WINTER – 2023 EXAMINATION
MODEL ANSWER

Subject: Data Communication & Computer Network **Subject Code:** **22414**

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 anyequivalent 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.
8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q. No	Sub Q.N.	Answer	Marking Scheme
1.	**a)** **Ans.**	**Attempt any FIVE of the following:** **List advantages of Computer Network (any two)** 1. Convenient resource sharing 2. Connectivity 3. Security 4. Easy File/Data Sharing 5. Highly Flexible 6. Reduced cost 7. Great storage capacity	**10** **2M** ***Any two advantages 1M each***
	b)	**Draw process of Data Communication**	**2M**

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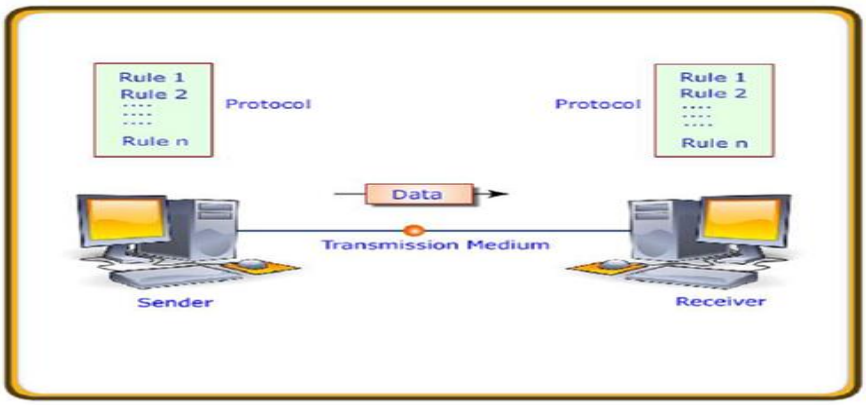
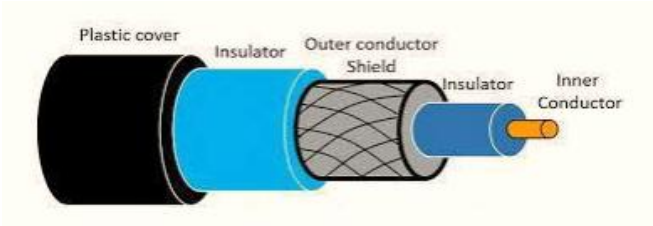
	Ans.		***Correct labelled diagram 2M***
	c) Ans.	**List Networking Topologies** The structure of a network including physical arrangement of devices is called topology. Topologies are of following types: 1. Mesh Topology 2. Star Topology 3. Bus Topology 4. Ring Topology 5. Hybrid Topology 6. Tree Topology	**2M** ***Listing any four topologies 2M***
	d) Ans.	**State types of errors** In Communication system any distortion of transmitted signal before reaching its destination is called **Error.** **Errors can be of 2 types** **1. Content errors** • Single-Bit Error • Burst Error **2. Flow Integrity Errors**	**2M** ***Each type 1M***
	e) Ans.	**Draw a neat labelled diagram of co-axial cable** 	**2M** ***Correct labelled diagram 2M***

f) Ans. **Compare LRC and VRC** — **2M**

Any two valid differences 1M each

S. No.	Vertical Redundancy Check (VRC)	Longitudinal Redundancy Check (LRC)
1.	In this redundant bit called parity bit is added to each data unit.	In this redundant row of bits is added to the whole block.
2.	VRC can detect single bit errors.	LRC can detect burst errors.
3.	It is not capable of checking the burst error in case of change of bits is even.	If two bits in data unit are damaged and also in other data unit the same bits are damaged at same position, then it is not capable of detecting such kind of error.
4.	It is also known as parity checker.	It is also known as 2-D parity checker.
5.	The advantage of using VRC is that it can checks all single bit errors but can check odd parity only in the case of change of odd bits.	The advantage of using LRC over VRC is that it can check all the burst errors.

g) Ans. **List any four networking connecting devices** — **2M**

Listing Any four devices 2M

Followings are the Network Control/Connecting device:

1. Repeater
2. Hub
3. Switch
4. Bridge
5. Router
6. Gateway
7. Modem

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2. **a) Ans.** **Attempt any THREE of the following:** **12**

