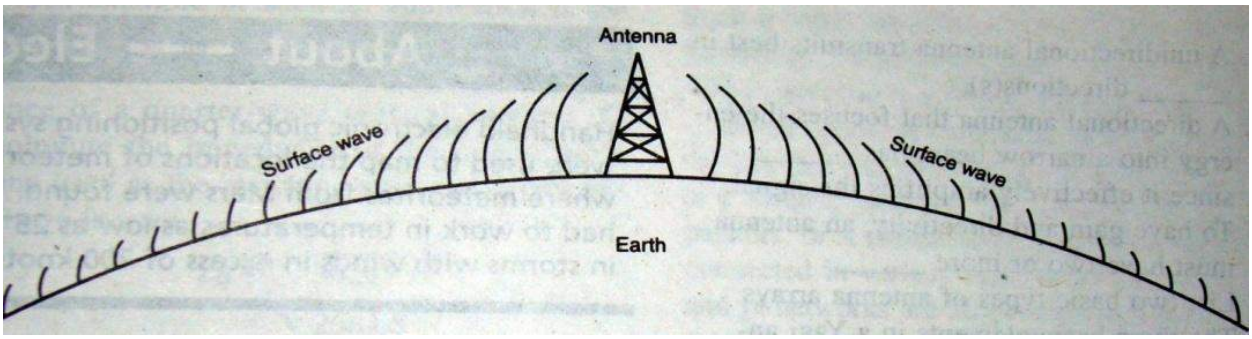
In FDM, signal generated by each sending device modulate different carrier frequencies.These modulated signals are combined into a single composite signal that can be transported by the link. Carrier frequencies are separated by guard bands to prevent over- lapping of signal. Though it is an analog multiplexing system, digital signals can also be sending by converting them into analog signals.

The demux uses a series of filters to decompose the multiplexed signal into its constituent carrier signals.These modulated carrier signals are passed through demodulators to separate them from their carrier and then are passed to their output lines**.**

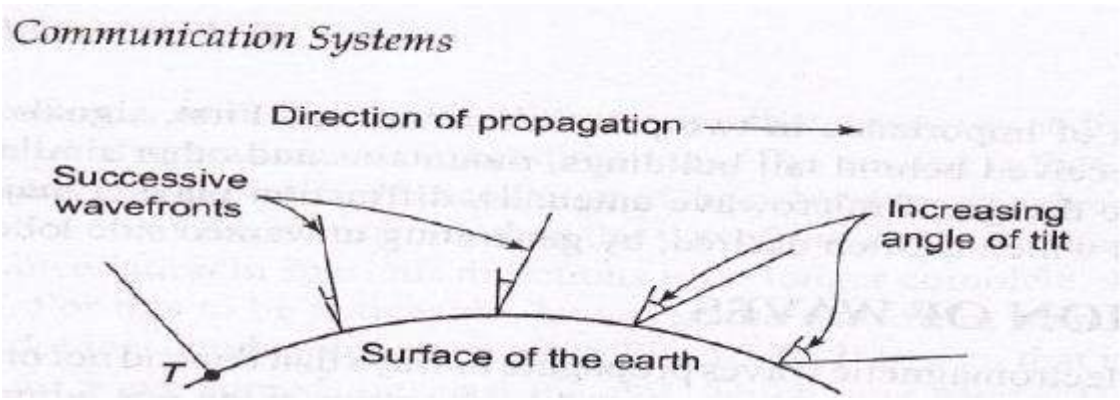
IV. A) Attempt any three: **12**

i) With the help of neat sketch, describe ground wave propagation.
(Diagram-2M & Explanation-2M)

Ans:



OR



The ground or surface wave leaves the antenna & remains close to the earth. From fig. the ground wave will actually follow the curvature of the earth & can therefore travel of distances beyond the horizon. Ground wave propagation is strongest at the low & medium frequency ranges that is ground waves are the main signal path for the radio signals in the 30 KHz to 3 MHz range. The signals can propagate for hundreds & sometimes thousands of miles at these low frequencies. Amplitude modulation broadcast signals are propagated primarily by ground waves. At the higher frequencies beyond 3 MHz the earth begins to attenuate the radio signals. Objects on the earth & terrain features become the same order of magnitude in size as the wavelength of the signal & will therefore absorb & otherwise affect the signal for this reason the ground wave propagation of signals above 3 MHz is insignificant except within several miles of the antenna.

