SUMMER– 14 EXAMINATION

Subject Code: 12185 **Model Answer**

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.

4) While assessing figures, examiner may give credit for principal components indicated in the figure. 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 constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.

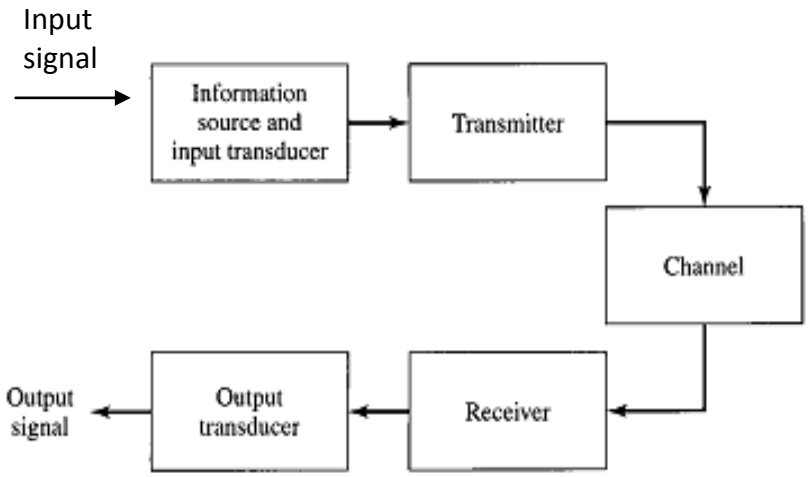
7) For programming language papers, credit may be given to any other program based on equivalent concept.

1) a) Attempt any THREE of the following (12marks)

i) Draw block diagram of communication system & explain.

Ans: **(Diagram – 2 marks, explanation – 2 marks)**

Diagram **(2 marks)**



Explanation **(2 marks)**

Transducer: A transducer is usually required to convert the output of a source into an electrical signal that is suitable for transmission. For example, a microphone serves as the transducer that converts an acoustic speech signal into an electrical signal, and a video camera converts an image into an electrical signal. At the destination, a similar transducer is required to convert the electrical signals that are received into a form that is suitable for the user; e.g., acoustic signals, images, etc.

The transmitter: The transmitter converts the electrical signal into a form that is suitable for transmission through the physical channel or transmission medium. For example, in radio and TV broadcast, the federal communications commission (FCC) specifies the frequency range for each transmitting station. Hence, the transmitter must translate the information signal to be transmitted into the appropriate frequency range that matches the frequency allocation assigned to the transmitter.

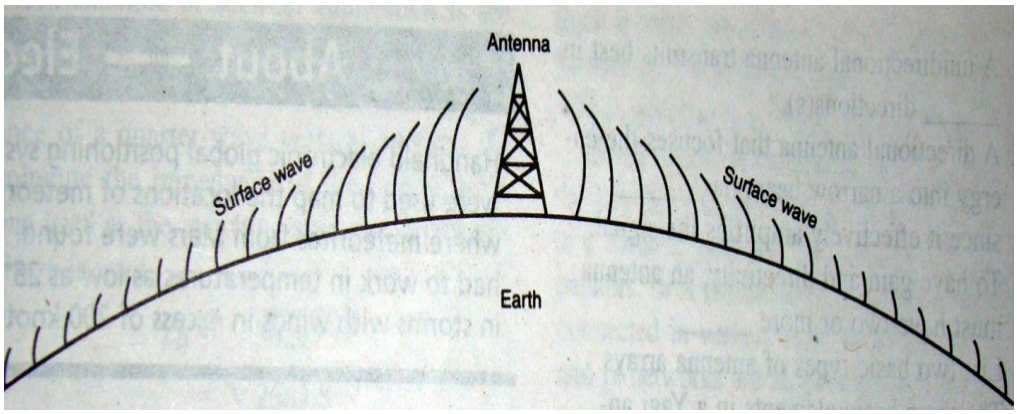
The channel: The communications channel is the physical medium that is used to send the signal from the transmitter to the receiver. In wireless transmission, the channel is usually the atmosphere (free space).

The receiver: The function of the receiver is to recover the message signal contained in the received signal. if the message signal is transmitted by carrier modulation, the receiver performs *carrier demodulation* in order to extract the message from the sinusoidal carrier.

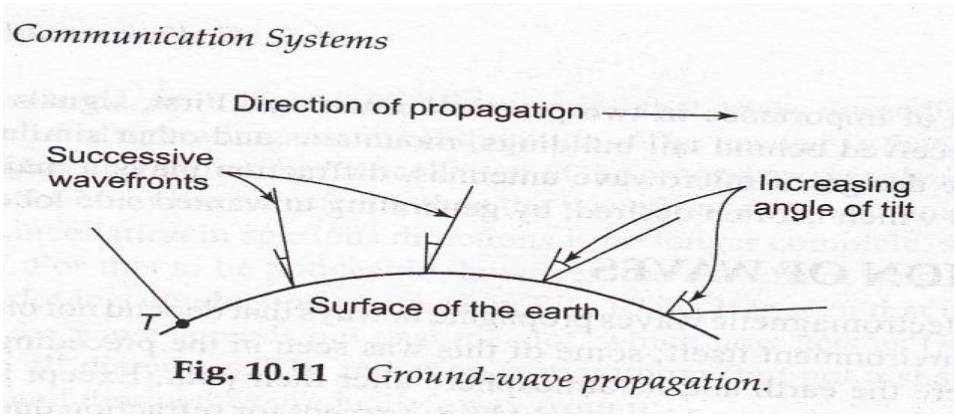
ii) Explain ground wave propagation .State what is wave propagation.

Note: Any other relevant diagram of ground wave propagation to be considered

Ans:- **(diagram – 2 marks, explanation – 1 mark, wave propagation - 1mark)**



(OR)



Ground wave propagation

Explanation **(1 mark)**

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, i.e. 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.

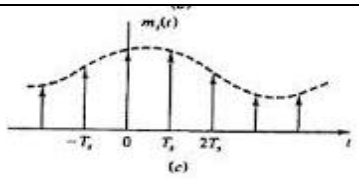
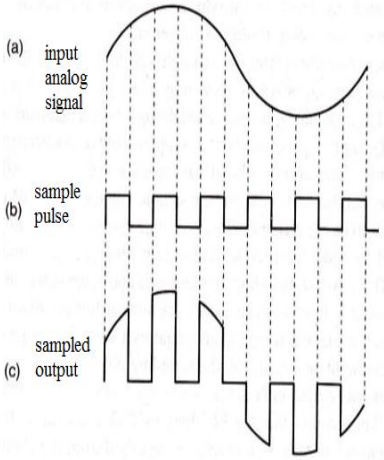
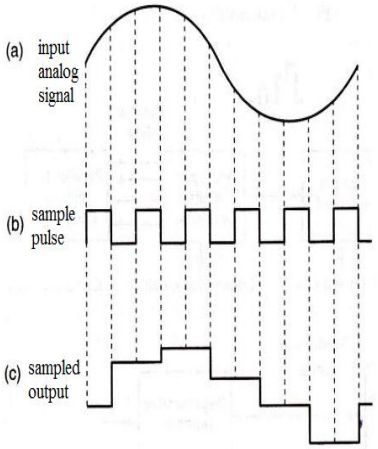
At the higher frequencies beyond 3 MHz the earth begins to attenuate the radio signals. Objects on the earth & terrain features become the same order of magnitude in size as the wavelength of the signal & will therefore absorb & otherwise affect the signal for this reason the ground wave propagation of signals above 3 MHz is insignificant except within several miles of the antenna.

Wave Propagation **(1 mark)**

When a high frequency signal leaves the antenna, the electromagnetic energy called as electromagnetic wave can propagate and reach the receiver in many ways, called as wave propagation.

iii) Draw waveform for ideal, natural, practical sampling & compare them.

Ans:- **(Waveforms 2 marks, Compare any two points -2 marks)**

Criteria	Ideal sampling	Natural sampling	Flat top sampling
Nature	Impulse train	Pulse train	Pulse train
Reliability	Practically not realizable	Practically realizable	Practically realizable
Circuit used for generation	Multiplier	`chopper circuit	Sample and hold circuit
Signal power	Very low	Increases with increase in pulse width	Increases with increase in pulse width
Impact of noise	Very high	Increases with decrease in width	Increases with decrease in width
waveform	 Fig. 5-2 Ideal signal sampling		

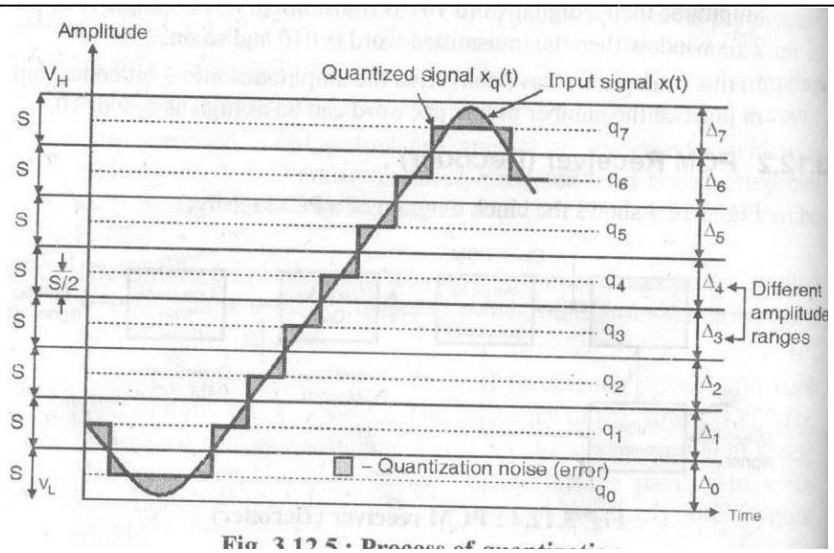
iv) Define quantization noise .Show how it depends on step size.

