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 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 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 constantvalues 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 judgment 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.

Q.1 A) Attempt any SIX : 12 M

a. State sampling theorem.

Ans:-

Sampling theorem: 2M

A continuous time signal x(t) can be completely represented in its sampled form and recovered back from the sampled form if the sampling frequency fs >= 2fm, where fm is the maximum frequency of the continuous signal.

b. Define orbit with reference to satellite

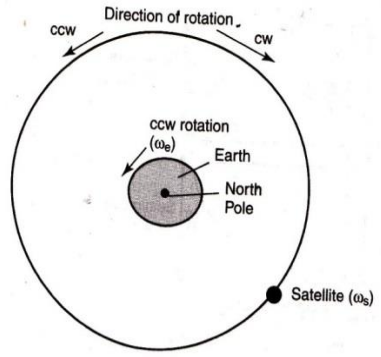
Ans:

Satellite orbit: 2M

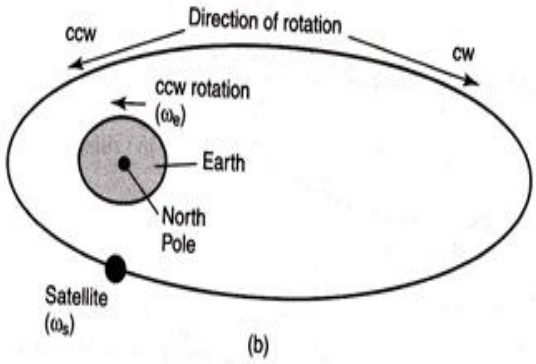
The orbit in which satellite revolves is called orbit of satellite. Most of the satellites are called orbital satellites, which are nonsynchronous. Nonsynchronous satellites rotate around earth in an elliptical or circular pattern.

Diagram: ***(NOTE: Diagram is optional)***

Circular orbit:



Elliptical orbit:



c. Calculate modulation index for frequency modulated wave if frequency deviation is 75kHz, Modulation frequency is 5KHz and carrier frequency is 100MHz.

Ans: **Formula 1M calculation 1M**

Given:

Modulating frequency:5KHz

Frequency deviation:75KHz

Carrier frequency:100MHz

$$M_f = \frac{Frequency\ deviation}{Modulating\ frequecy}$$

$$= \frac{75KHz}{5KHz}$$

$$= 15$$

d. Define multiplexing and state any two types of multiplexing techniques.

Ans: **(Definition – 1 M, Each type – 1/2 M)**

Definition of Multiplexing:

Multiplexing is a set of techniques that allows the simultaneous transmission of multiple signals across a signal data link.

Types of multiplexing: (any two)

1. Frequency division multiplexing (FDM)
2. Time division multiplexing (TDM)
3. Wavelength division multiplexing (WDM)

e. State two advantages and two disadvantages of ring topology.

Ans:

Advantages: (Any two) **½M each**

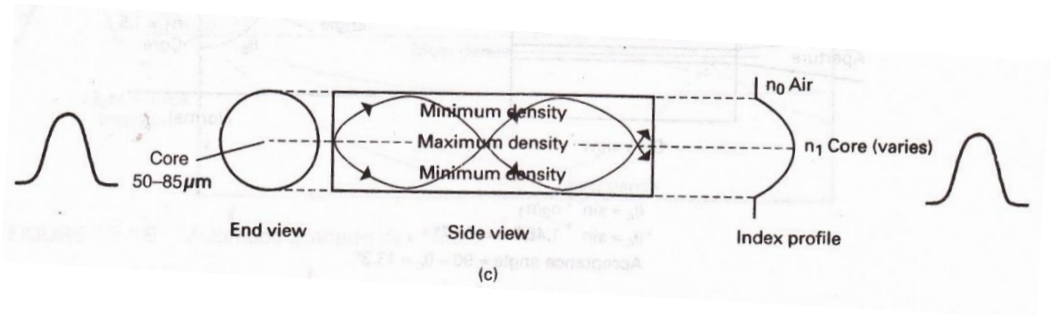
1. Very organized, each node gets to send the data when it receives an empty token. This helps to reduce chances of collision.
2. Even when the load on the network increases, its performance is better than that of bus topology.
3. Additional components do not affect the performance of network.
4. Each computer has equal access to resources.

Disadvantages:((Any Two) **½M each**

1. Each packet of data must pass through all the computers between source and designation. This makes it slower than star topology.
2. If one workstation goes down, the entire network gets affected.
3. Network is highly dependent on the wire which connects different components.
4. Network cards are expensive as compared to Ethernet cards and hubs.

f. Draw cross sectional diagram of graded index fiber and label it.

Ans: **2M**

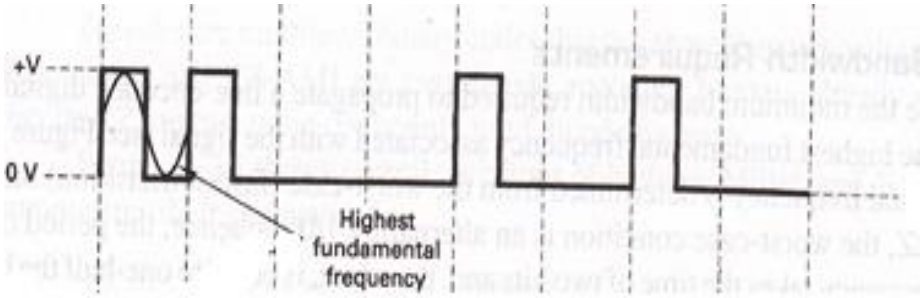


g. Define unipolar RZ and NRZ encoding techniques techniques with neat waveforms.

Ans:
Unipolar encoding scheme, all the signal levels are on one side of the time axis, either above or below.

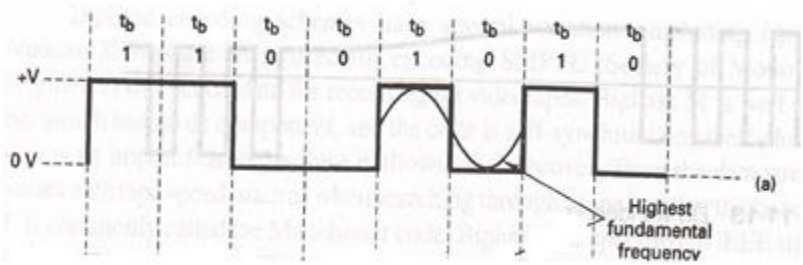
Unipolar RZ: **½M**
Return-to-zero (RZ or RTZ) describes a line code used in telecommunications signals in which the signal drops (returns) to zero between each pulse. This takes place even if a number of consecutive 0s or 1s occur in the signal.

Waveform: **½M**



Unipolar NRZ: **½M**
A unipolar scheme was designed as a non-return to zero (NRZ) scheme in which the positive voltage defines bit 1 and zero voltage defines bit 0.It is called NRZ because the signal does not return to zero at the middle of the bit.

Waveform: **½M**



h. Define Noise and Noise figure.

Ans:

Definition of Noise: **1M**

Noise is defined as any unwanted introduction of energy tending to interfere with the proper reception and reproduction of transmitted signals.

Definition of Noise figure: **1M**

Noise figure is defined as the ratio of the signal to noise power supplied to input terminals of the receiver to the signal to noise power supplied to the output or load resistor.

F(Noise Figure) = $\frac{Input\ SNR}{Output\ SNR}$

Noise figure will be 1 for ideal receiver.

Noise figure may be expressed as an actual ratio or in decibels.

Q.1B Attempt any TWO: **8M**

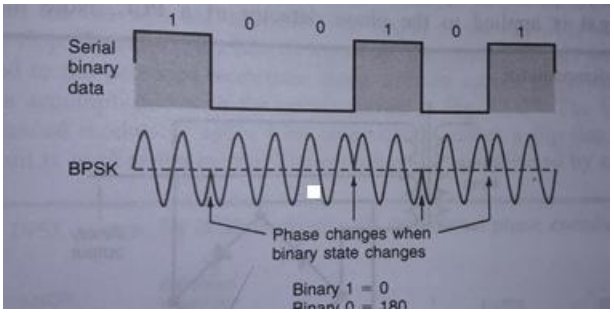
a) Define with neat waveform BPSK and state two advantages of it over others.

Ans:

Definition of BPSK: **1M**

(Binary Phase shifting keying) In phase shifting the phase of carrier is varied or shifted representing binary 1 & 0. Both amplitude and frequency remain constant. Waveform:

Waveform: **1M**



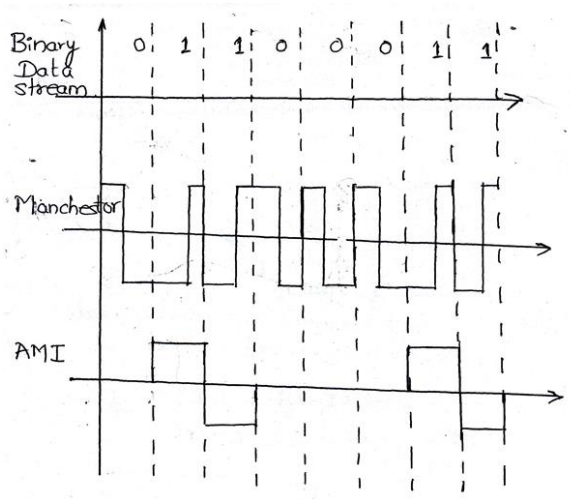
Advantages: (Any two) **2M**

1. Noise immunity is high.
2. Bit rate is very high (>1800bps) compared to ASK & BFSK.
3. Used for High speed MODEMS.

b) Show the Manchester and Alternative Mark Inversion (AMI) pattern for the bit stream- 01100011.