Application of ground wave propagation:

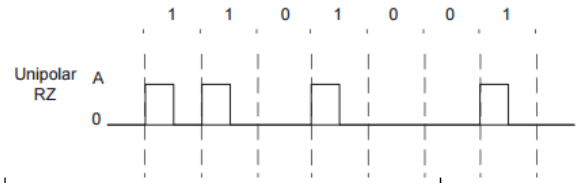
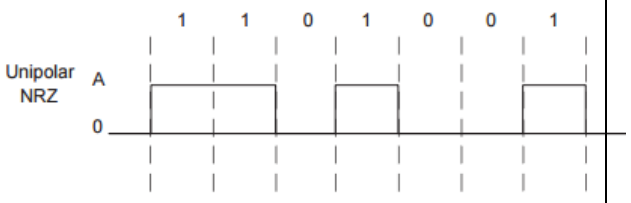
1. In the AM radio broadcasting operating in MW band.

2. The VLF transmission is used for ship communications such as radio navigation & marine mobile communication.

3. The VLF transmission is also used for time & frequency transmission

ii) Compare unipolar RZ and unipolar NRZ encoding scheme for four points.
(Any four points- 1M for each)

Ans:

Unipolar RZ	Unipolar NRZ
In this format each "0" is represented by an off pulse(0)& each "1" by an on pulse With amplitude A & duration $T_b/2$..	In this format each "0" is represented by an off pulse(0)& each "1" by an on pulse With amplitude A & duration T_b
During the on time, the pulse return to zero after half bit period.	During the on time, the pulse does not return to zero after half bit period.
Unipolar RZ pulses carry less energy.	Unipolar NRZ pulses carry more energy.
Clock recovery is Poor.	Clock recovery is Good.
Synchronization is not essential	Synchronization is not essential.
	

iii) State two applications of ASK and PSK.
(Any two Application of ASK and PSK-2M each)

Ans:

Application of ASK:

1. ASK is used to transmit data over optical fiber.
2. Used for data transmission at very low bit rates.
3. Automotive Antitheft Alert System
4. Modems

Application of PSK:

1. PSK is used in wireless LAN standards.
2. Used for high speed modems.
3. Used in biometric passport and contactless payment systems.

iv) Describe the principle of cell splitting with a neat sketch.
(Diagram-2M & Explnation-2M)

Ans:

Cell splitting means to split up cells into smaller cells. The process of cell splitting is used to expand the capacity (number of channels) of a mobile communication system. As a network grows, a quite large number of mobile users in an area come into picture. Consider the following scenario. There are 100 people in a specific area. All of them owns a mobile phone (MS) and are quite comfortable to communicate with each other. So, a provision for all of them to mutually communicate must be made. As there are only 100 users, a single base station (BS) is built in the middle of the area and all these users' MS are connected to it. All these 100 users now come under the coverage area of a single base station. This coverage area is called a cell.

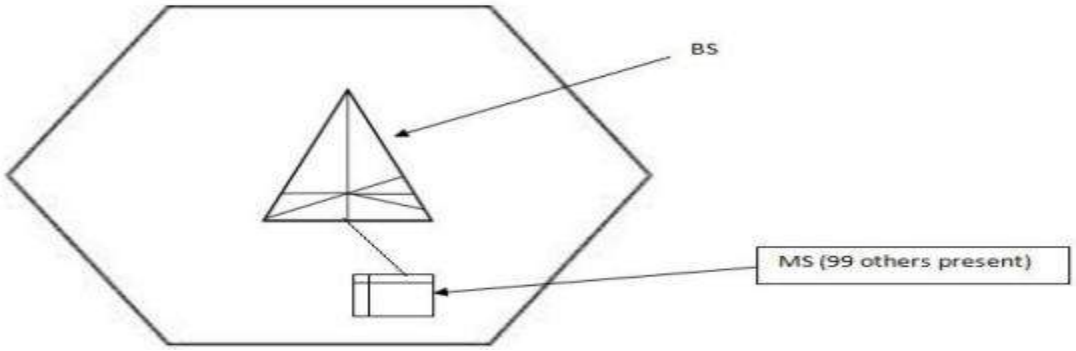


Fig: A single BS for 100 MS users.