Ans: Quantization error (noise) **(2 marks)**

The difference between the original analog signal x(t) & its quantized version xq(t) , which is measured & is called Quantization error.

$$€=xq(t)-x(t)$$

The maximum value of quantization error is S/2 where S is the step size. In order to reduce the quantization noise the number of quantization levels need to be increased that is the step size will reduce as shown in the figure- **(1 mark)**



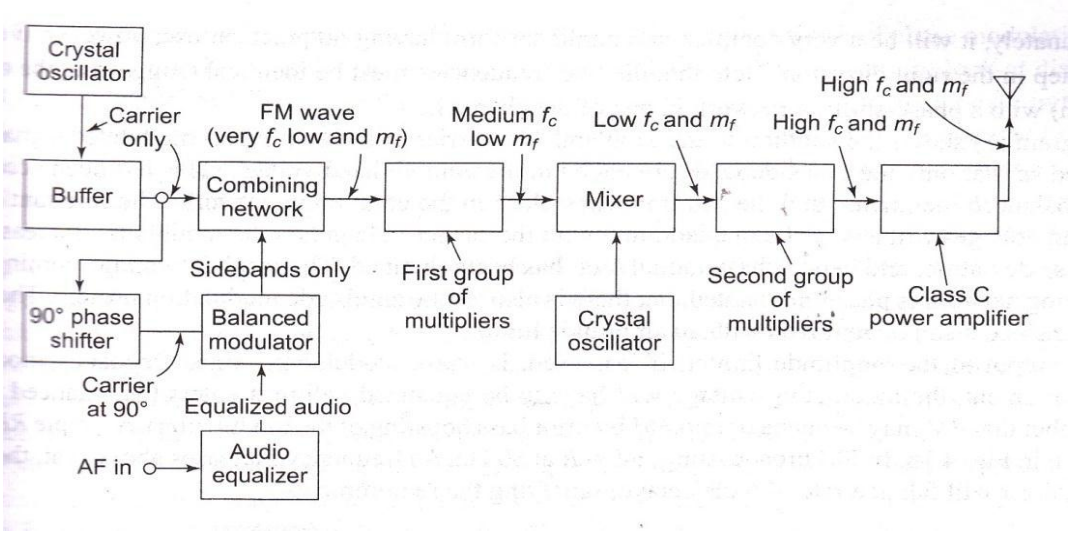
(1 mark)

b) Attempt any ONE of the following (06 marks)

i) Draw & describe the block diagram of Armstrong (indirect) FM transmitter.

Ans:-

Diagram **(4 marks)**



Explanation **(2 marks)**

Crystal oscillator:-The function of crystal oscillator is used to generate very high frequency i.e. 1MHz.

Buffer:-Buffer stores the high frequency signal then some of signal is given to the combining bandwidth and some of the high frequency signal is given to the 90º phase shifter.

Combining network:-combines the audio equalized signal and carrier signal and it gives the FM wave which is having low Fc and mf. The resultant of the two sidebands voltages will always be in quadrature with carrier voltage the output is phase modulated.

90º phase shifter:-The carrier signal phase is shifted by 90º phase shifter.

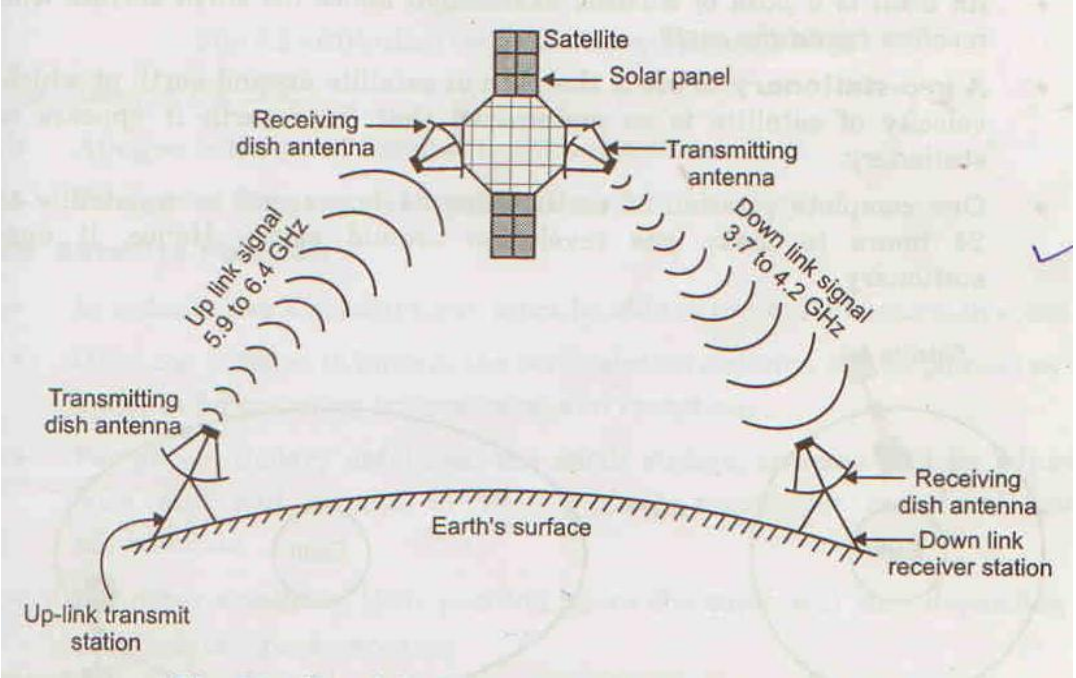
Balanced modulator:-the carrier of the modulated signal has been removed so that only two sidebands are added to unmodulated voltage.

Group of multiplier:- Group of multiplier is used to boost up the carrier frequency fc and low mf.

Mixer:-Mixer mixes two carrier signal with the output of first group of multiplier and gives the low fc and mf.

Second group of multiplier:-it gives the high fc and mf signal which fed to class c power amplifier.
Class c power amplifier:-it high power amplifier which is used to reduce the power level of the FM wave.

ii) Draw neat block diagram of satellite communication system. State function of up convertor.
Note: Any other relevant diagram of ground wave propagation to be considered
Ans:- **(Diagram 4 mks, function of up convertor-2 mks)**



(OR)

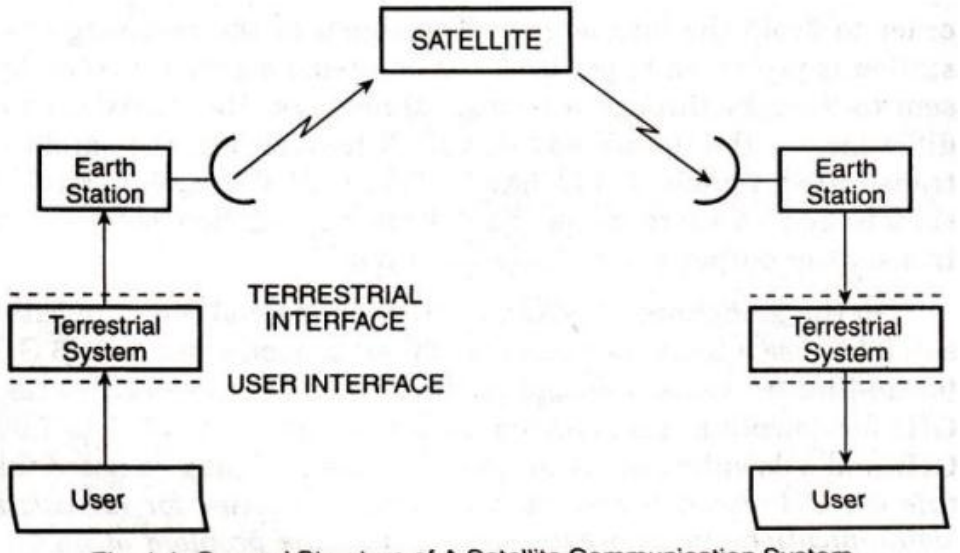


Fig. 1.1. General Structure of A Satellite Communication System.

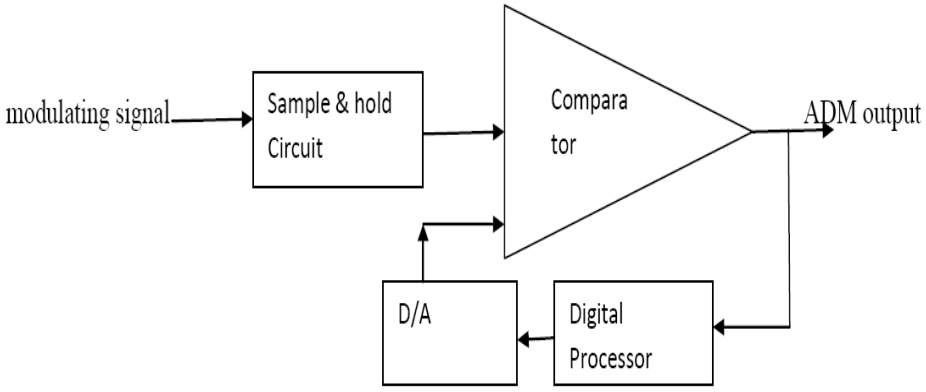
Function of Up Convertor- Up convertor is responsible for converting the modulated 70 MHz (generally) to actual broadcast uplink frequency such as 6 GHz.

2) Attempt any FOUR of the following (16 marks)

a) Draw neat block diagram of adaptive delta modulation .State its advantages.

Ans:-

Diagram **(2 marks)**



block diagram of adaptive delta modulation

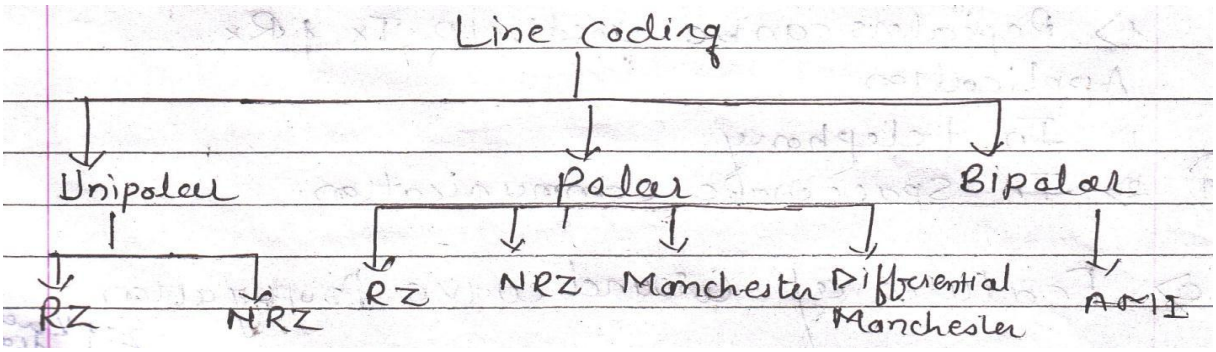
Advantages **(any 2 points)** **(2 marks)**

- 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.

b) What is line coding .Give classification of line coding.