Ans:

Waveform: **2M each**



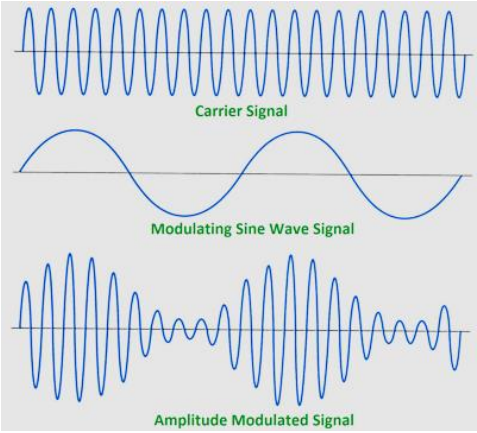
c) Define Amplitude modulation. Draw AM wave and state two applications of AM.

Ans:

Definition of AM wave: **1M**

Amplitude modulation is the process of variation in the amplitude of a relatively high frequency carrier signal in proportional with the instantaneous value of the modulating signal.

Waveform of AM wave: **2M**



Applications of AM (any two) **½ M each**

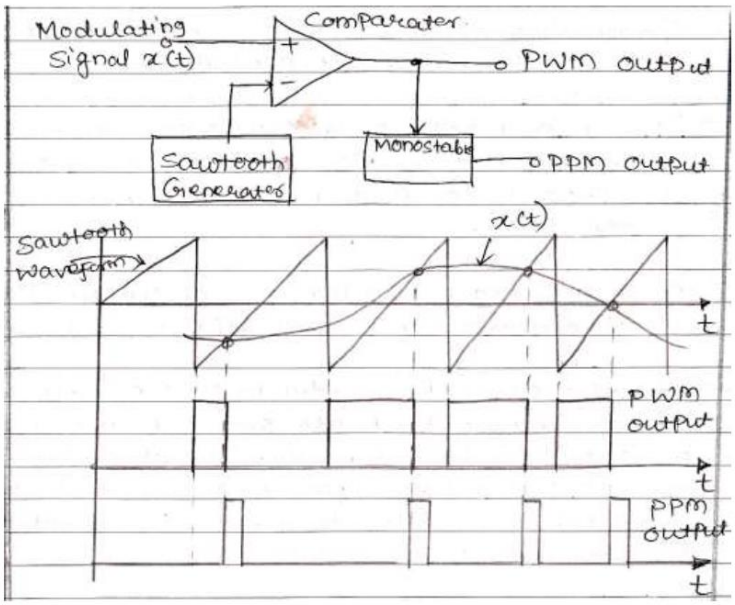
1. Broadcast transmissions
2. Air band radio
3. Amplitude modulation in the form of single sideband is still used for HF radio links
4. AM is widely used for the transmission of data in everything from short range wireless links such as Wi-Fi to cellular telecommunications and much more.

Q2. Attempt any FOUR: 16M

a) Draw the block diagram of generation of PPM and its working

Ans: (2M Diagram, 2M explanation)

[Note:- Any other relevant diagram and its explanation should be considered]



Working Principle:

- A saw-tooth generates a saw-tooth signal which is sampling signal. It is applied to the inverting terminal of the comparator. The modulating signal x(t) is applied to the non-inverting terminal of the same comparator.
- Comparator output will be PWM.
- These PWM signals are fed to mono-stable vibrator, So that every trailing edge of PWM pulses trigger mono-stable vibrator and produce the pulses which is PPM.

b) Draw frequency spectrum of AM wave if modulation frequency of 2 KHz with amplitude of 1V is modulated with carrier frequency 600 KHz with amplitude of 2V

Ans: (fig a-1M fig b-1M,fig c-2M)

- Modulation frequency of 2 KHz with amplitude of 1V
- Carrier frequency 600KHz with amplitude of 2V
- $m_{a=}$50%

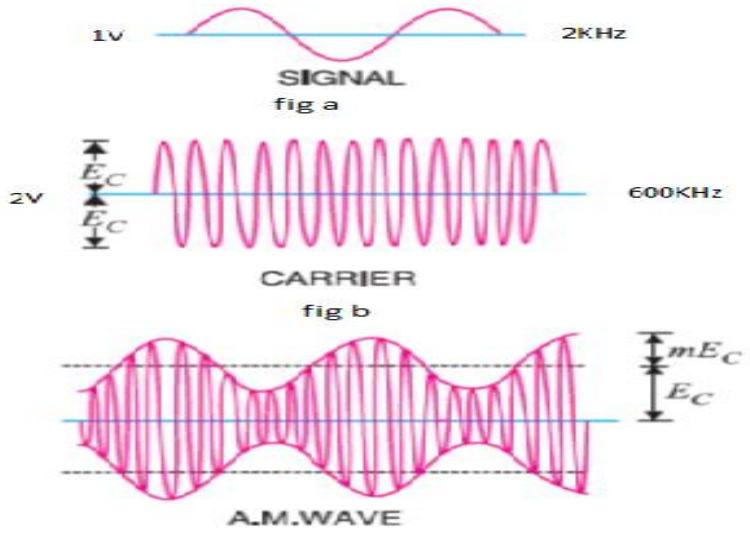
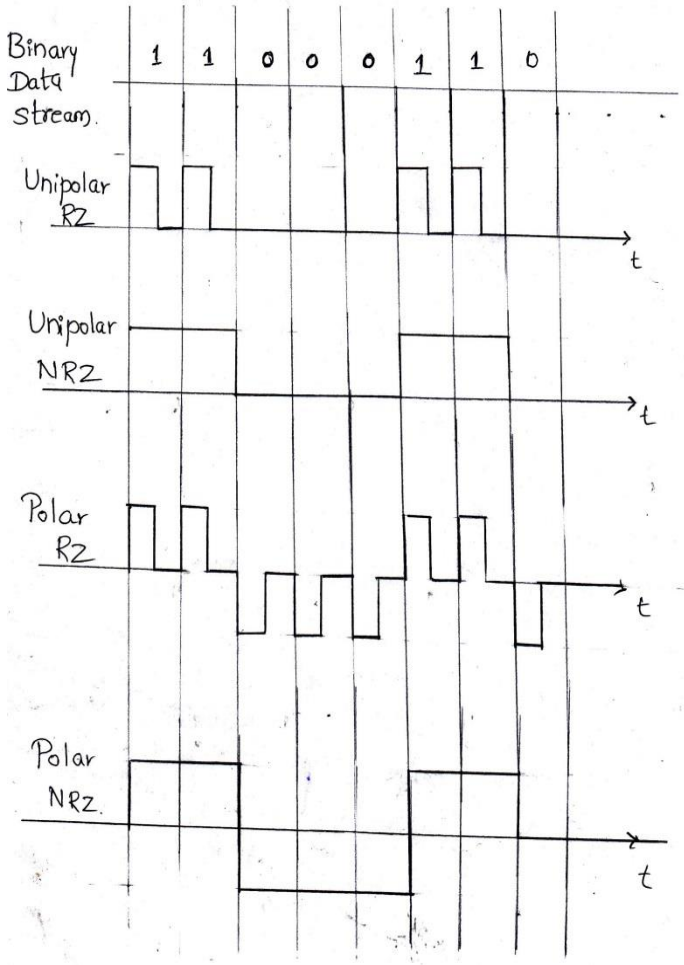


fig c

c) Draw polar RZ,NRZ and Unipolar RZ,NRZ pattern for bit stream-11000110.

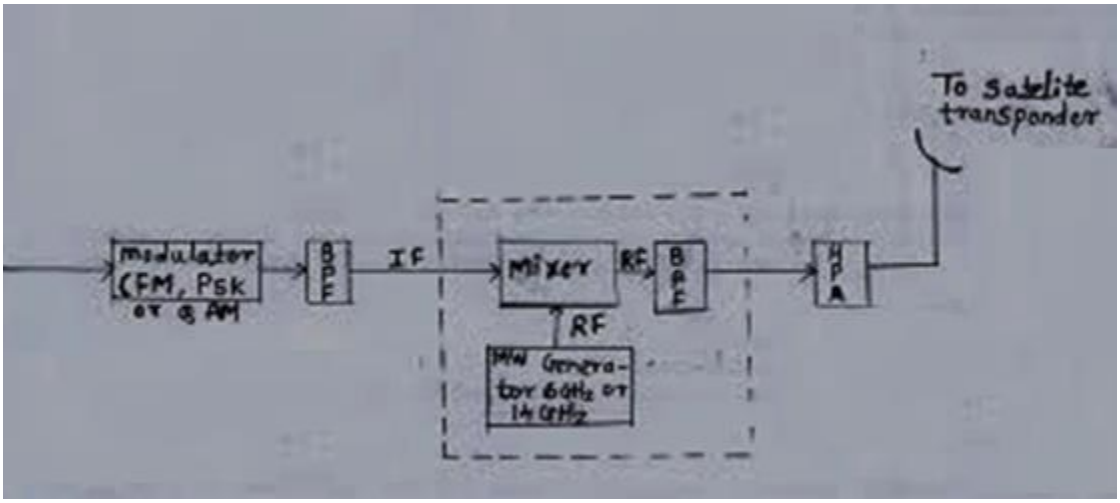
Ans: **1M each**



d) Draw block diargram of satellite uplink model and state function of up converter and power amplifier.