But now, as time passed by, the number of mobile users in the same area increased from 100 to 700. Now if the same BS has to connect to these 700 users' MS, obviously the BS will be overloaded. A single BS, which served for 100 users is forced to serve for 700 users, which is impractical. To reduce the load of this BS, we can use cell splitting. That is, we will divide the above single cell into 7 separate adjacent cells, each having its own BS.

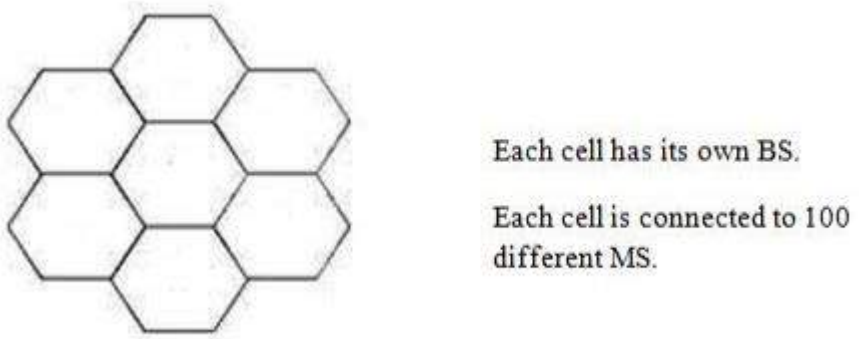


Fig: Single cell split up into 7 cells.

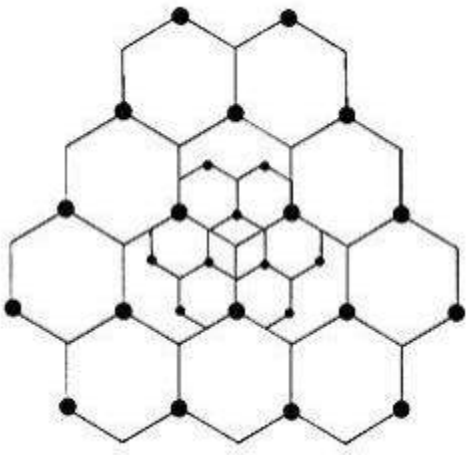


Fig: Cell splitting

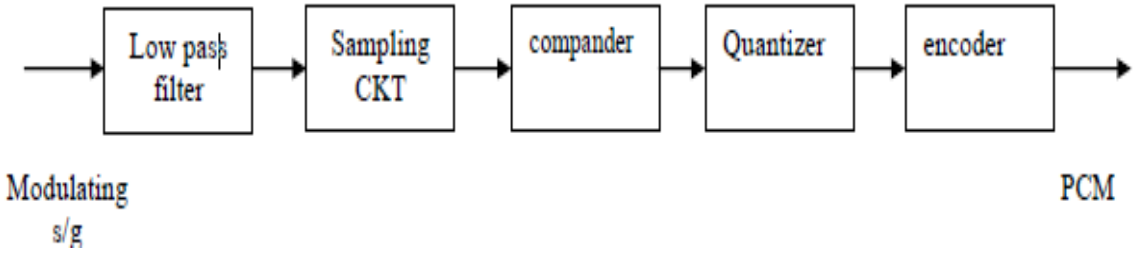
The concept of cell splitting can further be applied to the split cells as well. That is, the split up cells can further be split into a number of smaller cells to improve the efficiency of the BS even more.