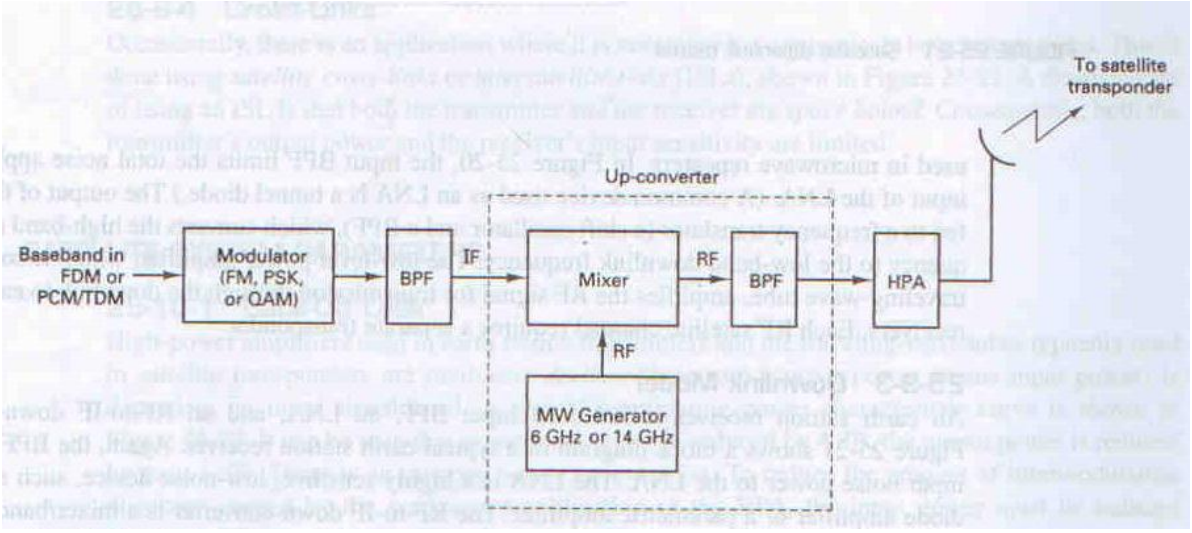
Ans: **(definition – 2 marks, classification – 2 marks)**

It is a process of converting binary data (a sequence of bits) to a digital signal in order to detect and hence correct errors ,thus reducing the probability of errors , is called as line coding. **(2 marks)**

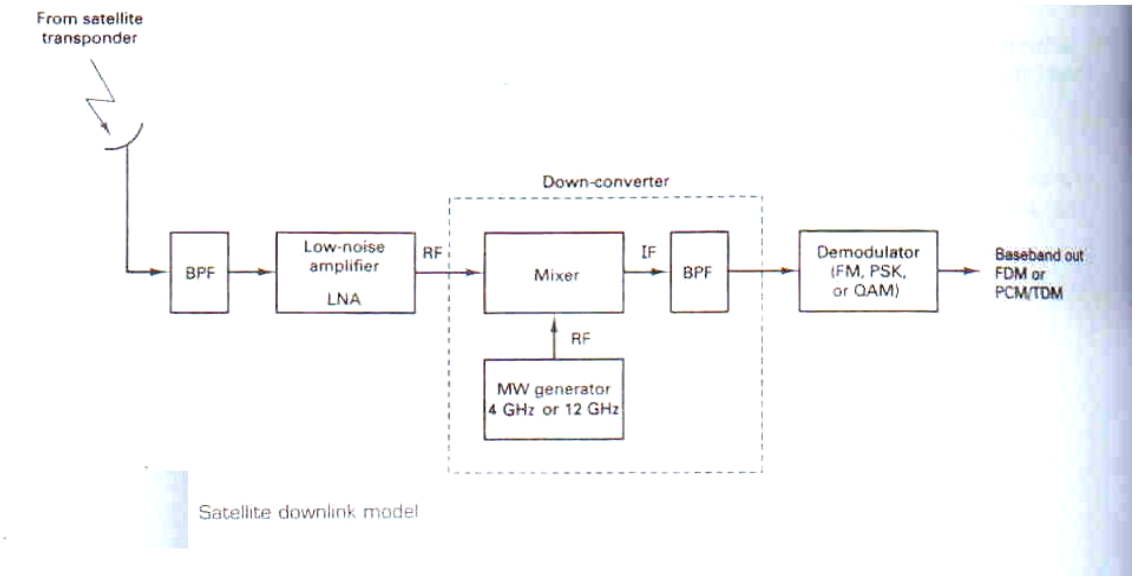


c) Draw uplink and downlink model of satellite communication system.

Ans- **(uplink model - 2 marks, downlink model – 2 marks)**



Uplink Model



Downlink Model

d) Explain in short analog hierarchy and digital hierarchy.

Ans:- Explanation 1 mks, diagram 1 mks for each.

Analog Hierarchy- One of the important applications of the FDM system is the analog telephone system. Here each telephone signal is in the range of 300 Hz to 3.7 kHz. These voice channels modulate different subcarriers. These modulated subcarriers are then added together. As the numbers of telephone channels are very large, the multiplexing process is repeated at several levels. The different levels of multiplexing which is also called multiplexing hierarchy.

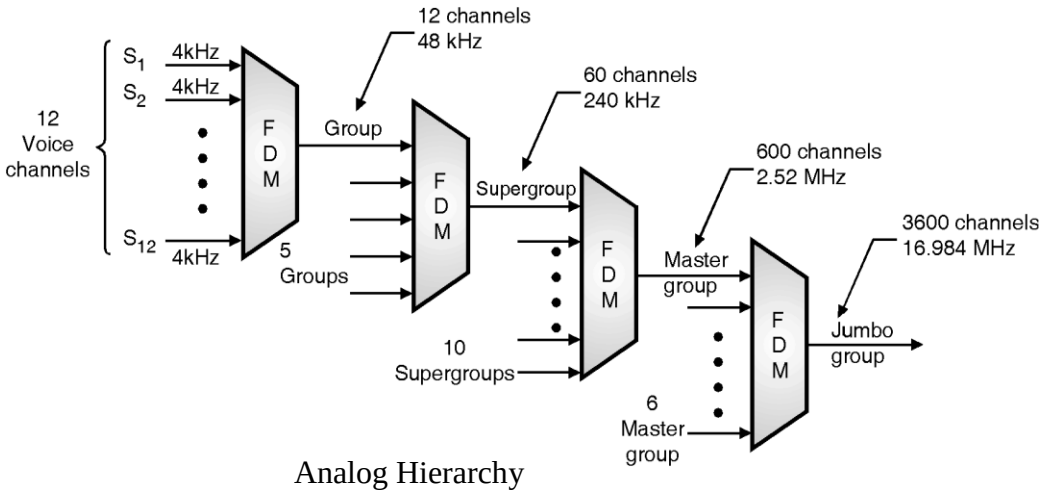
Level (1): Basic group. 12 voice channels multiplexed together.

Level (2): Super group. Up to 5 basic groups multiplexed together i.e. up to 60 voice channels.

Level (3): Master group. Up to 10 super groups multiplexed together i.e. up to 600 voice channels.

Level (4): Jumbo group. Up to 6 master groups multiplexed together i.e. up to 3600 voice channels.

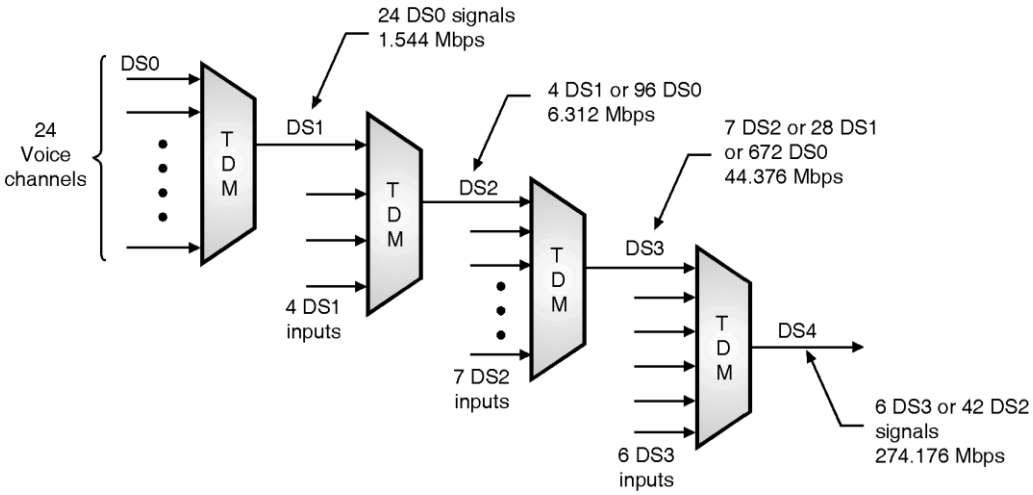
This hierarchy is used by AT and T as shown below-



Analog Hierarchy

Digital Hierarchy- The telephone companies implement TDM (Time Division Multiplexing) through the hierarchy of digital signals. This is called as Digital Signal (DS) service or Digital Hierarchy-

- A DS0 signal is the basic input signal which is a single digital channel; usually 64 Kbps PCM channel produce a DSl signal. The bit rate of DSl is 24 × 64 Kbps = 1.544 Mbps plus 8 Kbps of overhead. Such DSl signals are multiplexed at the second level of multiplexing to obtain the DS2 signal. One DS2 signal is equivalent to 4 DSl or 96 DS0 signals and it has a bit rate of 6.312 Mbps.
- 7 DS2 signals are multiplexed to produce a DS3 signal. Its bit rate is 44.376 Mbps and it is equivalent to 7 DS2 or 28 DSl or 672 DS0 signals. Finally 6 DS3 lines are multiplexed to obtain a DS4 signal. Its bit rate is 274.176 Mbps. It is obtained as a result of 6 DS3 or 42 DS2 channels.