Answer: **(Diagram 2M, Explanation2M)**

Diagram:

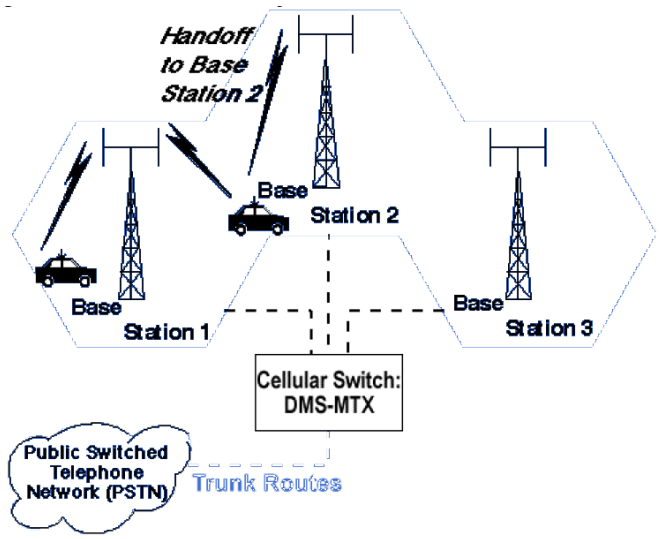


- The up converter (mixer and band pass filter) converts the IF to an appropriate RF carrier frequency.
- The HPA provides adequate gain and output power to propagate the signal to the satellite transponder. HPAs commonly used are klystron and travelling wave tube.

e)Describe with neat diagram the procedure of Hand-off operation in mobile communication

Ans:Hand off procedure 2M ,Diagram 2M

Handoff: Cellular system has the ability to transfer calls there are already in progress from one cell-site controller to another as the mobile unit moves from cell to cell within the cellular network. The transfer of a mobile unit from one base stations control to another base stations control is called a handoff.



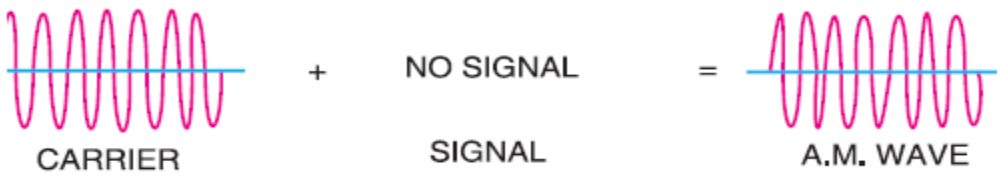
During a call, two parties are on one voice channel. When the mobile unit moves out of the coverage area of a given cell site, the reception become weak. At this point the cell site in use requests a hand off. The system switches the call to a stronger-frequency channel in a new site without interrupting the call or altering the user. The call continues as long as the user is talking, and the user does not notice the hand off at all.

f) Draw amplitude modulated wave form for the conditions:

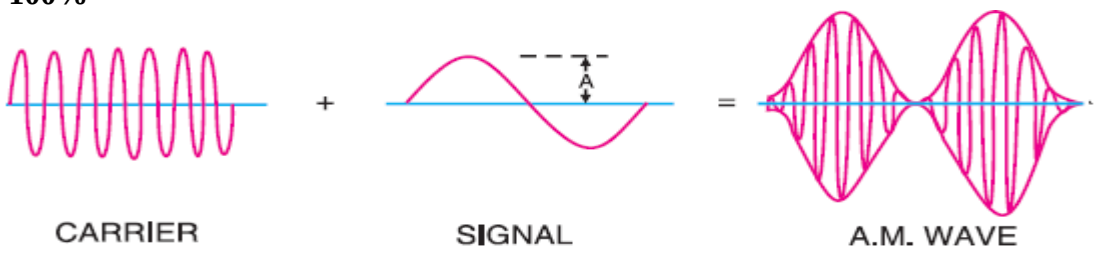
1)m=0%
2)m =100%
3) m<100%
4)m >100%

Ans:- **(1M Each)**

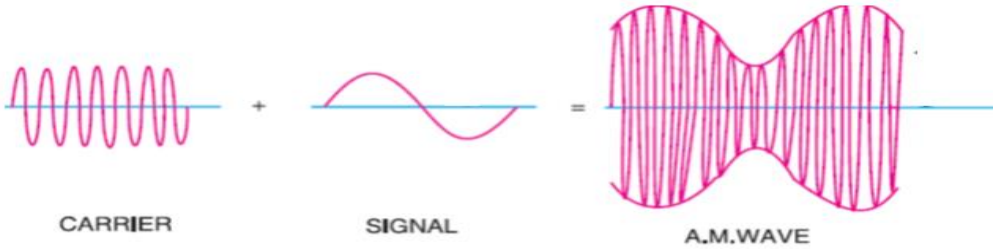
1) m=0%



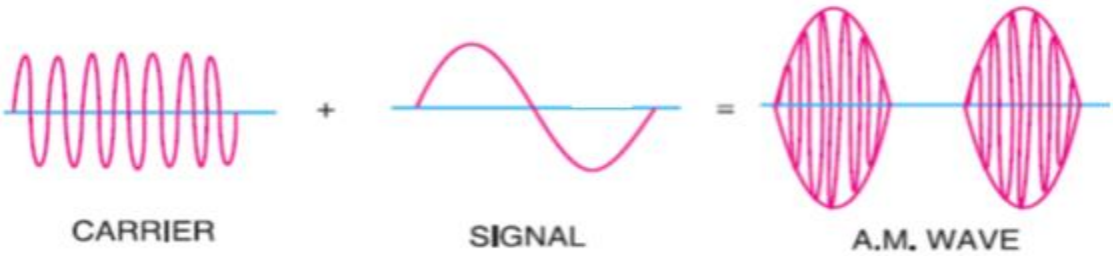
2) m =100%



3) m<100%



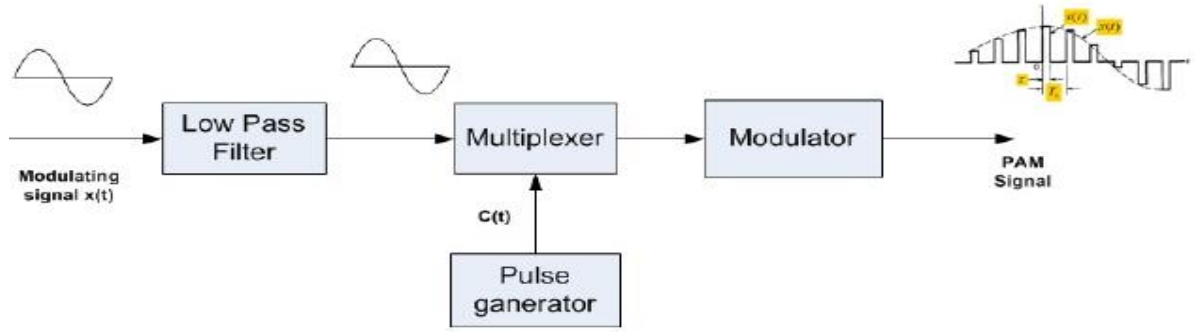
4)m>100%



Q3. Attempt any FOUR. **16M**

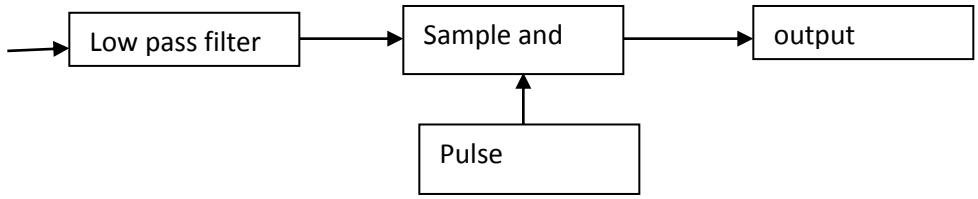
a) Draw block diagram of PAM generator and state two advantages of PAM

Ans:- **(3M Diagram, 1M Advantage)**



OR

Message (Modulating signal)