IV. B) Attempt any one: 6

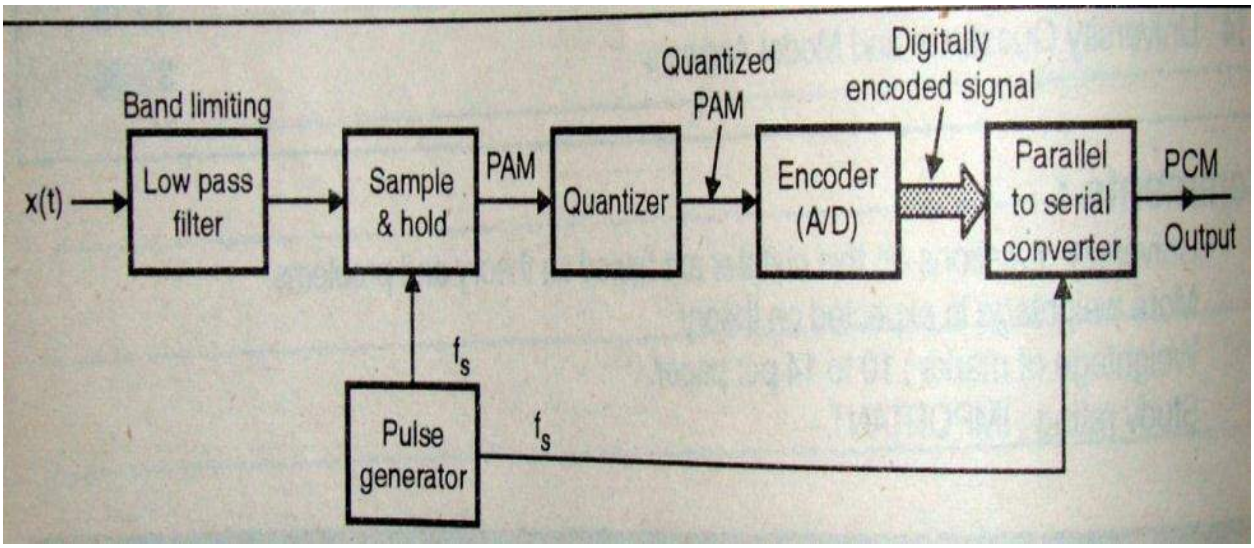
i) Draw the block diagram of a PCM transmitter and state the function of each block.
(Block diagram -2M, Waveforms-with quantum levels- 2M and Explanation – 2M)

Ans.

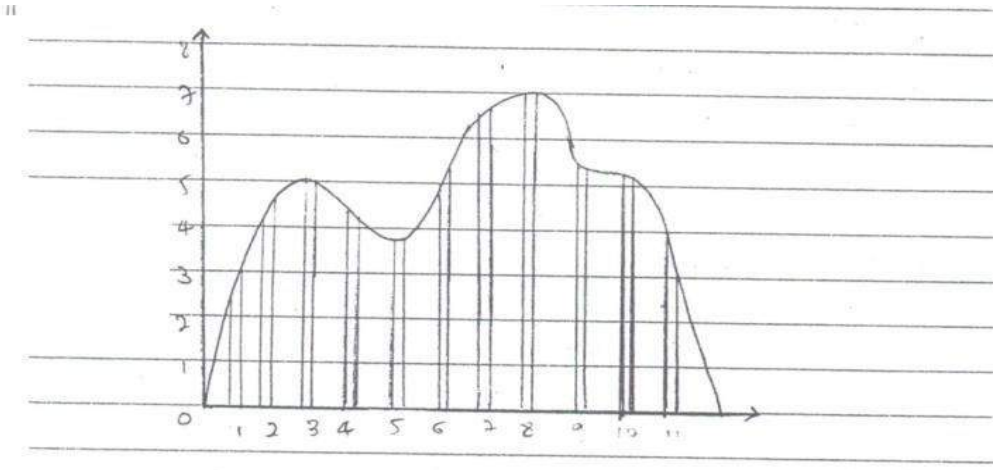
Block diagram of PCM:



OR



PCM is a digital pulse modulation system in which analog information signal is sampled according to sampling theorem, quantized and then encoded the sequence of 0's 1's obtained are transmitted. Thus, the analog signal is transmitted using digital signal and hence PCM is a digitalmodulation system. Quantum Level: The signal amplitude is divided into discrete level called quantum level.



Samp. pulse	1	2	3	4	5	6	7	8	9	10	11
Actual voltage	3V	4.6V	5V	4.2V	3.8V	5.1V	6.5V	7V	5.3V	5.2V	4V
Quantum level	3V	4V	4V	4V	3V	5V	6V	6V	5V	5V	3V
Encode	011	100	100	100	011	101	110	110	101	101	011

1. Low pass filter:

It is used to limit the bandwidth of the information signal to the desired value. LPF is a frequency selection network that allows a desired frequency range to pass & removes all other unwanted frequency.

2. Sampling circuit:

It carries out the process of sampling according to sampling theorem.

3. Quantization circuit

Performs the process of quantization. In this, the entire signal is divided into no. of discrete levels called quantum levels. Quantization is the process of approximation of the sampled value to the nearest quantum level.