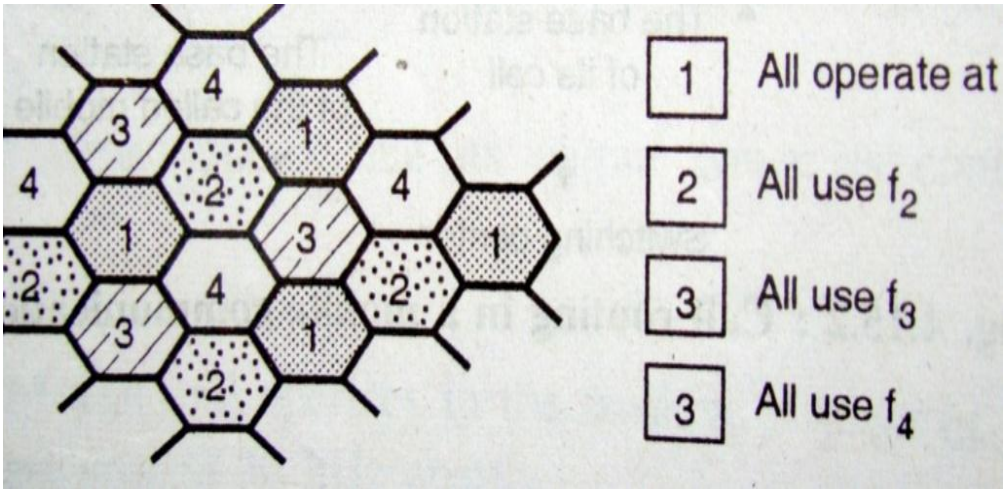


Digital Hierarchy

e) Explain concept of frequency reuse.

Ans:-

Diagram **(2 marks)**



Frequency reuse **(2 marks)**

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.

f) What is fading? Explain.

Ans: Fading **(02 marks)**

Fading is the fluctuation in signal strength at a receiver & may be rapid or slow, general or frequency selective. It occurs due to interferences between two waves which left the same source but arrived at destination by different paths.

Different reasons for fading: **(02 marks)**

- The fading can take place due to interference between the lower & upper rays of the sky wave.
- It can take place due to interference between waves arriving by different number of hopes or paths.
- Due to interference between the ground waves & sky waves.
- Due to fluctuations of height or density in ionosphere layers.
- As the fading is a frequency selective process, the signals very close to each other in the frequency domain will fade to a different extent.

- The AM signal is very badly distorted due to such a frequency selective fading. The SSB signal is not affected to such an extent.
- One way to counteract the problem of fading is to use space or frequency diversity reception system. The other way is to use the automatic gain control (AGC) for the receiver.

3. Attempt any FOUR of the following (16 marks)

a) What is hand off? Explain Handoff procedure.

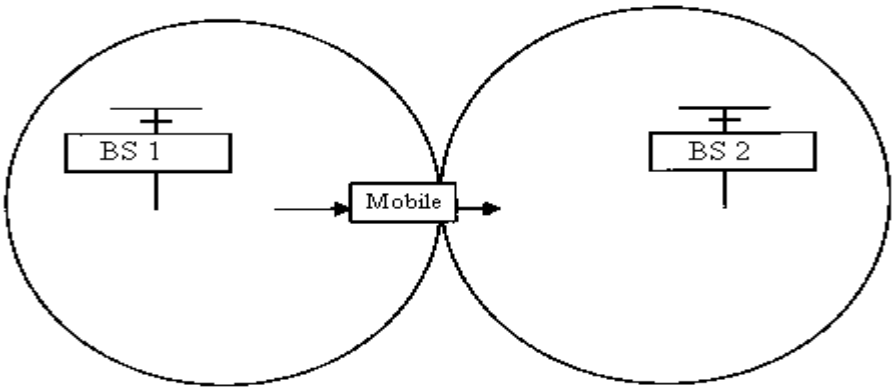
Note: Any of the two relevant diagram to be considered

Ans:-

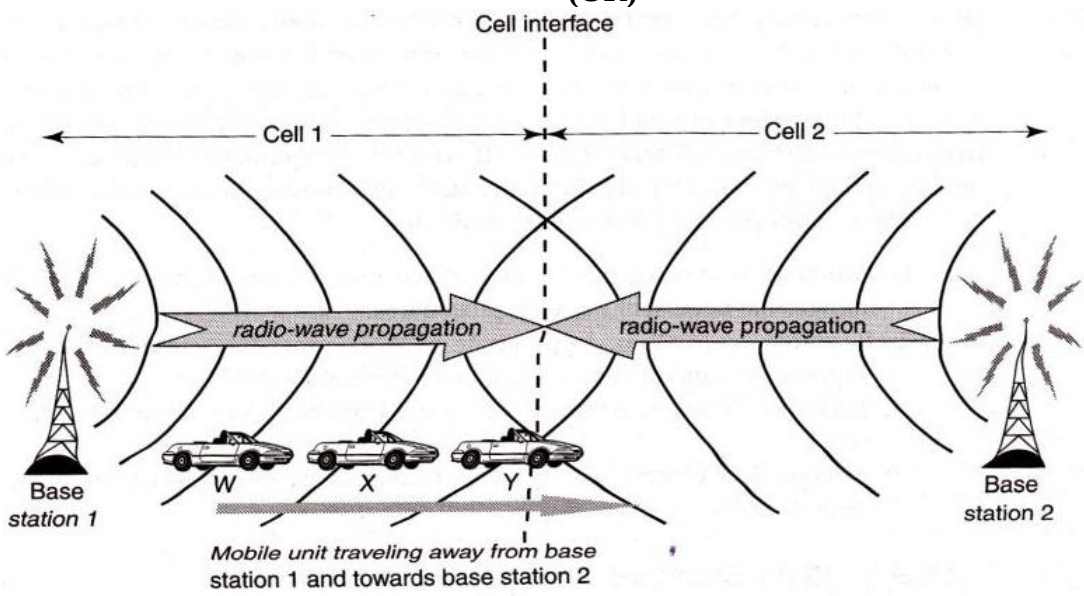
Hand Offs **(1 mark)**

When a mobile user travels from one area of coverage or cell to another cell within a call's duration the call should be transferred to the new cell's base station. Otherwise, the call will be dropped because the link with the current base station becomes too weak as the mobile recedes. Indeed, this ability for transference is a design matter in mobile cellular system design and is call *handoff*.

Diagram **(1 mark)**



(OR)



Hands Off Procedure **(2 marks)**

It involves

- Initialization:- either mobile device or network determines necessity of handoff & initiastes handoff
- Resource reservation:- appropriate network procedure reserves resources needed to support handoff (voice ,control channels)
- Execution:- actual control transfer from one base station to another base station take place
- Completion:- unnecessary network resources are relinquished & made available to another mobile device .

(OR)

Hands Off Procedure **(2 marks)**

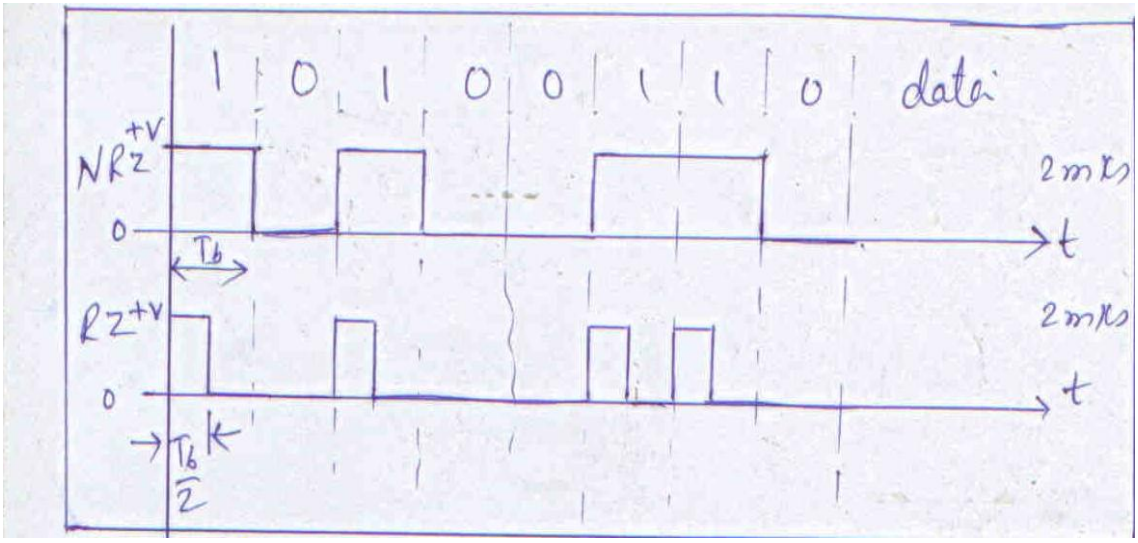
- During a call, the serving base station monitors the signal strength (RSS) from the mobile on a reverse voice channel.
- If the signal strength falls below a pre designated threshold, the base station sends a request to the MTSO for a hand off of the call.
- The MTSO then requests the location receivers of neighboring base stations to measure the signal strength (RSSI) from the mobile.
- If another base station from one of the neighboring cells indicates better signal strength , than under instructions from the MTSO the serving base station sends a signaling message to the mobile on the speech channel asking the mobile to return to a free channel in the neighboring cell.
- The mobile returns to the new channel (new cell),and simultaneously the MTSO switches the call to the new base station.

b) Convert the bit stream 10100110 into:

i) NRZ

ii) RZ formats

Ans: **(NRZ - 2 marks, RZ – 2 marks)**



c) Compare PAM & PWM (any four points)