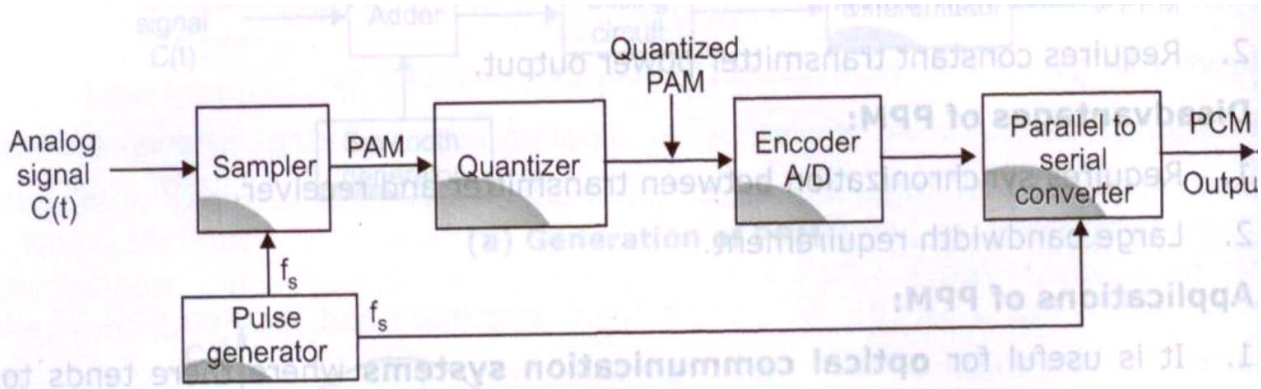


Advantage of PAM: ***[Note: Any other advantage can be considered.]***

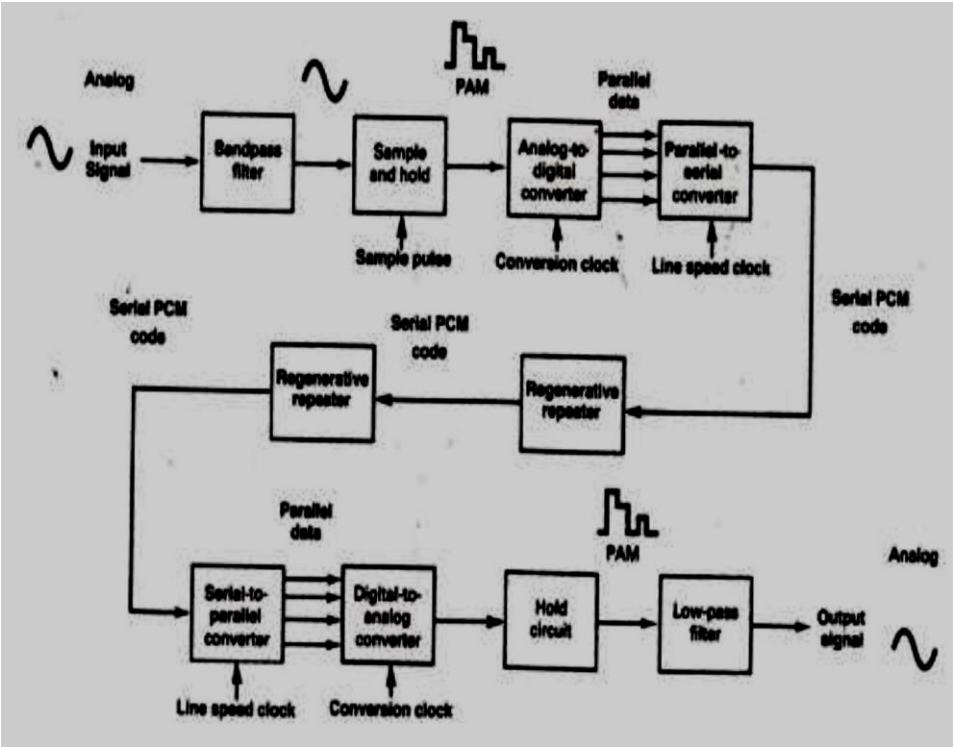
1. It is very simple to Genrate
2. It is basic building block of PCM generation with low cost.
3. Easy for detection.

b) Draw block diagram of PCM transmitter and state function of quantizer block in it

Ans:- **(Block diagram 3 M, quantizer function 1M)**



OR



Function Of Quantinizer:
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.

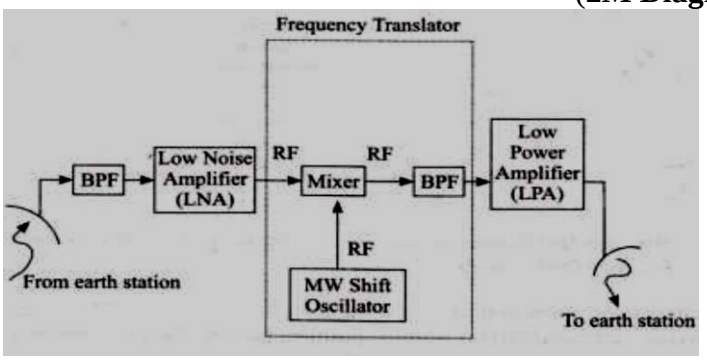
c) State operating principle of LED and list four specifications of LED.
Ans:- **(2M principle, 2M specification)**

Principle Of LED:
This is semiconductor junction diode which emit light when current is passed through it in the forward direction. It is working on the principle of spontaneous emission. It made of GaAs or any other combination with aluminum, phosphorous.

Specification: ***[any Four]***
- Wavelength
- Operating voltage
- Maximum current through it.
- Size
- Intensity
- Type of light(coherence or non-coherence)
- Operating Frequency.(colour)

d) Draw block diagram of transponder and describe function of each block.

Ans:- **(2M Diagram, 2 M Explanation)**

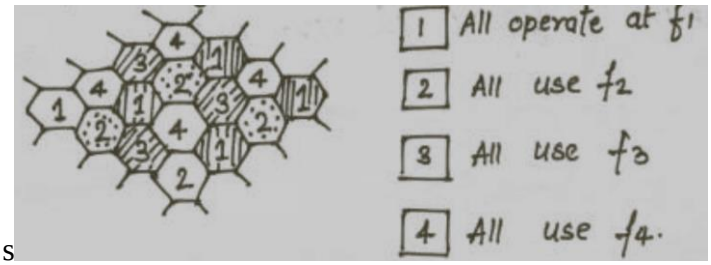


Explanation:

It consists of receiving antenna (f = uplink frequency), a band limiting circuit band pass filter, an input low noise amplifier, frequency translator, output low power amplifier, and transmitting antenna (f = downlink frequency).The frequency translator is basically an RF to RF repeater. The frequency of MW shift oscillator is equal to frequency shift required and hence it is equal to difference of uplink and downlink frequency (usually = 2GHz.)

e) Describe frequency reuse feature used in mobile communication with proper cell diagram.

Ans:- **(Frequency reuse diagram2 M, Explanation 2M)**

s 

Explanation:

- Frequency reuse refers to the use of radio channels operating on the same frequency, to cover different areas that are physically separate from each other.
- In the frequency reuse it is necessary to see that co-channel interference is not objectionable.
- In frequency reuse concept, a single transmitter of higher power need not to be used to cover entire area.
- Instead many transmitters of small output power operating at the same frequency can be used.
- This technique also reduces the minimum height of transmitting antenna, because each antenna has to cover small area.
- The users located in different geographical area i.e. different cells can use same frequencies.
- The advantage of frequency reuse is that it drastically increases the spectrum efficiency but if the system is not designed properly then co-channel interference may take place.
- Frequency reuse technique popularly use in cellular phone system as shown in the above diagram.
- It uses the same frequency repeatedly in the same area in one system.
- Here the total frequency spectrum allocation is divided into four co-channel cells in the system.
- The cells marked -1 will use same frequency say f1, the cells marked 2 will use same frequency f2 and so on.

f) Define with proper structural diagram 'cell' and 'cluster' with reference to mobile communication.

Ans:-

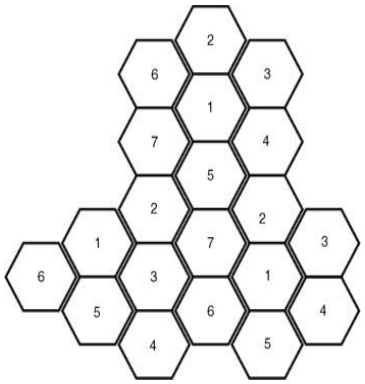
Cell **1M**

Cellular base station is allocated a group of radio channels to be used within a small geographic area called cell With limited frequency resource, cellular principle can serve thousands of subscribers at an affordable cost. In a cellular network, total area is subdivided into smaller areas called "cells". Each cell can cover a limited number of mobile subscribers within its boundaries. Each cell can have a base station with a number of RF channels.

Cluster: **1M**

The group of cells where the available frequency spectrum is totally consumed is called a cluster of cells.

2M



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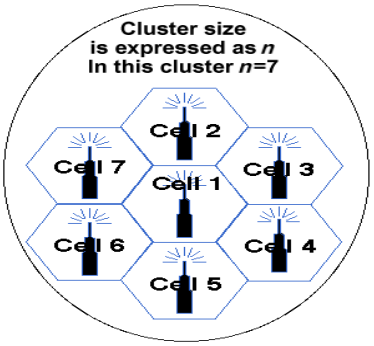


Q4. Attempt any FOUR : **16M**

a) Calculate frequency swing and bandwidth of F.M. system using Carson's rule, if the maximum frequency deviation is 50 KHz and maximum modulating frequency is 5 KHz.

Ans:- **(2M frequency swing, 2M bandwidth, definition is not expected)**

∂=maximum deviation, Fm = maximum modulating frequency

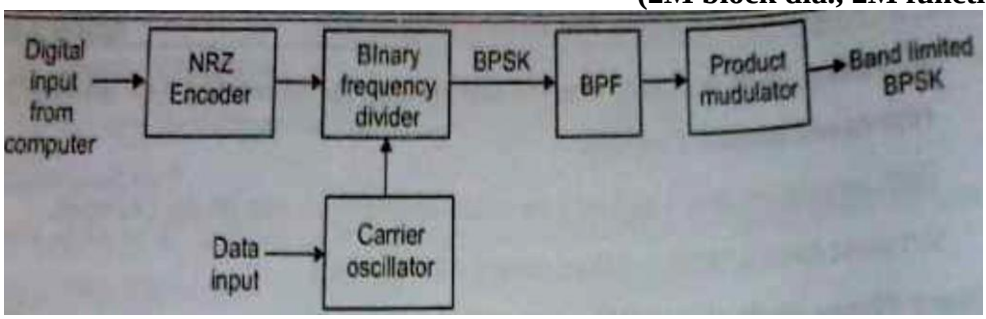
BW=2(∂ +Fm (max)) =2(50K+5K) =110K

Frequency swing is maximum frequency change above and below the carrier frequency i.e. frequency deviation above and below:

Frequency swing = 2x ∂= 2x50K= 100kHz

b) Draw block diagram of BPSK generation and state function of each block.