Quantization noise errors: The quantized level is transmitted & these are a difference between the actual sampled value & the quantized value. This error is random in nature & it is not uniform. Hence, it is called as a noise & since error is caused due to transmission of quantized levels, it is called as quantization error. Companding circuits can be used for reducing quantization error.

4. **Companding circuit**:

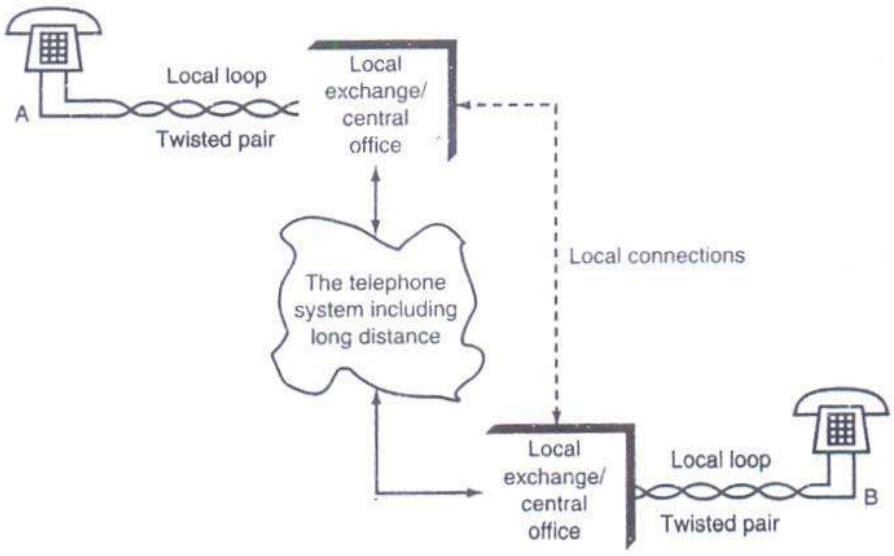
This reduces quantization error without increasing bandwidth. This is a process of artificially boosting low amplitude signal during transmission and to reduce quantization error. This is called compression. The reverse process of enhancing this compressed signal (expansion) is carried out at the receiver to large the signal back to original value.

5. **Encoder**

This counts the quantized value into sequence of 0's & 1's. the sequence depends on number of bits used for each quantum level and the type of encoding mechanism.

ii) Draw the block diagram of a telephone system and describe the various blocks.
(Diagram-3M & Explanation-3M)

Ans:



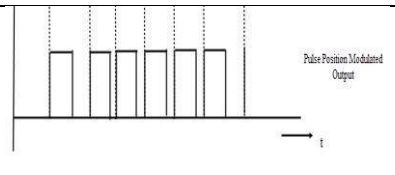
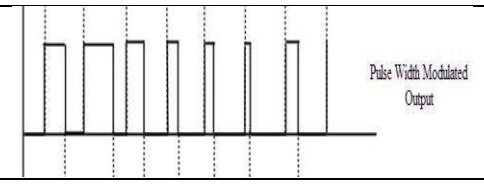
The basic telephone system.

The telephone system permits any telephone to connect with any other telephone in the world. This means that each telephone must have a unique identification code- the 10 digit telephone number assigned to each telephone, the telephone system provides a means of recognizing each individual number and switching system that can connect any switching systems that can connect any two telephones. The local loop Standard telephones are connected to then telephone system by way of a two-wire, twisted pair cable that terminates at the local exchange or central office. As many as 10000 telephone line can be connected to single central office. Then connections from then central office go to then "telephone system'. A call originating at telephone A will pass through the central office and then into the main system where it is transmitted via one of many different routes to the central office connected to the desired location designated as B. The connection between nearby local exchange is direct rather than long distance. The two wire twisted pair connection between the telephones and the central office is referred to as the local loop or subscriber loop. All dialing and signaling operations are also carried on this shingle twisted pair. A basic telephones or telephone set is an analog baseband transceiver. It has a handset which contains a microphone and a speaker, better known as a transmitter and a receiver. It also contains a ringer and a dialing mechanism.

V) Attempt Any Four: 16

a) Compare PPM & PWM w.r.to
i) Bandwidth ii) Transmitted Power
iii) Output Waveform iv) Definition
(Each Point – 1M)

Ans.