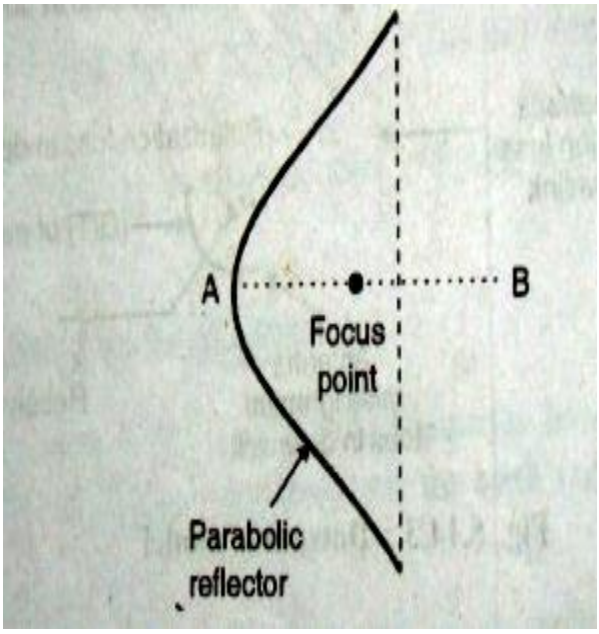
Ans: **(any four points)** **(4 marks)**

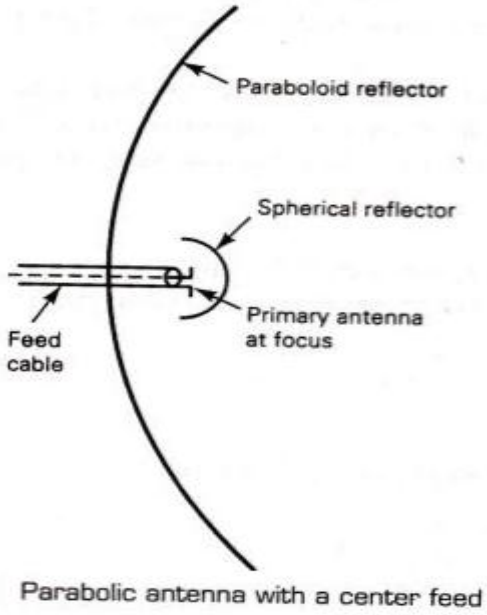
PAM	PWM
it is modulation technique in which amplitude of train of pulses is varied	It is modulation technique in which width of train of pulses is varied
It requires low bandwidth	It requires high bandwidth
Information is contained in amplitude variations	Information is contained in width variations
Transmitted power varies with variation of amplitude	Transmitted power varies with variation of width
It have low noise immunity	It has high noise immunity

d) Describe working principal of horn feed & parabolic dish antenna.

Note: Any of the two relevant diagram to be considered

Ans:- Dish antennas **(1 mark**





Explanation **(1 mark)**

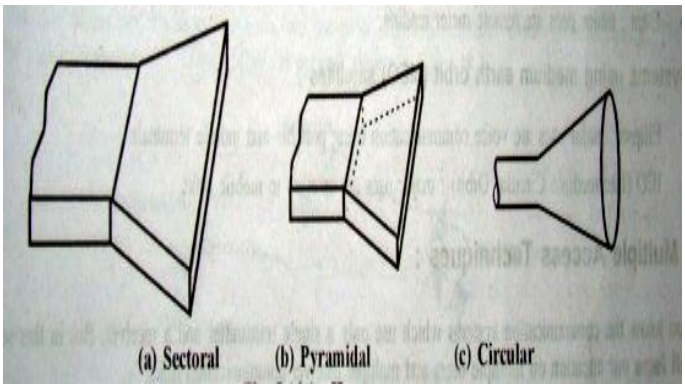
Dish antennas are the microwave antennas which use parabolic reflectors. The antenna is actually placed at the focal point of the parabolic reflector. The special geometric properties of parabolic reflectors make it very useful as a microwave or light reflector. Fig shows a dish antenna with a parabolic reflector. The dish antenna can be a transmitting antenna or a receiving antenna.

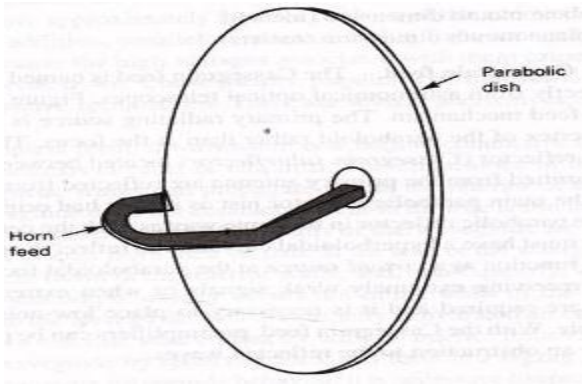
If it is a transmitting antenna, then all the waves coming out of the source (which is at the focal point) are reflected equally by the reflector from every point. It should be noted that all the reflected

waves are in phase with each other. So they will assist each other, get added to give out a strong radiation along the axis AB. However cancellation of waves will result in all other directions. This shows that the parabolic reflector leads to the production of concentrated beams of radiation.

We can use the dish antenna as a receiving antenna as well. The construction remains same but at the focal point, we need to use a receiver instead of a source. The parabolic reflector will bring only those rays together which are coming in direction BA. These rays are brought together at the focal point. The rays arriving from any other direction are canceled out. The reflector acts like a mirror to collect radiation from a large area. A practical parabolic reflector is a 3 dimensional bowl shaped surface which obtained by revolving the parabola about the axis AB. This 3 dimensional surface is called as paraboloid or a parabolic reflector or a microwave dish. The parabolic reflector actually increases the gain as well as the directivity of the microwave antenna.

Horn antennas **(1 mark)**





Explanation **(1 mark)**

A waveguide can radiate energy (i.e act like an antenna) into space if we excite it from one end and if its other end is left open. The waveguide radiates a large amount of energy as compared to that radiated by a two wire transmission line. But the problem is waveguides is that a very small amount of energy out of the total is actually radiated and a large part of energy is reflected back due to open circuit. Similar to transmission line, the open circuit at the far end actually acts as a discontinuity. So that waveguide is very poorly matched to the space. A poor end non directional pattern will result due to the diffraction taking place around the edges of a waveguide. In order to improve the radiation, we have to open out the mouth of waveguide. When a transmission line is opened it results into a dipole antenna but when a waveguide is opened, it results in an electromagnetic horn.

e) Compare TDMA & FDMA.

Ans: **(any 4 relevant points)** **(4 marks)**

Sr.no	TDMA	FDMA
1	Time sharing of satellite transponder takes place.	Overall bandwidth is shared among many stations.
2	Synchronization is essential.	Synchronization is not essential.
3	It is suitable for digital voice signals.	It is suitable only for analog signal.
4	It is possible to store digital information.	Storage, enhancement of signal is not possible.

4. a) Attempt any THREE of the following. (12 marks)

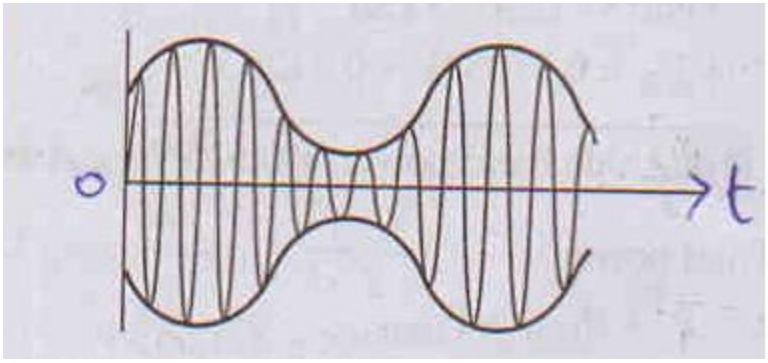
i) Draw neat waveform of AM signal with m=1, m<1 where m=modulation index of AM.

Ans:-

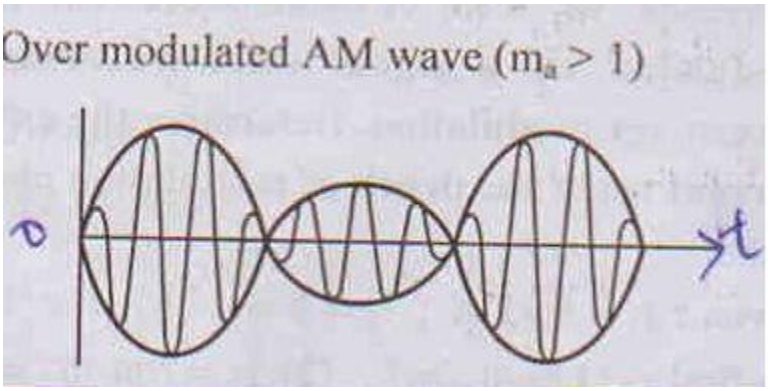
Modulation index m is given as

m=Vm/Vc **(1 mark)**

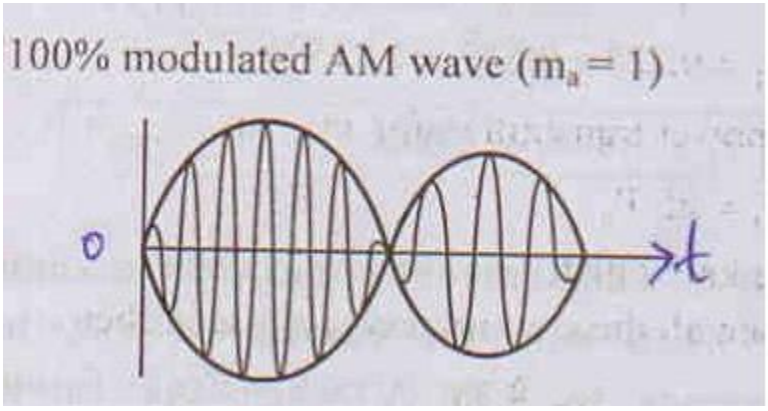
a) m < 1 (m < 100%) - no distortion in the Recovered signal at the receiver. **(1 mark)**



b) m<1 (m < 100%)- no distortion in the Recovered signal at the receiver. . **(1mark)**



c) m=1 (m=100%) -Distortion occurs at the receiver after demodulation. . **(1 mark)**



ii) Define

1) **Elevation angle**
2) **Azimuth angle**
3) **MTSO**
4) **Base station**

Ans:-

Elevation Angle: **(1 mark)**

It is the vertical angle formed between the direction of travel of an electromagnetic wave radiated from an earth station antenna pointing directly towards the satellite & the horizontal plane.