Ans:- **(2M block dia., 2M function)**



Function of block:

- **NRZ Encoder:** This converts binary data signal (0's and 1's) into NRZ bipolar system**.**
- **Carrier Oscillator:** Generates sine wave carrier signal.
- **Product Modulator:** Multiplies input data and carrier which results BPSK signals.
- **BPF:**IT is band pass signal which limits the frequency band of BPSK.

c) State different frequency bands used for satellite communication with their uplink and downlink frequencies.

Ans:- **(any4,1mark each)**

Frequency Band	Uplink Frequency In Ghz	Down Link Frequency In Ghz
UHF	.292 to .312	.25 to .27
S band	3.2-3.7	1.8-2.3
C-band	5.9-6.4	3.7-4.2
X-band	7.9-8.4	7.25-7.75
Ku-band	14-14.5	11.7-12.2
Ka band (commercial)	27-30	17-20
Ka band(military)	30-31	20-1
V-band	50-51	41-41

d) Define Acceptance angle and Numerical aperture with reference to optical fiber communication.

Ans:- **(2M each definition)**

Acceptance angle:

The maximum value of incident angle for which the incident light can propagate through the fiber to the far end is called the acceptance angle.

Numerical Aperture:

This parameter determines the quantity of light coupled from source to fiber from various angles

OR

Numerical Aperture represents a figure of merit used to find light gathering capability of fiber from various angles

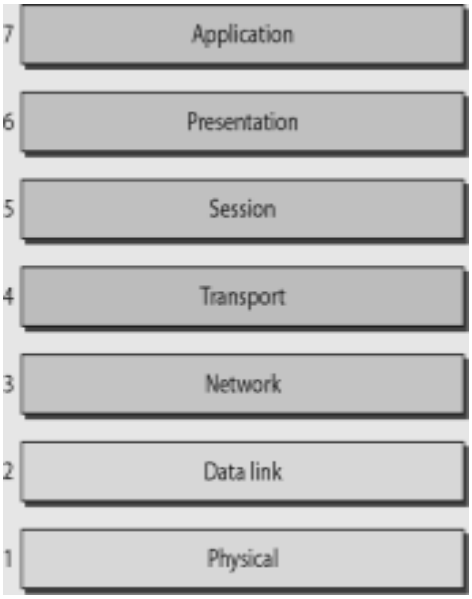
e) Draw neat architecture of OSI model and state function of router in networking

Ans:- **(3 M model diagram, function of router 1 M)**

Router:

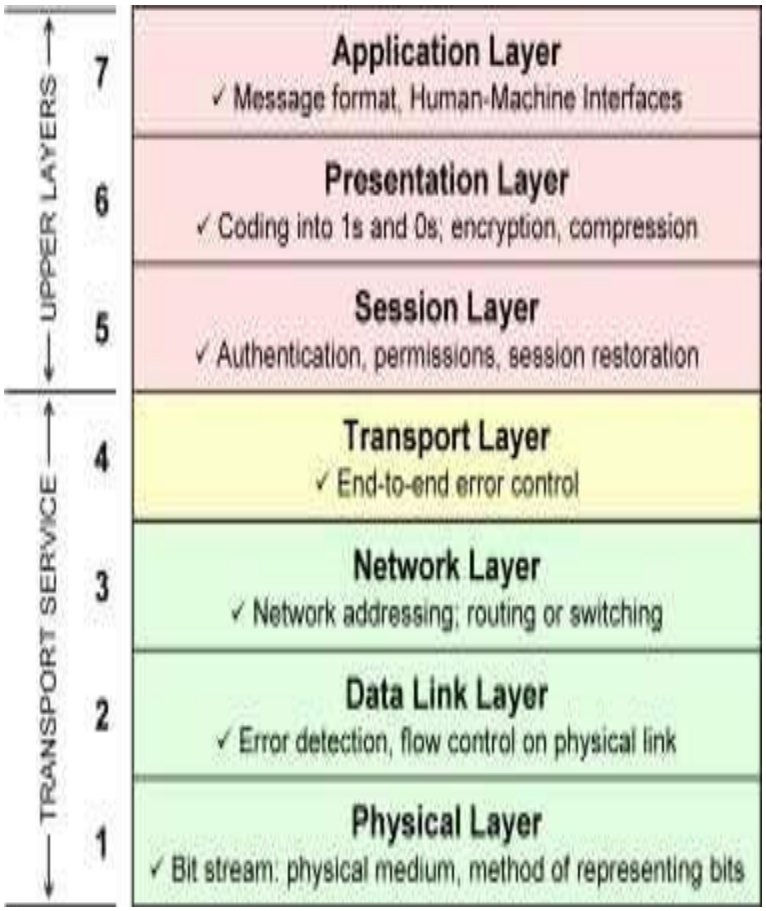
A device that connects any number of LANs. Routers use headers and a forwarding table to determine where packets go, and they use ICMP to communicate with each other and configure the best route between any two hosts. Very little filtering of data is done through routers. Routers do not care about the type of data they handle.

OSI model:-



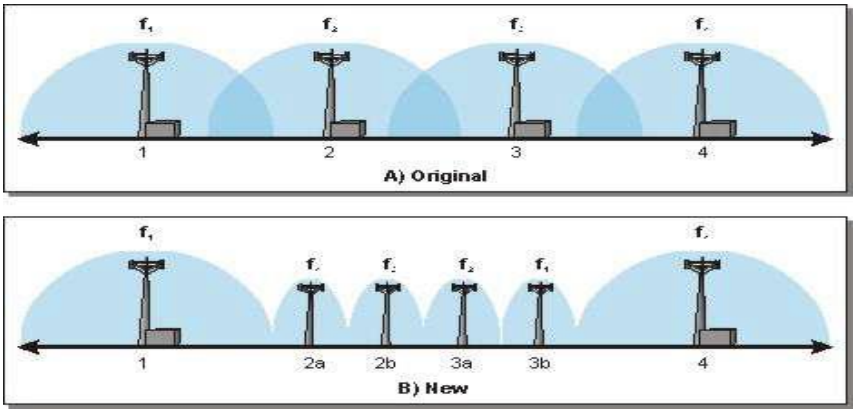
OR

OSI model:-



f) Describe cell splitting technique with proper cell diagrams used in mobile communication.
Ans:- **[2mark explanation 2mark diagram]**

Cell Splitting:
Cell splitting is the process of dividing the radio coverage of a cell site in a wireless telephone system into two or more new cell sites. Cell splitting may be performed to provide additional capacity within the region of the original cell site.



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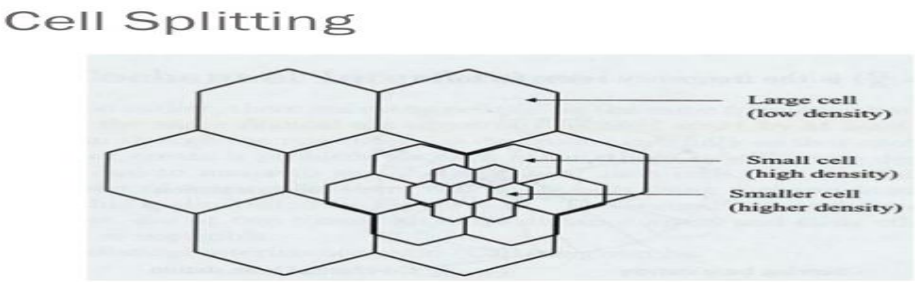

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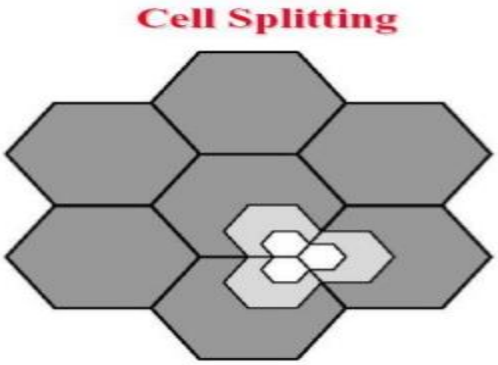


[Note :- Any other relevant diagram can be considered.]

- This diagram shows the process of cell splitting that is used to expand the capacity (number of channels) of a mobile communication system.
- In this example, the radio coverage area of large cells sites are split by adjusting the power level and/or using reduced antenna height to cover a reduced area.
- Reducing the radio coverage area of a cell site by changing the RF boundaries of a cell site has the same effect as placing cells farther apart, and allows new cell sites to be added.