Parameter	**PPM**	**PWM**
Bandwidth	High as compare to PWM	High
Transmitted power	Remains constant	Varies with variation in width.
Output wave		

Definition	When position of carrier pulse is varied in accordance with the instantaneous value of modulating signal keeping pulse amplitude and pulse width constant is called PPM	When width of pulsed carrier varies in accordance with instantaneous value of modulating signal keeping pulse amplitude and pulse position constant is called PWM.

b) State the need of modulation (Any 4 Points)
(Any 4 Points – 1M Each)

Ans.

Need of Modulation:

1. **Reduction in height of antenna:** For transmission of radio signals ,antenna height must be multiple of (λ/4). Minimum height required to transmit a baseband signal of **f=10 KHz** is calculated as
Minimum height of antenna = λ/4=c/4f=7.5Km. The antenna of this height is practically impossible to install
Minimum height required to transmit a baseband signal of **f=1MHz** is calculated as **Minimum height of antenna = λ/4=c/4f=75m.**
Thus modulation is necessary to reduce the height of antenna.

2. **Avoids mixing of signals:** If the baseband sound signals are transmitted without using the modulation my more the one transmitter then all signals will be in frequency 0 to 20 KHz. Therefore all the signals get mixed together and a receiver cannot separate them from each other. So if the baseband signal is used to modulate different carrier then they will occupy different slots in frequency domain. **Thus modulation is necessary to avoid mixing of signals.**

3. **Increases range of communication:** The frequency of baseband signal is low and thus the low frequency signal cannot travel a long distance when they are transmitted they get heavily attenuated. The attenuation reduces with increase in frequency of the transmitted signal and they can travel longer distance.

4. **Makes multiplexing possible:** Multiplexing is the process in which two or more signals can be transmitted over same communication channel simultaneously. This is possible only with modulation. Therefore many TV channel can use same frequency range without getting mixed with each other.

5. **Improves quality of reception:** With FM and digital communication technique like PCM, the effect of noise is reduced to a great extent.

c) State the bandwidth requirement for QPSK, BPSK, ASK & FSK.
(Bandwidth – 1M Each)

Ans.

F_b = input bit rate, ΔF = frequency deviation

QPSK = $F_b/2$

BPSK = F_b

ASK = F_b

FSK = $2(\Delta F + 2F_b)$

d) **Compare AM & ASK**
(Any 4 Points – 1M Each)

Ans.

Parameter	AM	ASK
Variable characteristics of the carrier.	Amplitude	Amplitude
Nature of modulating signal	Modulating signal is analog.	Modulating signal is digital.
Variation in the carrier amplitude.	Continuous variation in accordance with the amplitude of modulating signal.	Carrier ON or OFF depending on whether a 1 or 0 is to be transmitted.
Bandwidth.	2fm f_m = Modulating frequency	(1+ r)R R is bit rate r is factor related to filter characteristic
Noise immunity.	Poor	Poor
Application	Radio broadcasting	Data transmission at low bit rate, Modems

e) Observe fig.(1) (a) & fig (b). Identify encoding technique.

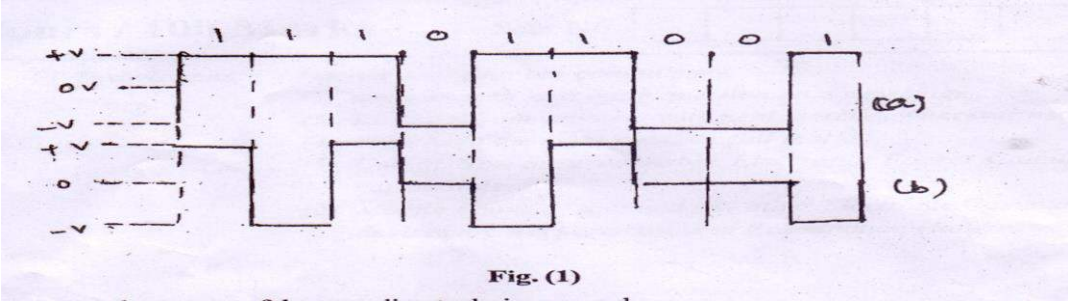


Fig. (1)

State advantages of encoding techniques used.

(Identify Encoding Technique –2M & Any one Advantage of each encoding technique - 1M Each)

Ans.

Figure (a) Encoding Technique -Polar NRZ

Advantages –

- Low bandwidth requirement compared to unipolar NRZ.
- Very good error probability.
- Greatly reduced dc.