Azimuth Angle: **(1 mark)**

It is defined as the horizontal pointing angle of an earth station antenna. It is usually measured in a clockwise direction in degrees from true north.

MTSO: **(1 mark)**

A mobile telephone switching office (MTSO) is a centrally-located switch that controls all the operations of a cellular system. It is usually a highly sophisticated computer that monitors all calls, keeps a record of billing information and tracks cellular-equipped vehicles.

It is responsible for interconnecting calls with the local and long distance landline telephone companies, compiling billing information (with the help of its CBM/SDM), etc. It also provides resources needed to efficiently serve a mobile subscriber such as registration, authentication, location updating and call routing.

Base station: **(1 mark)**

A fixed station in a cellular wireless network, used for communicating with mobile terminals (phones). A base station is what links mobile phones to a wireless carrier's network.

iii) Draw block diagram of ASK transmitter & explain.

Ans:-

This was the earliest form of digital modulation technique used in wireless telephone & is the simplest form.

BASK is described as, $Vask = b(t) \cos(2\pi fct)$

Where, $Vask = \cos(2\pi fct)$; $b(t)=1$

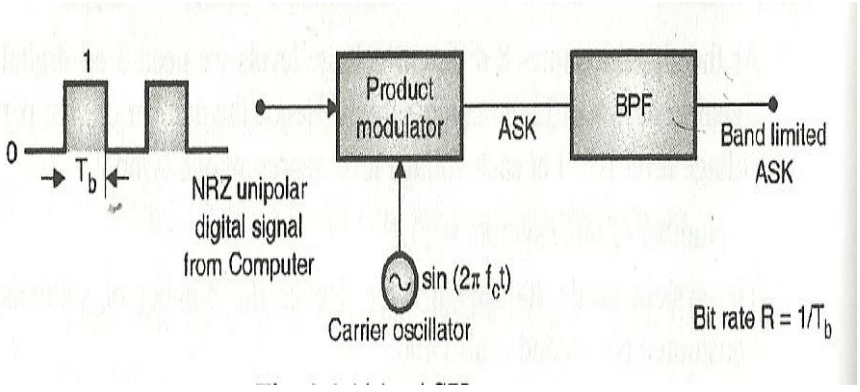
$Vask = 0$; $b(t) = 0$

ASK Transmitter **(2 marks)**

The expression indicates that ASK can be achieved by product modulator.

To the product modulator, apply two inputs i.e. the carrier signal A cos (2πfct) & the digital information b(t). At the output at which the carrier amplifier is switched ON & OFF.

Diagram **(2 marks)**



Block diagram of ASK transmitter

iv) Describe sky wave propagation.

Ans:-

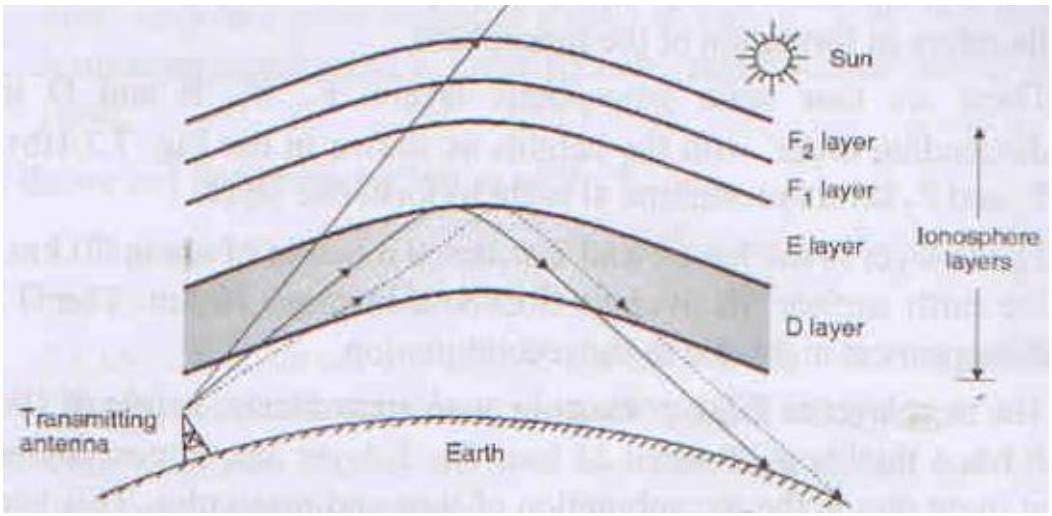
Sky wave propagation **(2 marks)**

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 **(2 marks)**



b) Attempt Any one of the following **(06 marks)**

i) Explain DPSK transmitter with neat diagram.

Ans:- **(Explanation 4 marks, diagram 2 marks)**

DPSK Transmitter Explanation **(4 marks)**

The differential phase shift keying (DSPK) is a modification of BPSK.

Below Diagram Shows the block diagram of DPSK generator and the relevant waveform are as shown in the below diagram.

Principle:- It combines, differential encoding and phase shift keying.

In BPSK receiver, the carrier recovery is done by squaring the received signal.

Hence, when the received signal is generated by negative data bit, it is squared and thus we cannot determine if the received bit is –b(t or b(t.)

Hence DPSK is used to eliminate the ambiguity of the received bit.

Operation of DSPK generator is as follows: 1M

- d (t) represents the data stream which is to be transmitted it is to one input of an EX-OR logic gate.

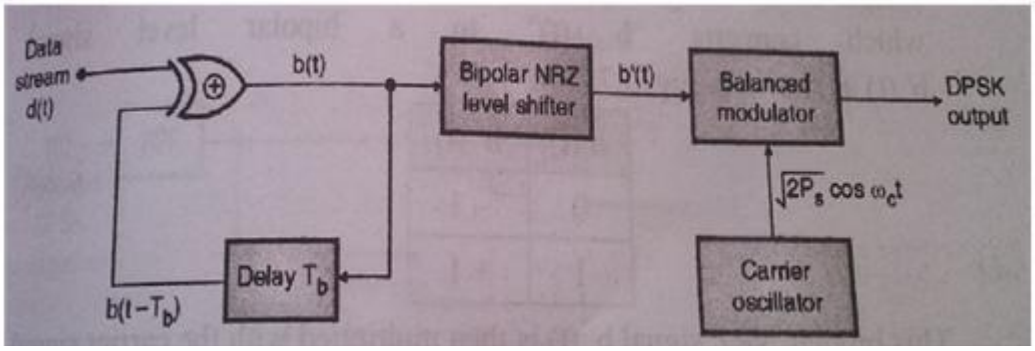
- The EX-OR gate output "b (t)" is delayed by one bit period the applied to the other input of EX-OR gate.
- The delayed represented by "b (t-Tb)"depending on the values of "d (t)" and "b (t-Tb)" the EX-OR produces the output sequence "b(t)".the waveform for the generator .the waveform drawn by arbitrarily assuming that in the first interval

  b (0)=0
- Output of EX-OR gate is the applied to a bipolar NRZ level which converts "b(t)" to a bipolar level "b(t)as shown

b(t)	b‟(t)
0	-1
1	+1

- This bipolar NRZ signal b‟(t) is then multiplied with the current to produce the DPSK signal.

Diagram **(2 marks)**



ii) Explain about frequency band in satellite communication & state functions of satellite communication (any four)

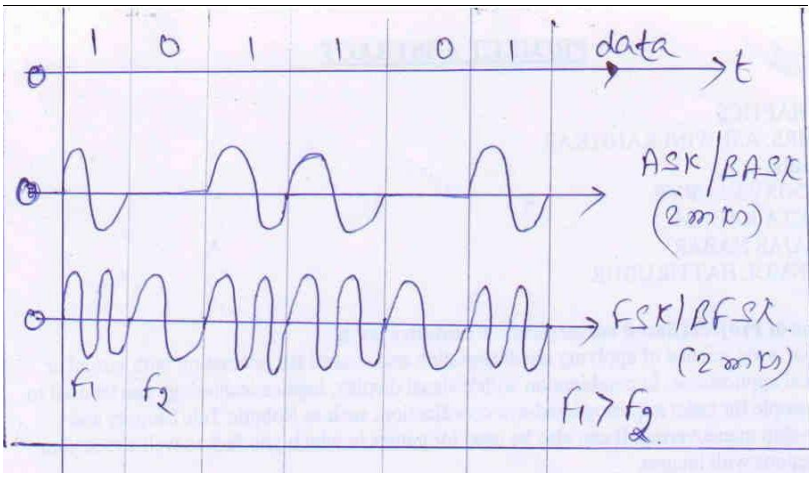
Ans: **(4 marks frequency bands,2 marks functions of satellite communication) (any four points)**

Frequency Band	Application / Functions
C-Band	TV broadcast
X-Band	Military use, Mobile radio relay(Ship aircraft)
Ku-Band	TV Broadcast, non-military applications
Ka-Band (Commercial)	Commercial Broadcasting.
Ka-Band (Military)	Military

5. Attempt any four of the following **(16 marks)**

a) Draw waveform of ASK & FSK for data 101101

Ans:- **(ASK - 2 marks, FSK – 2 marks)**



b) State advantages and disadvantages of analog communication

Ans:- Advantages of Digital Communication:- **(any 2 points)** **(2 marks)**

i. It has simple design due to high speed PC's.
ii. Cost is less.
iii. High data carrying capacity.
iv. High security due to data encryption
v. Using multiplexing text, video, audio data can be merged and transmitted over common channel.
vi. Effect of noise is less.
vii. Error detection is easier
viii. Very high processing speed.
ix. Very high accuracy.