Q5 Attempt any FOUR : 16M

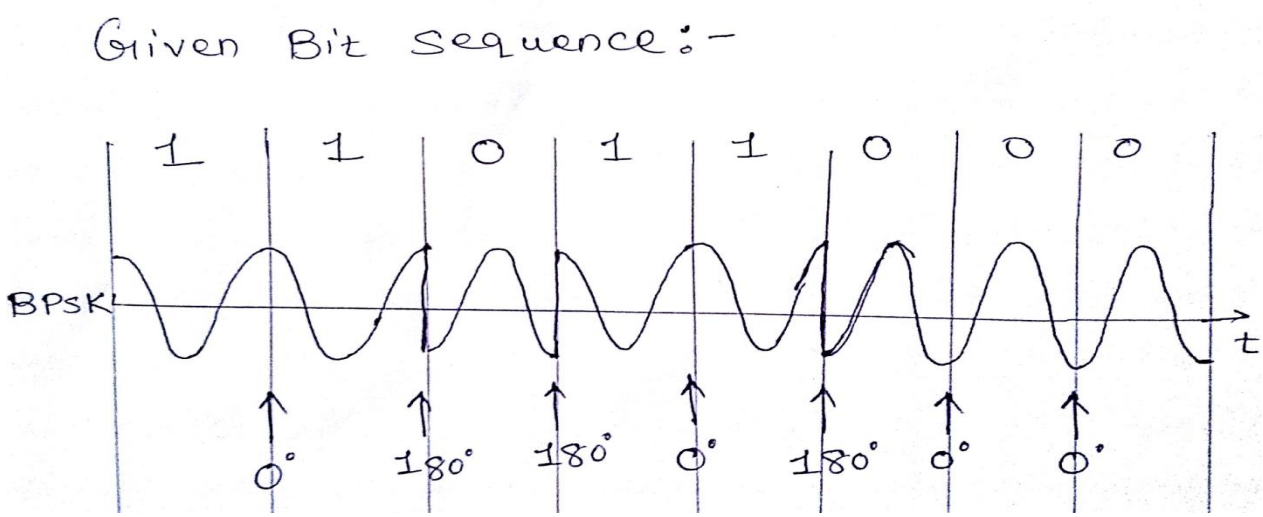
a) Compare PCM and DM on the basis of
i. Number of bits per sample
ii. Distortions/errors
iii. Bandwidth
iv. Feedback from output

Ans: 1M each

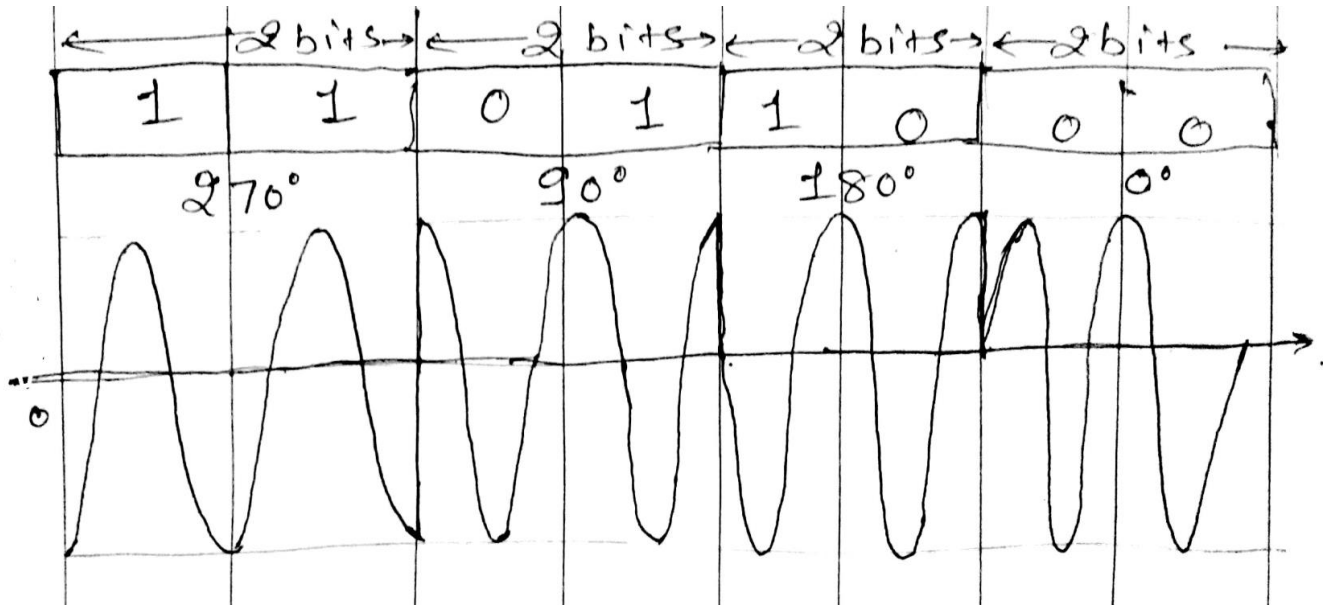
SR.NO	PARAMETERS	PCM	DM
1	Number of bits per sample	N can be 4, 8, 16, 32, 64 etc.	N= 1
2	Distortions/errors	Quantization error	Slope generated and granular noise
3	Bandwidth	Highest	Low, if the input is slow varying
4	Feedback from output	No feedback	Feedback is present

b) Draw BPSK and QPSK waveforms for bit sequence 11011000.

Ans:
BPSK waveform: 2M



QPSK Waveform: **2M**



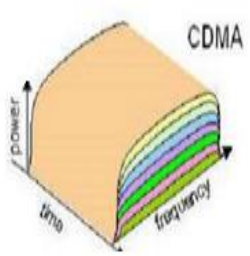
c) With neat diagram describe CDMA and state two advantages of it.

Ans:

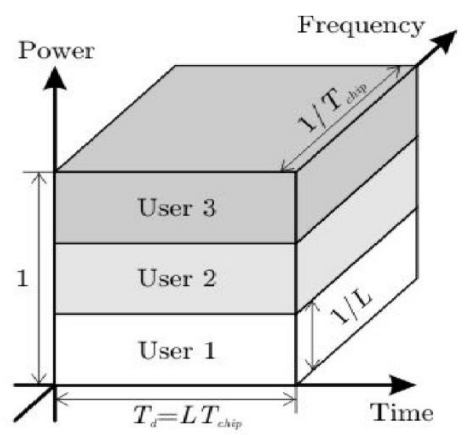
CDMA: **1M**

- There is no restriction of time and frequency in this method.
- All the users can transmit at all times and all frequencies.
- Because users are isolated by code, they can share same carrier frequency, eliminating the frequency reuse problem encountered in other technologies.
- With CDMA, unlike other cellular telephone standards, subscriber data change in real time, depending on voice activity and requirements of the network and other users of the network.

Diagram: **1M**



OR



CDMA

Advantages: (Any two) **1M each**

- Dropouts occur only when the phone is at least twice as far from the base station.
- It has a very high spectral capacity that it can accommodate more users per MHz of bandwidth.
- Efficient practical utilization of fixed frequency spectrum.
- Flexible allocation of resources.
- Many users of CDMA use the same frequency, TDD or FDD may be used
- Multipath fading may be substantially reduced because of large signal bandwidth
- No absolute limit on the number of users, Easy addition of more users.
- Impossible for hackers to decipher the code sent
- Better signal quality
- No sense of handoff when changing cells

d) List different types of network connecting devices and state functions of repeaters, bridges.
Ans:
List of different network connecting devices: **2M**

- Repeater
- Hub
- Bridge
- Routers
- Switch
- Gateways

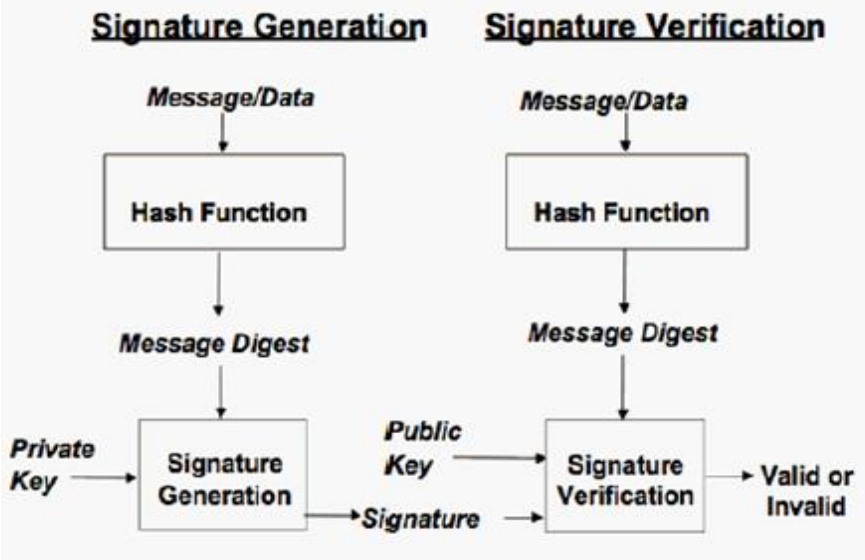
BRIDGE: **1M**
A device that connects two local-area networks (LANs), or two segments of the same LAN. The two LANs being connected can be alike or dissimilar. For example, a bridge can connect an Ethernet with a Token-Ring network. Unlike routers, bridges are protocol -independent. They simply forward packets without analyzing and re-routing messages. Consequently, they're faster than routers, but also less versatile

REPEATER: **1M**
A network device used to regenerate or replicate a signal. Repeaters are used in transmission systems to regenerate analog or digital signals distorted by transmission loss. Analog repeaters frequently can only amplify the signal while digital repeaters can reconstruct a signal to near its original quality. In a data network, a repeater can relay messages between sub networks that use different protocols or cable types. Hubs can operate as repeaters by relaying messages to all connected computers. A repeater cannot do the intelligent routing performed by bridges and routers.

e) Describe digital signature with reference to network security.
Ans:
Digital Signature :- **4M**

- It is signing of a document electronically. When we send a document electronically, we can also sign it. There are two choices:
  (i) One can sign entire document.
  (ii) One can sign a digest. (condensed version of document)

- In the digital signature a private key is used for encryption and the public key is used for decryption. The sender uses private key to encrypt (sign) the message just as person uses own signature to sign a paper document. The receiver on the other hand uses the public key of the sender to decrypt the message just as the person verifies from memory another person's signature. This is possible because the encryption and decryption algorithm are used. e.g. RSA. In Message authentication the receiver needs to be sure of sender's identity and that an imposter has not send the message. Entity authentication is a technique designed to let one party prove the identity of another party. Entity can be a person, process or server.



f) Compare LAN and WAN on the basis of
i. Principle
ii. Propagation delay
iii. Bandwidth
iv. Communication medium

Ans: **1M each**

SR NO	PARAMETERS	LAN	WAN
1	Principle	LAN (Local Area Network) is a computer network covering a small geographic area, like a home, office, school, or group of buildings.	WAN (Wide Area Network) is a computer network that covers a broad area (e.g., any network whose communications links cross metropolitan, regional, or national boundaries over a long distance).
2	Propagation delay	High speed (1000 mbps)	Less speed (150 mbps)
3	Bandwidth	High bandwidth is available for transmission.	Low bandwidth is available for transmission.