Compare client server and peer to peer networks ***4M Any four points 1M each***

Basis of Comparison	**Client-Server Network**	**Peer-to-Peer Network**
Basic	In a client-server network, certain computers act as server and other act as clients.	In a peer-to-peer network, every node act as a client and server.
Expense	A Client-Server network is more expensive to implement.	A Peer-to-Peer is less expensive to implement.
Stability	It is more stable and scalable tha n a peer-to-peer network.	It is less stable and scalable, if the number of peers increases in the system.
Data	In a client-server network, the data is stored in a centralized server.	In a peer-to-peer network, each peer has its own data.
Server	A server may get overloaded when many clients make simultaneous service requests.	A server is not bottlenecked since the services are dispersed among numerous servers using a peer-to-peer network.
Focus	Sharing the information.	Connectivity.
Service	The server provides the requested service in response to the client's request.	Each node has the ability to both request and delivers services.
Performance	Because the server does the bulk of the work, performance is unaffected by the growth of clients.	Because resources are shared in a big peer-to-peer network, performance will likely to suffer.
Security	A Client-Server network is a secured network because the server can verify a client's access to any area of the network, making it secure.	The network's security deteriorates, and its susceptibility grows as the number of peers rises.

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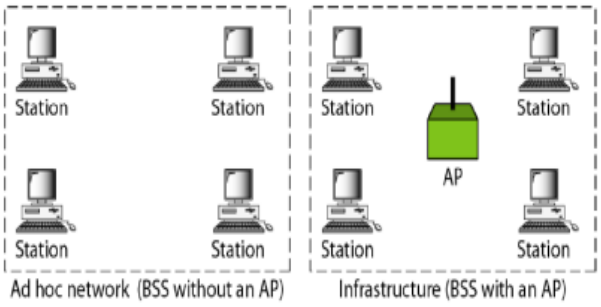
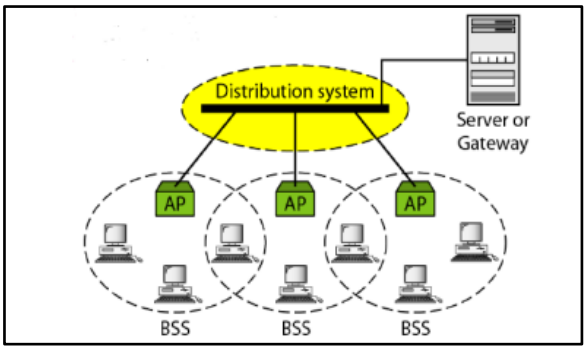
	b) **Ans.**	**Draw a neat labeled diagram of Twisted Pair Cable and state its types.** A twisted pair cable comprises of two separate insulated copper wires, which are twisted together and run in parallel, as shown in following fig:  One of the wires is used to carry signals to the receiver and the other is used only as ground reference. There are two type of twisted pair cable: **1. Unshielded Twisted Pair (UTP)** 2. **Shielded Twisted Pair (STP)**	**4M** ***3M for correct labeled diagram,*** ***1M for types***
	c) **Ans.**	**Explain wireless LAN 802.11 architecture.** IEEE has defined the specifications for a wireless LAN, called IEEE 802.11, which covers the physical and data link layers. **IEEE 802.11 defines two types of services which are** 1) Basic Service Set (BSS) 2) Extended Service Set (ESS) **1) Basic Service Set (BSS)** IEEE 802.11 defines the basic service set (BSS) as the building block of a wireless LAN. A basic service set is made of stationary or mobile wireless stations and an optional central base station, known as the access point (AP). Figure shows two sets in this standard. The BSS without an AP is a stand-alone network is called an ad hoc architecture. A BSS with an AP is referred to as an infrastructure network  	**4M** ***2M for BSS explanation with diagram,*** ***2M for ESS explanation with diagram***

		2) Extended Service Set (ESS) An extended service set (ESS) is made up of two or more BSSs with APs. In this case, the BSSs are connected through a distribution system, which is usually a wired LAN. The distribution system connects the APs in the BSSs. Note that the extended service set uses two types of stations: mobile and stationary. The mobile stations are normal stations inside a BSS. The stationary stations are AP stations that are part of a wired LAN. Figure shows an ESS.  **Extended service set (ESS)** When BSSs are connected, the stations within reach of one another can communicate without the use of an AP. However, communication between two stations in two different BSSs usually occurs via two APs.	
	d) Ans.	**Explain OSI reference model in detail.** OSI model (Open System Interconnection) model was developed by ISO (international standard organization) which provides way to understand how internetwork operates. It gives guidelines for creating network standard. OSI model has 7 layers as shown in the figure. Application Presentation Session Transport Network Data Link Physical	**4M** ***Explanation 3M*** ***Diagram 1M***