Fast speed of response

Disadvantages:- **(any 2 points)** **(2 marks)**

i. Large Bandwidth .
ii. It needs Synchronization.
iii. Less reliability.

c) State sampling theorem. Define Nyquist rate

Ans:-

Sampling theorem **(2 marks)**

A continues time signal x (t) can be completely represented in its sampled form and recovered back from its sampled form if the sampling frequency

fs≥2w

Where Fs=Sampling Frequency
W=Maximum modulating frequency

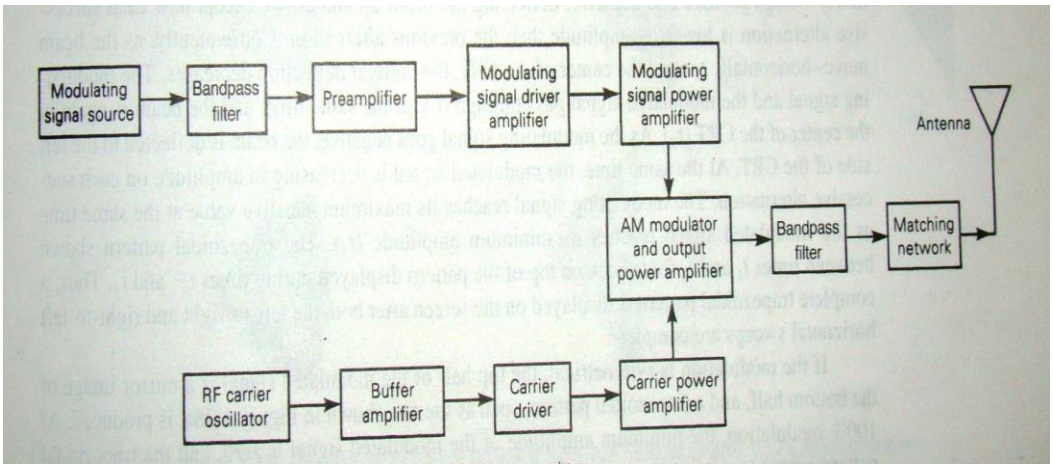
Nyquist rate **(2 marks)**

The minimum sampling rate of "2w" samples per second for a signal x (t) having maximum frequency of "w" Hz is called as Nyquist rate.

d) Draw block diagram of AM transmitter & receiver state functions of each block.

Ans:-AM Transmitter **(1 mark)**

(Either High level or Low level modulation)



High Level Modulation

Explanation **(1 mark)**

Stabilized Crystal Oscillator: It is used for generating carrier signal

Class –A RF Amplifier: amplifies carrier voltage level

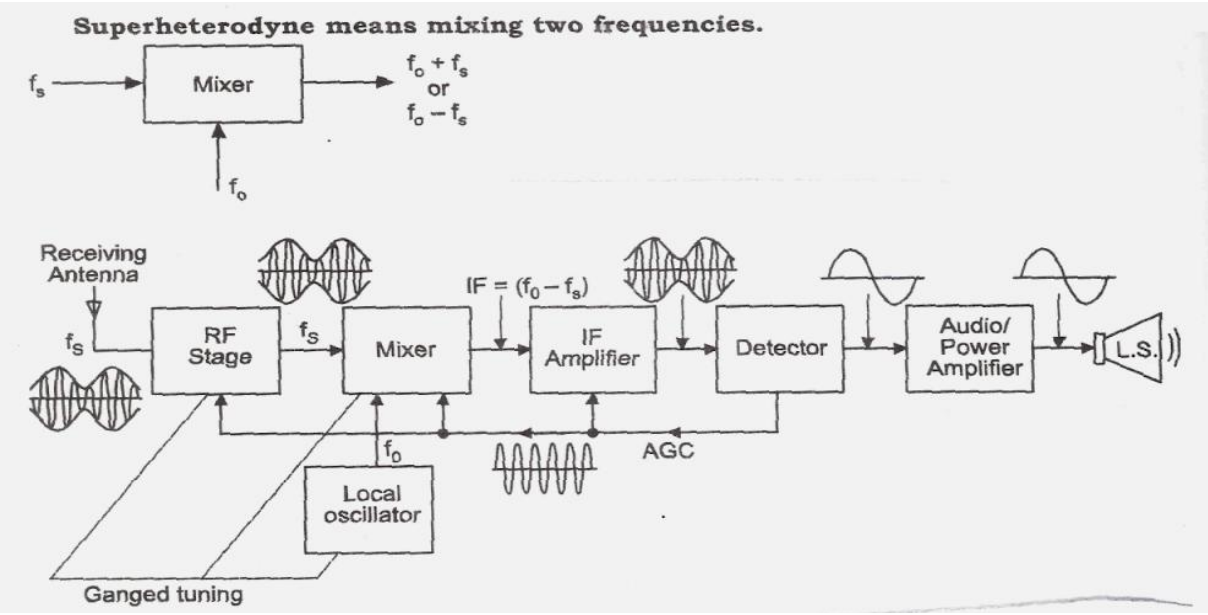
Class –C RF Power Amplifier: It increases power level of carrier

Class –A amplifier: It amplifies audio processed & filtered modulating signal

Class B Power Amplifier: It amplifies power level of modulated signal

Class –C RF output Amplifier: It combines carrier & modulated signal to generate output AM Signal.

Receiver **(1 mark)**



Explanation **(1 mark)**

RF stage: it is responsible for select ting particular frequency signal & rejects all other signals to reduce impact of noise.

Mixer:-It mixes signal received from RF stage & crystal oscillator & produces intermediate frequency signal (IF)

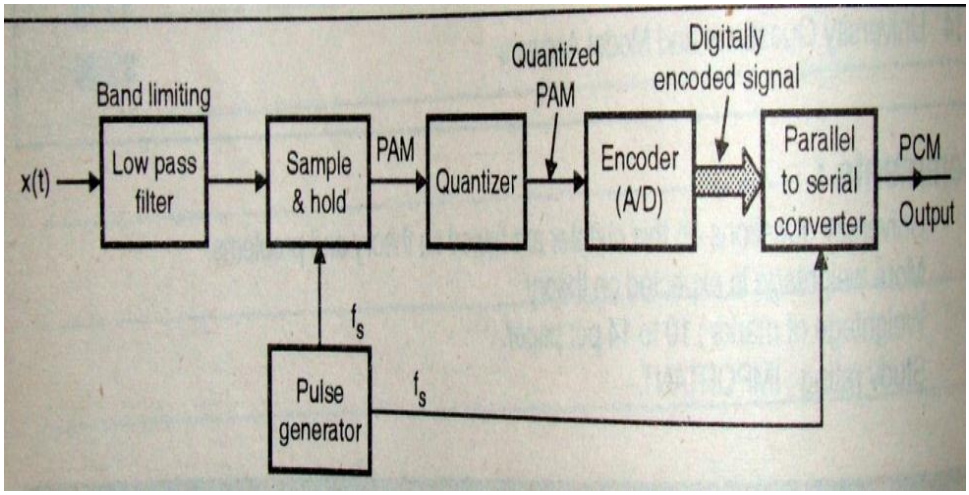
Ganged Tuning: it maintains constant difference between local oscillator & RF signal frequency

IF amplifier: It is responsible for amplifying signal

Detector: It demodulates AM signal received to original signal.

AGC: It controls gain of IF & RF amplifiers to maintain constant output voltage level even though signal at input are fluctuating in nature .

e) Draw block diagram of PCM transmitter &explain.
Ans: **(Diagram – 2 marks, Explanation – 2 marks)**



Operation of PCM transmitter

The analog signal x(t) is passed through a band limiting low pass filter, which has a cut-off frequency fc =W Hz. This will ensure that x (t) will not have any frequency component higher than "W". This will eliminate the possibility of aliasing.

The band limited analog signal is then applied to a sample and hold the circuit where it is sampled at adequately high sampling rate. Output of sample and hold block is a flat topped PAM signal.
These samples are then subjected to the operation called "Quantization" in the "Quantizer". The quantization is used to reduce the effect of noise. The combined effect of sampling and quantization produces the quantized PAM at the quantizer output.
The quantized PAM pulses are applied to an encoder which is basically an A to D converter. Each quantized level is converted into an N bit digital word by the A to D converter. The value of N can be 8,16,32,64 etc. The encoder output is converted into a stream of pulses by the parallel to serial converter block. Thus at the PCM transmitter output we get a train of digital pulses.

f) Define following

i) Data rate
ii) Baud rate
iii) Bit rate
iv) Channel capacity

Ans:-

i) Data rate: **(1 mark)**

It is the number of bits transmitted per seconds increasing the number of bits per samples increases the bit rate which is given as,

$$D = nfs$$

Where D= data rate in bits per seconds
Fs=sample rate in sample per seconds ($fs \geq 2Fm$)
n=number of bits per sample.

ii) Baud rate: **(1 mark)**

Is a unit of transmission rate, modulation rate or symbol rate.

(OR)

Baud refers to the rate of change of a signal on the transmission medium.

iii) Channel capacity: **(1 mark)**

Channel capacity is defined as the maximum possible bit rate supported by a channel without introducing errors.

$$C = B \log_2 (1+S/N)$$

iv) Bit rate: **(1 mark)**

It is the simply the number of bits transmitted during one second

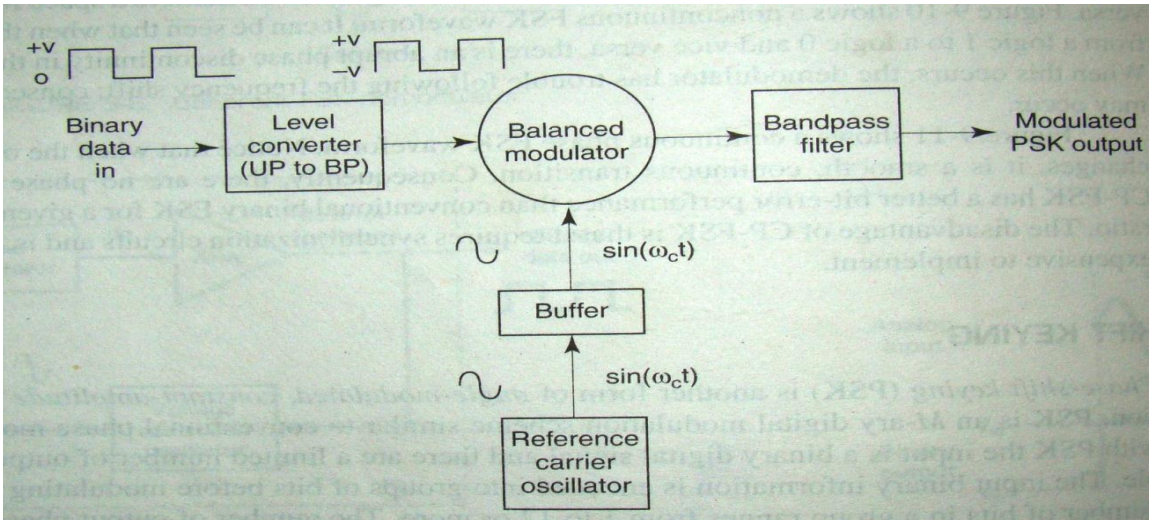
(OR)

Bit rate is defined as bits per seconds.