4	Communication medium	One LAN can be connected to other LANs over any distance via telephone lines and radio waves.	Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites.

Q6. Attempt any FOUR **16M**

(a) What is slope overload distortion in DM? How it is minimized in ADM? Show with appropriate waveforms.

Ans:

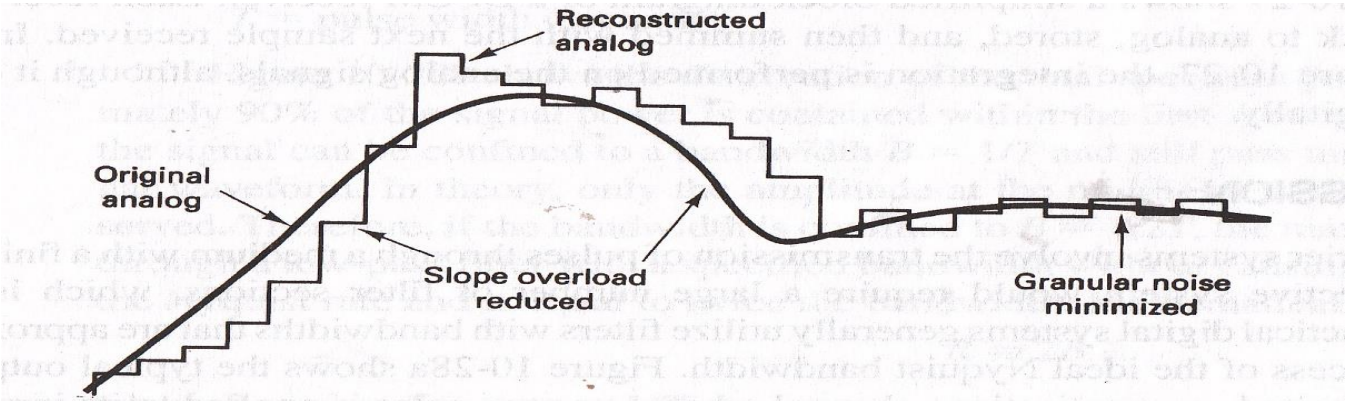
Slope Overload: **1M**

- When the analog input signal changes at faster rate, the slope of analog signal is greater than the delta modulator can maintain and is called slope overload.
- Using Adaptive delta modulation or continuously variable slope delta modulation (CVSD) is a modification of DM in which the step size is not fixed. Rather, when several consecutive bits have the same direction value, the encoder and decoder assume that slope overload is occurring, and the step size becomes progressively larger.

Minimization in ADM: **1M**

- Otherwise, the step size becomes gradually smaller over time. ADM reduces slope error, at the expense of increasing quantizing error. This error can be reduced by using a low pass filter. ADM provides robust performance in the presence of bit errors meaning error detection and correction are not typically used in an ADM radio design, this allows for a reduction in host processor workload (allowing a low-cost processor to be used)

Waveform: **2M**



(b) Draw block diagram of fiber optic communication system and give two advantages.

Ans: **(Block diagram- 2M, advantages- 2 M)**

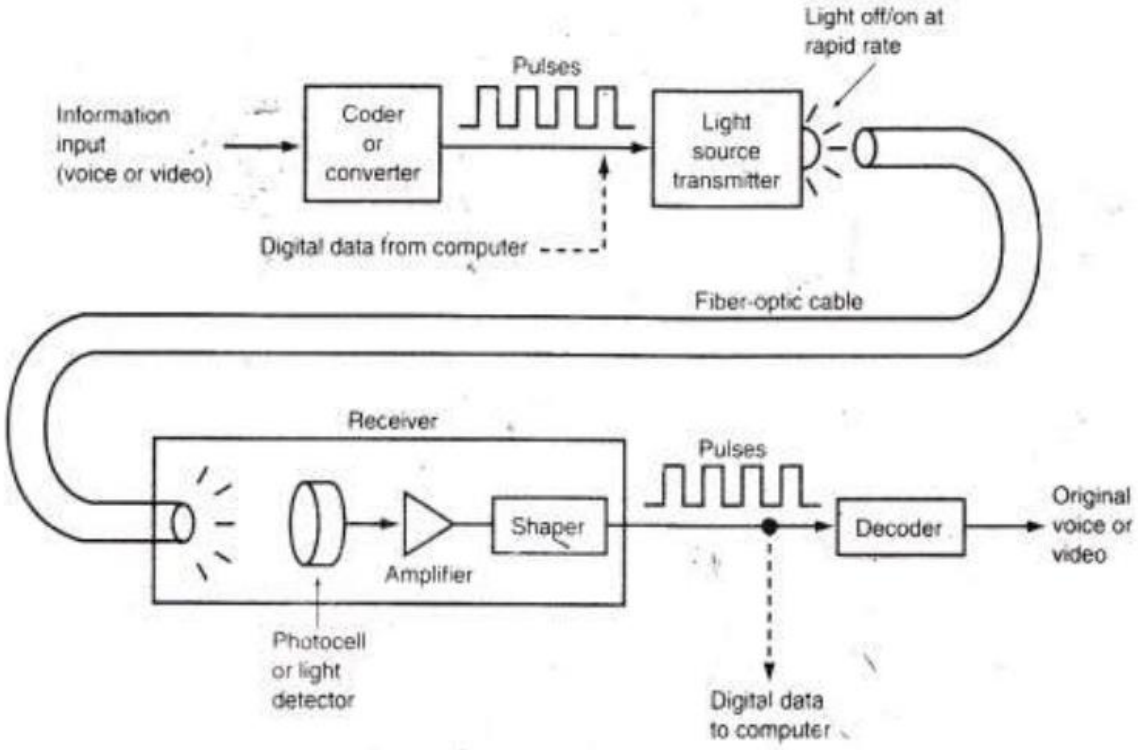


Fig. Optical fiber communication system

Advantages(Any two)

- High Bandwidth
- Light weight and small diameter
- Low Losses
- Less number of repeaters
- Immune to electromagnetic interference
- High degree of data security
- Noise is comparatively less in optical communication
- Lower attenuation
- Transmission cost per bit is low
- Controlled dispersion gives low error rate

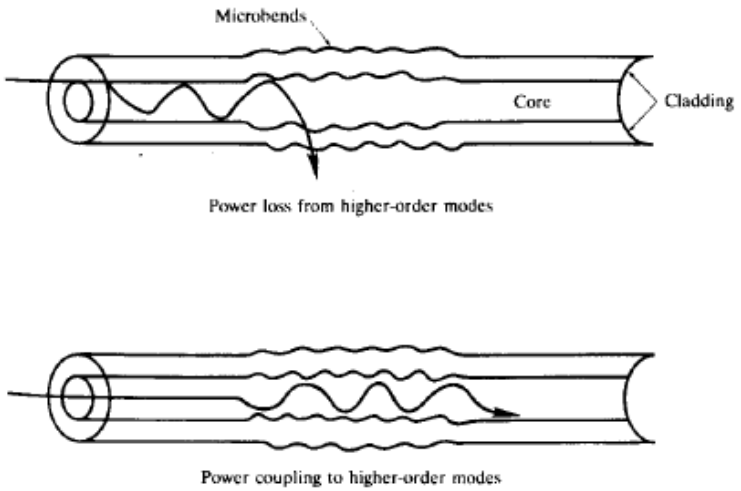
(c) Describe losses in optical fiber due to bending.

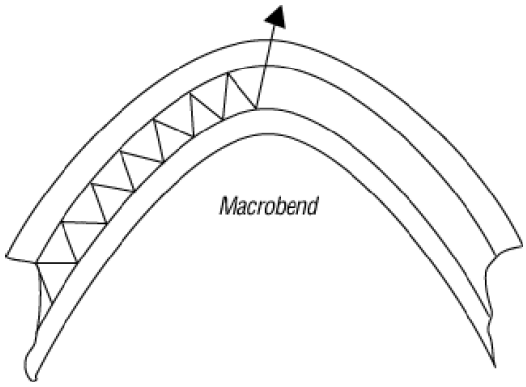
Ans:

- Losses due to bending are two types:

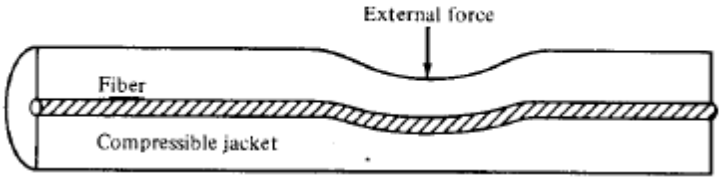
Macro bends and Macro bends (constant radius bends).

Macrobending losses: **2M**





- Fiber subjected to macroscopic bend having radii large as compared to the fiber diameter (Eg: when a fiber cable turns a corner results in large curvature radiation losses called as **macro- bending** losses. It is the bend in the entire cable which causes certain modes not to be reflected and therefore causes loss to the cladding. In a typical fiber cable, it is around 0.5dB per bending and fiber bending shall be kept minimum.
- The macro-bending loss can be taken care by properly laying the cable in duct or plastic pipes so that macro-bending is within limits as specified by the manufacturer.