Encoding Technique – Alternate Mark Inversion (AMI)

Advantages –

- No dc component.
- Occupies less bandwidth compared to unipolar & polar NRZ.
- Suitable for transmission over ac coupled lines.
- Possesses signal error detection capability.

f) Describe the sequential procedure for operation of handset to handset call.

(4M for step by step procedure for call origination call in progress and call termination)

Ans.

i) Caller enters mobile no of receiver(or fetches from phone memory) and depresses call button after this no. is transmitted through reverse control channel to base station along with callers unique identification

ii) Base station forwards the callers identification no & destination no to MTSO

iii) MTSO sends page command to all cell sites controller to locate destination party.

iv) Once the destination mobile is located destination cell site controller sends page request through control channel to destination party to determine if the unit is on or off hook.

v) After receiving positive response to the page, ideal user channel are assigned to both mobile units

vi) Call progress tones are applied to both direction (ring& ring back)

vii) When system receives notice that the called party has answered the call switches terminates call progress tone and conversation begins.

viii) If all user channels are busy sends directed retry command instructing caller unit to retry call through neighboring cell

ix) If system cannot allocate user channel through neighboring cell then switch transmits intercept message to calling mobile unit over control channel

x) If called party is off hook calling party gets busy signal. If called no. is invalid then caller will get reply of dialed number is invalid.

VI) Answer Any Four: 16

a) State two applications each of PAM & PPM.

(Any Other Appropriate Two Applications of PAM - 2M & Any Other Appropriate Two Applications of PPM - 2M)

Ans.

Applications of PAM-

- Used in PAM-TDM system.
- Used in PAM-FM system.
- Used in radio telemetry for remote sensing & monitoring.

Applications of PPM –

- It is useful for optical communication system where there tends to be little of no multipath interference.
- It is useful for Narrowband FM channels application with these channel characteristic is the radio control & model aircraft, boats & cars.
- In some military applications.

b) Describe sky wave propagation with diagrams.

(Description – 2M & Diagram – 2M)

Ans.

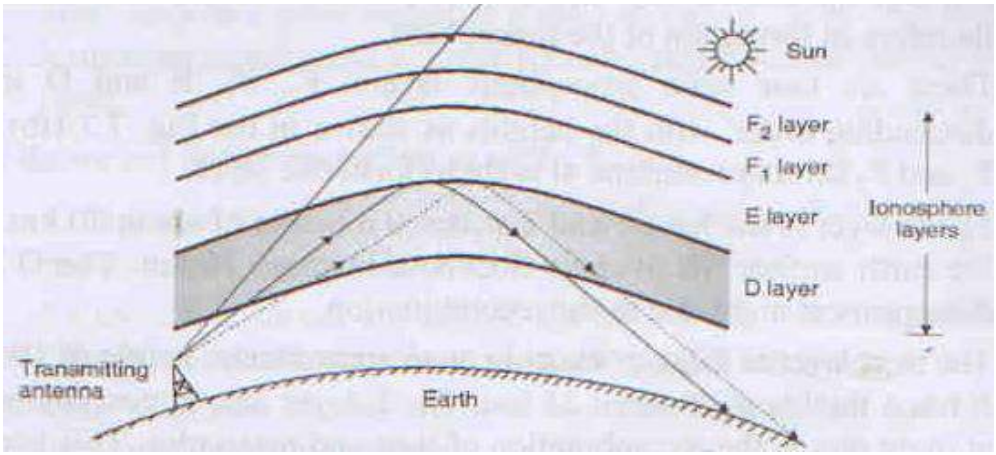
Sky wave propagation

These waves travel by reflecting (refracting) from ionosphere.

Ionosphere is made up of ions & density of ions increases as height from earth surface increases. As density increases refractive index decreases& because of this change in refractive index wave starts deflecting farther &farther from normal .After reaching to particular height it come backs to earth surface

By using sky wave propagation signal can be send almost anywhere on earth surface .it is not affected by curvature of earth The quality of reception of sky wave is not uniform & constant to all locations & it gets affected by environmental factors.

Diagram



c) State advantages of ADM over DM.