6. Attempt any four of the following **(16 marks)**

a) Explain BPSK generation .Draw waveform of BPSK modulation

Ans: **(diagram – 2 marks, explanation – 1 mark, waveform – 1 mark)**



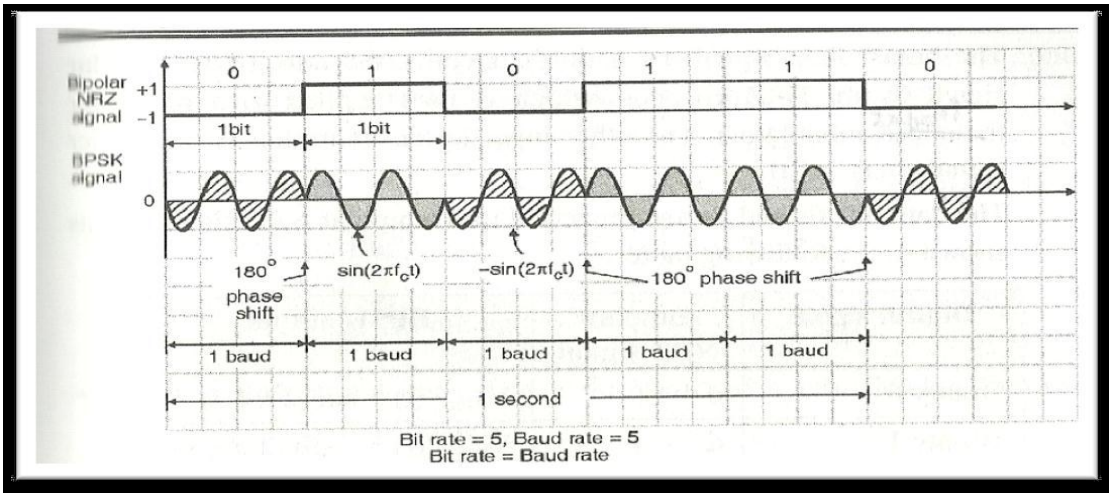
Block diagram of BPSK generation

Explanation **(1 mark)**

- As the input digital signal changes state (i.e. from 1 to 0 or from 0 to 1), the phase of the output carrier shifts between two angles separated by 180°.
- Level convertor: The binary input data is given to this stage which converts unipolar signal to bipolar signal.
- Reference carrier oscillator: This block generates the high frequency carrier signal for modulation. Crystal controlled oscillator is used which provides high accuracy and stability.

- Buffer: Its function is to isolate the oscillator from modulator. Buffer provides a relatively constant carrier frequency signal.
- Balanced modulator: The balanced modulator acts as a phase reversing switch depending on the logic condition of the digital input the carrier is transferred to the output either in phase or 180° out of phase with the reference carrier oscillator.
- Band Pass filter: It is used to limit the band of output signal produced by modulator.

Waveform **(1 mark)**



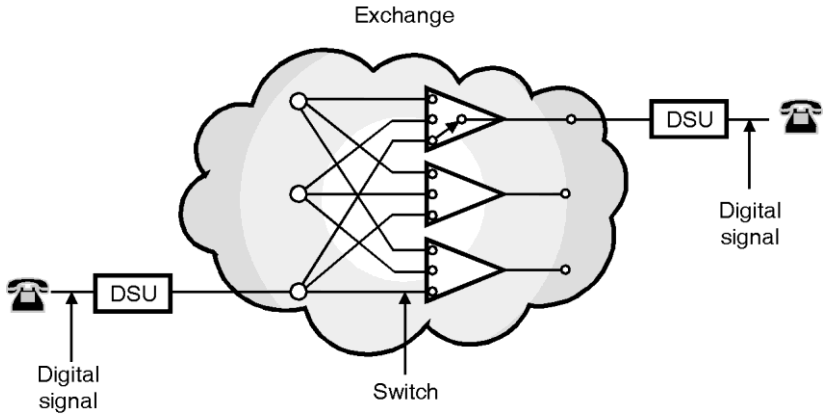
b) Explain the switched services of digital carrier system.

Ans: **(diagram 2 marks, explanation 2 marks)**

It is an equivalent version of the analog switched service. It allows data rates up to 56 Kbps. To communicate through this service both parties must subscribe. A caller with normal telephone service cannot connect to a telephone or computer with a switched/56 even if using a modem.

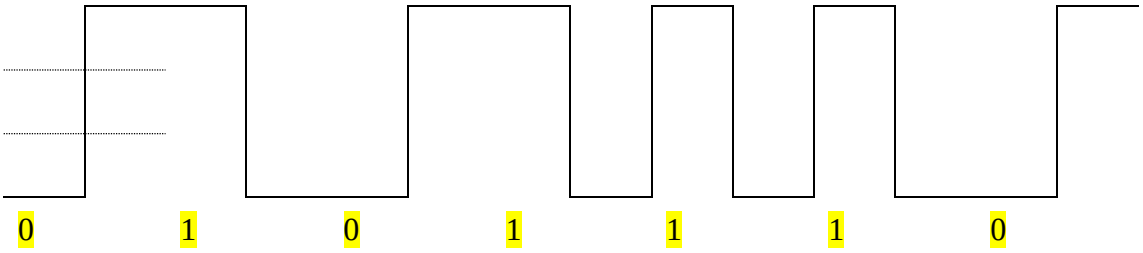
On the whole digital and analog services represent two completely different domains for the telephone companies. Since the line in a switched/56 sender is already digital, subscribers do not need modems to transmit digital data. The switched/56 sender needs a device called a Digital Service Unit (DSU) as shown in Figure-

Diagram

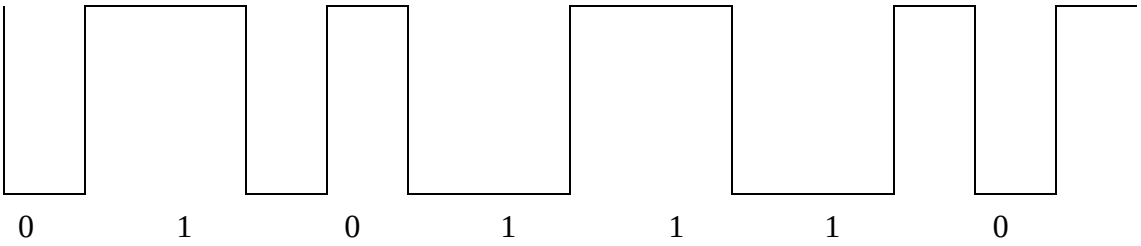


c) Draw the waveform for 0101110 using Manchester and differential Manchester encoding
Ans:- **(Manchester - 2 marks, Differential Manchester – 2 marks)**

Manchester -



Differential Manchester



d) Define following terms

i) Critical frequency
ii) Maximum usable frequency
iii) Skip distance & fading

Ans:

i) Critical frequency Fc : **(1 mark)**

It is maximum frequency of particular layer of projected signal that will return to earth if projected in straight vertical direction.

ii) MUF: **(1 mark)**

It is the highest frequency that can be used for the sky wave communication between two given points on the earth. It is also given by

MUF = critical frequency/ = Fc / Sec ϴ

iii) **Skip distance:** **(1 mark)**

The skip distance is defined as the shortest distance from a transmitter measured along the surface of the earth at which sky wave of fixed frequency returns back to the earth.

iv) Fading: **(1 mark)**

Fading is the fluctuation in signal strength at a receiver & may be rapid or slow , general or frequency selective. It occurs due to interferences between two waves which left the same source but arrived at destination by different paths.

e) Explain digital subscriber line

Ans:-

Explanation **(2 marks)**

Digital Subscriber Line is one of the most promising for supporting high- speed digital communication over the existing local loop. DSL technology is a set of technologies each differing in first letter (ADSL, VDSL, HDSL & SDSL). The set is often referred to as xDSL. Where x can be replaced by A, V, H, or S. Asymmetric Digital Subscriber Line (ADSL): This provides higher speed (bit rate) in the downstream direction (from the internet to the resident) than in the upstream direction (from resident to the internet) that is the reason it is called asymmetric. High-bit-rate-Digital Subscriber Line (HDSL): This was designed to alternate T-1 line (1.544Mbps). HDSL used 2B1Q encoding which is less susceptible to attenuation. HDSL uses two twisted pairs (one pair for each direction) to achieve full- duplex transmission. Symmetric Digital Subscriber Line (SDSL): This is a one twisted pair version of HDSL. SDSL, which provides symmetric communication, can be considered an alternative to ADSL. Very High-bit-rate- Digital Subscriber Line (VDSL): This uses co-axial cable, fiber optic cable or twisted pair cable for short distances. The modulating technique is DMT.

Data rate for various Digital Subscriber Line: **(2 marks)**

Technology	Downstream data rate	Upstream data rate
ADSL	1.5-6.1Mbps	16-640Kbps
HDSL	1.5-2.0Mbps	1.5-2.0Mbps
VDSL	25-55Mbps	3.2Mbps
SDSL	768Kbps	768Kbps