Microbending: **2M**

- It is due to imperfection in the geometry of the fiber such as core-cladding irregularities, bubbles, diameter fluctuations and axis misalignment. Sometimes microbending arises from external influences such as mechanical stress caused by pressure, tension or twist. Scattering losses due to these mechanisms are called microbending losses.
- These losses can be reduced by increasing the index difference between core-cladding or by careful

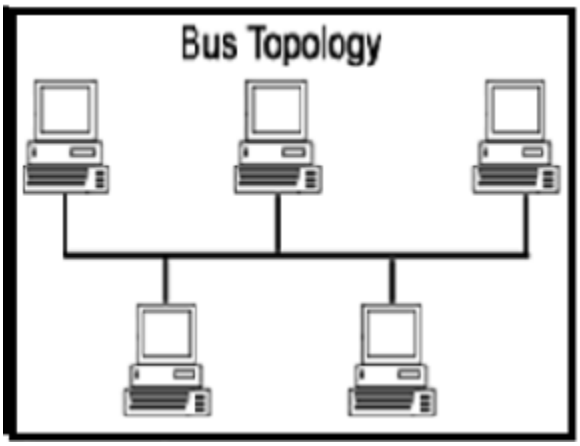
fiber drawing and cabling or by using compressable jackets for cabling.

(d) State any four network topologies with proper diagram.

Ans: **1M each**

BUS Topology:

Bus topology is a network type in which every computer and network device is connected to single cable. When it has exactly two endpoints, then it is called **Linear Bus topology**.



RING Topology:

It is called ring topology because it forms a ring as each computer is connected to another computer, with the last one connected to the first.

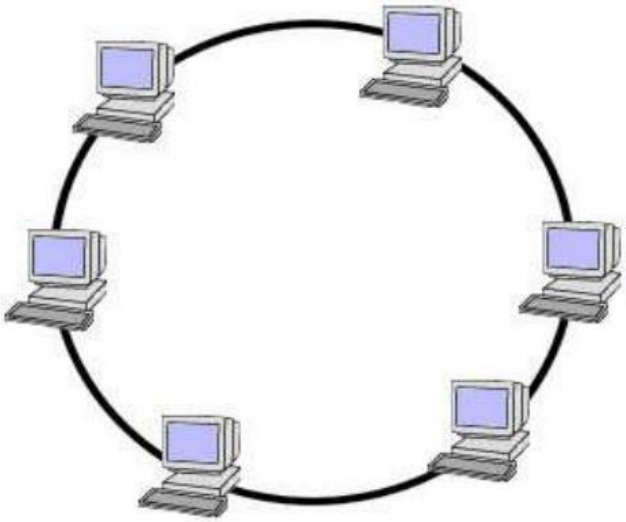
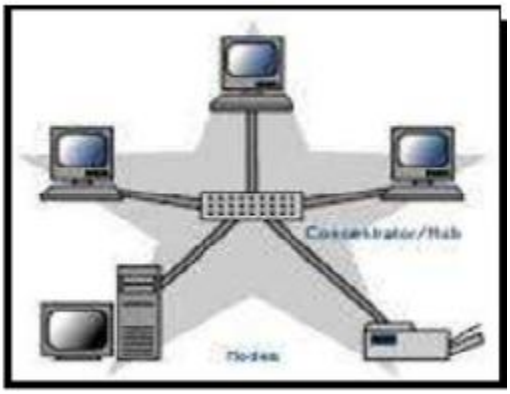


Fig. Ring Topology

STAR Topology:

In this type of topology all the computers are connected to a single hub through a cable. This hub is the central node and all others nodes are connected to the central node.



MESH Topology:

It is a point-to-point connection to other nodes or devices. All the network nodes are connected to each other.

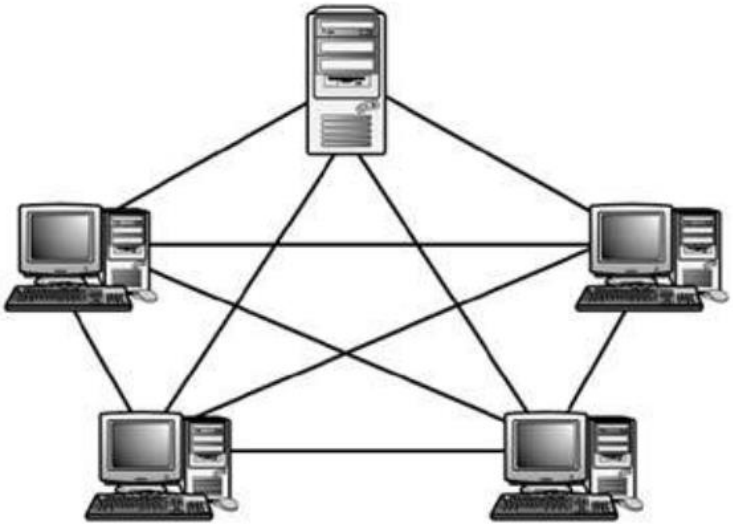
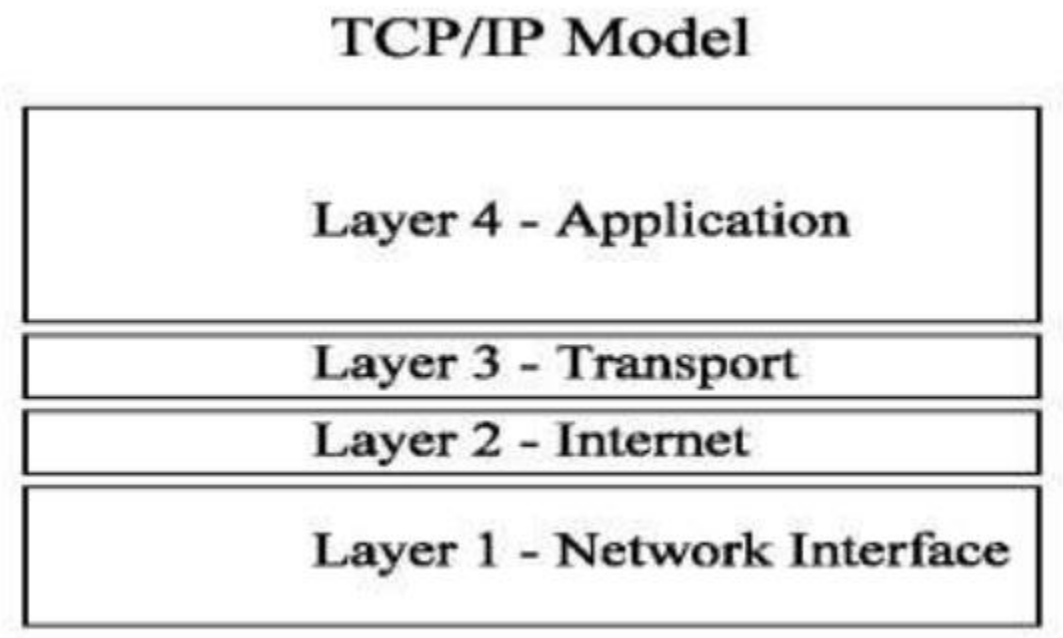


Fig.Mesh topology

(e) Draw TCP/IP model and state function of any two layers.

Ans: **(Diagram 2 M, function 1M each)**



Functions: ***(any two Layer)***

Layer 1. Network Interface

Network Access Layer is the first layer of the four layer TCP/IP model. Network Access Layer defines details of how data is physically sent through the network, including how bits are electrically or optically signaled by hardware devices that interface directly with a network medium, such as coaxial cable, optical fiber, or twisted pair copper wire.

Layer 2. Internet Layer

Internet Layer is the second layer of the four layer TCP/IP model. The position of Internet layer is between Network Access Layer and Transport layer. Internet layer pack data into data packets known as IP datagrams, which contain source and destination address (logical address or IP address) information that is usedto forward the datagrams between hosts and across networks. The Internet layer is also responsible for routingof IP datagrams.

Layer 3. Transport Layer

Transport Layer is the third layer of the four layer TCP/IP model. The position of the Transport layer is between Application layer and Internet layer. The purpose of Transport layer is to permit devices on the

source and destination hosts to carry on a conversation. Transport layer defines the level of service and status of the connection used when transporting data.The main protocols included at Transport layer are TCP (Transmission Control Protocol)and UDP (User
Datagram Protocol).

Layer 4. Application Layer

Application layer is the top most layer of four layer TCP/IP model. Application layer is present on the top of the Transport layer. Application layer defines TCP/IP application protocols and how host programs interface with Transport layer services to use the network.

Application layer includes all the higher-level protocols like DNS (Domain Naming System), HTTP (Hypertext Transfer Protocol), Telnet, SSH, FTP (File Transfer Protocol), TFTP (Trivial File Transfer Protocol), SNMP(Simple Network Management Protocol), SMTP (Simple Mail Transfer Protocol) , DHCP (Dynamic Host Configuration Protocol), X Windows, RDP (Remote Desktop Protocol) etc.

(f) Distinguish between FDMA and CDMA on the basis of

(i) Bandwidth

(ii) Synchronization

(iii) Guard band

(iv) Interference

Ans: **1M Each**

SR. NO	PARAMETER	FDMA	CDMA
1	Bandwidth	Sharing of overall bandwidth of satellite transponder.	
2	Synchronization	No synchronization is required.	No synchronization is required.
3	Guard band	Guard bands are required.	Guard bands are required.
4	Interference	Adjacent frequency and interference generated because of nonlinearity of satellite transponder amplifier.	Performance is affected because of adjacent time and frequency slots. But due to frequency hopping the effect is less.