		Physical Layer: OSI Model, Layer 1 conveys the bit stream - electrical impulse, light or radio signal — through the network at the electrical and mechanical level. It provides the hardware means of sending and receiving data on a carrier, including defining cables, cards and physical aspects. **Data Link Layer:** At OSI Model, Layer 2, data packets are encoded and decoded into bits. It furnishes transmission protocol knowledge and management and handles errors in the physical layer, flow control and frame synchronization.. **Network Layer: Layer 3** provides switching and routing technologies, creating logical paths, known as virtual circuits, for transmitting data from node to node. Routing and forwarding are functions of this layer, as well as addressing, internetworking, error handling, congestion control and packet sequencing. **Transport Layer:** This Layer, provides transparent transfer of data between end systems, or hosts, and is responsible for end-to-end error recovery and flow control. It ensures complete data transfer from source to destination. **Session Layer**: This layer establishes, manages and terminates connections between applications. The session layer sets up, coordinates, and terminates conversations, exchanges, and dialogues between the applications at each end. It deals with session and connection coordination **Presentation Layer**: This layer provides independence from differences in data representation (e.g., encryption) by translating from application to network format, and vice versa. The presentation layer works to transform data into the form that the application layer can accept. This layer formats and encrypts data to be sent across a network, providing freedom from compatibility problems. It is sometimes called the syntax & semantics. **Application Layer**: This Layer, supports application and end-user processes. Everything at this layer is application-specific. This layer provides application services for file	

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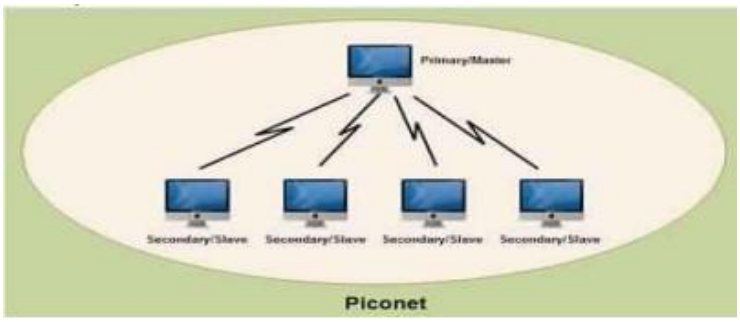
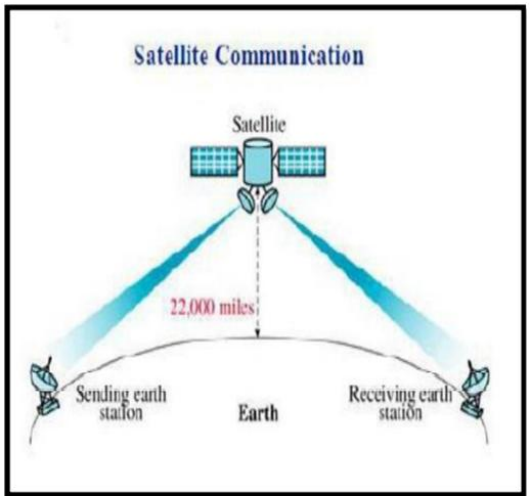
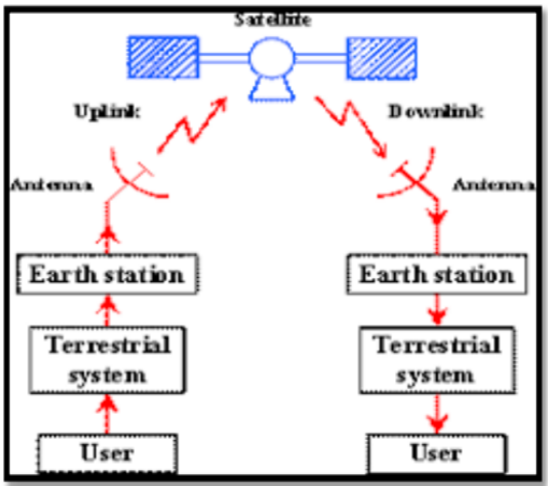
3.	**a) Ans.**	**Attempt any THREE of the following:** **Draw and explain piconet Bluetooth architecture** **Piconet** • Piconet is a Bluetooth network that consists of one primary (master) node and seven active secondary (slave) nodes. • Thus, piconet can have up to eight active nodes (1 master and 7 slaves) or stations within the distance of 10 meters. • There can be only one primary or master station in each piconet. • The communication between the primary and the secondary can be one-to-one or one-to-many.  • All communication is between master and a slave. Salve-slave communication is not possible. • In addition to seven active slave station, a piconet can have upto 255 parked nodes. These parked nodes are secondary or slave stations and cannot take part in communication until it is moved from parked state to active state. • If slave is not communicating for a certain period of time then they can be set to in active mode so that it enters in low power state. In order to save the power because Normally these Bluetooth devices takes power from batteries.	**12** **4M** ***Explanation 2M*** ***Diagram 2M***
	b) Ans.	**Explain satellite communication with the help of neat diagram** 1. Satellite is a natural /man-made system which is kept in continuous rotation around the earth in a specific orbit at a specific height above the earth and with specific speed. **2.** In satellite communication, signal transferring between the sender and receiver is done with the help of satellite. **3.** In this process, the signal which is basically a beam of modulated microwaves is sent towards the satellite called UPLINK (6 GHz).	**4M** ***Explanation 2M*** ***Diagram 2M***