(Any four points – 1M each)

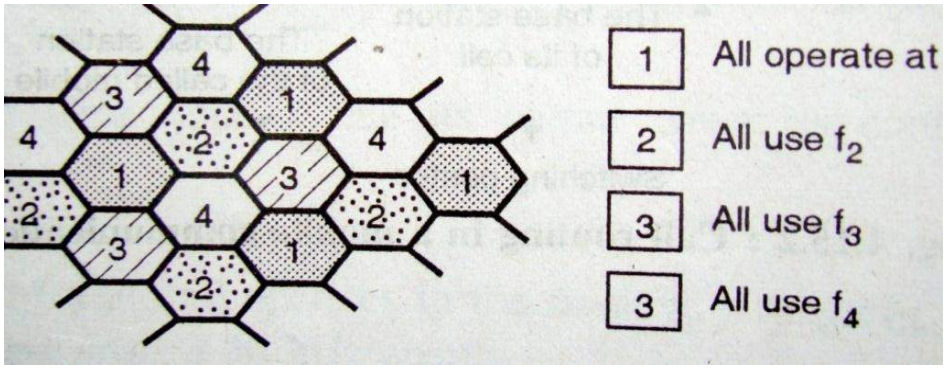
Ans.

- Reductions in slope overload distortion and granular noise.
- Improvement in signal to noise ratio.
- Wide dynamic range due to variable step size.
- Better utilization of bandwidth as compared to delta modulation.
- Low signaling rate and simplicity of implementation are also possessed by adaptive delta modulation.

d) Describe concept of frequency reuse in mobile communication.

(Concept of frequency reuse- 2M &Diagram – 2M)

Ans.



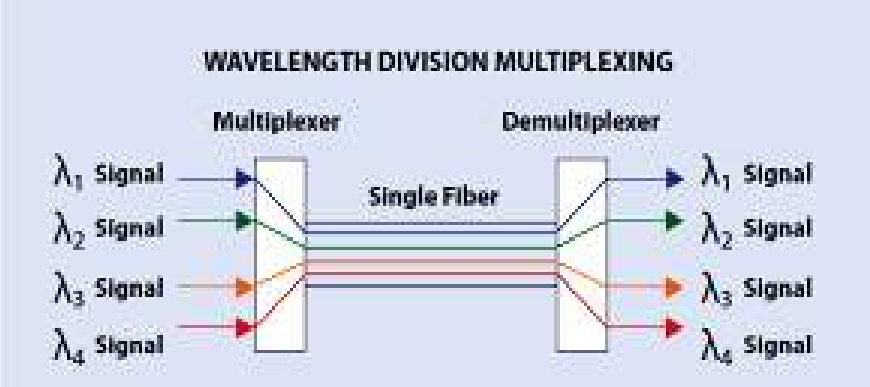
Frequency reuse-

Frequency reuse is the process in which the same set of frequencies (channels) can be allocated to more than one cell. Provided the cells are separated by sufficient distance reducing each cells coverage area invites frequency reuse cells using the same set of radio channels can avoid mutual interference, provided they are properly separated. Each cell base station is allocated a group of channel frequencies that are different from those of neighboring cells & base station antennas are chosen to achieve a desired coverage pattern within its cell. However as long as a coverage area is limited to within a cells boundaries the same group of channel frequencies may be used in different cells without interfacing with each other provided the two cells are sufficient distance from one another.

e) Describe schematic representation of WDM & describe its principle of working.
(Systematic representation – 2M & Description – 2M)

Ans.

- WDM is an analog multiplexing technique to combine optical signals.
- Principle: Very narrow bands of light from different sources are combined to make a wider band of lights & at the receiver, the signal are separated by demultiplexer.
- WDM is designed to use the high data rate capability of fiber optic cable.
- The optical fiber data rate is higher that the data rate of metallic transmission cable.
- Using a fiber optic cable for one single line wastes available bandwidth.
- Multiplexing allows us to connect several lines into one.
- WDM is conceptually same as FDM, except that the multiplexing &demultiplexing involve the optical signals transmitted through fiber optic cable.
- Conceptual view :



- Very narrow band of lights of differential wavelengths are combined to make wide band of light.
- All wavelength travels through signal cable.
- At receiver, the signals are separated by demultiplexer.
- Combining & splitting of light sources are easily handled by prism.
- Prism bends a beam of light based on angle of incidence & frequency.
- Using this technique, multiplexer can be made to combine several input beams of light, each containing narrow band of frequencies into one output beam of wider band of frequencies.
- Demultiplexer does reverse process.