		4. Then the satellite amplifies the signal and sent it back to the receiver's antenna present on the earth's surface called as DOWNLINK (4Ghz), as shown in the diagram given   As the entire signal transferring is happening in space. Thus, this type of communication is known as space communication. The satellite does the functions of an antenna and the repeater together	
	c)	**Compare circuit-switching and packet-switching, consider following parameter orientation, flexibility, technology and layers**	**4M**

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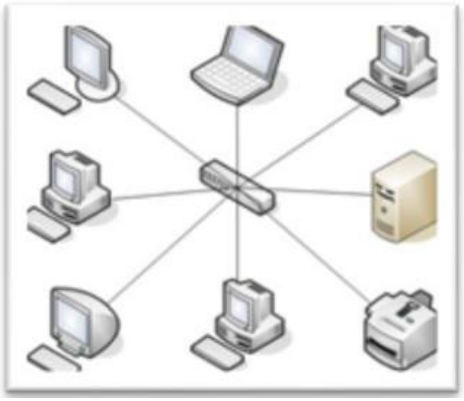
	Ans.		***Each comparison parameter 1M***

Parameter	Circuit-switching	Packet-switching
orientation	Connection oriented.	Connectionless.
flexibility	Inflexible, because once a path is set all parts of a transmission follows the same path.	Flexible, because a route is created for each packet to travel to the destination.
technology	Circuit switching can be achieved using two technologies, either Space Division Switching or Time-Division Switching.	Packet Switching has two approaches Datagram Approach and Virtual Circuit Approach.
layers	Circuit Switching is implemented at Physical Layer.	Packet Switching is implemented at Network Layer.

	d) Ans.	**Explain the function of presentation layer and network layer** **Functions of Presentation layer:** **Translation**: The processes in two systems exchange the information in the form of character strings, numbers and so on. Different computers use different encoding methods, the presentation layer handles the interoperability between the different encoding methods. It converts the data from sender-dependent format into a common format and changes the common format into receiver-dependent format at the receiving end. **Encryption**: Encryption is needed to maintain privacy. Encryption is a process of converting the sender-transmitted information into another form and sends the resulting message over the network. **Compression**: Data compression is a process of compressing the data, i.e., it reduces the number of bits to be transmitted. Data compression is very important in multimedia such as text, audio, video. **Functions of Network Layer:** **Internetworking**: An internetworking is the main responsibility of the network layer. It provides a logical connection between different devices.	**4M** ***Explanation of Each layer 2M***

		Addressing: A Network layer adds the source and destination address to the header of the frame. Addressing is used to identify the device on the internet. **Routing**: Routing is the major component of the network layer, and it determines the best optimal path out of the multiple paths from source to the destination. **Packetizing**: A Network Layer receives the packets from the upper layer and converts them into packets. This process is known as Packetizing. It is achieved by internet protocol (IP).	
4.	**a)** **Ans.**	**Attempt any <u>THREE</u> of the following:** **With suitable diagram Describe** **i) STAR Topology** **ii) RING Topology** **i) STAR Topology** Star topology is a network topology where each individual piece of a network is attached to a central node (often called a hub or switch). The attachment of these network pieces to the central component is visually represented in a form similar to a star. The hub and hosts, and the transmission lines between them, form a graph with the topology of a star. Data on a star network passes through the hub before continuing to its destination. The hub manages and controls all functions of the network. It also acts as a repeater for the data flow.  **Fig: Star Topology** The star network is one of the most common computer network topologies.	**12** **4M** ***Each description with diagram 2M***

ii) RING Topology

A ring network is a network topology in which each node connects to exactly two other nodes, forming a single continuous pathway for signals through each node - a ring. Data travels from node to node, with each node along the way handling every packet.

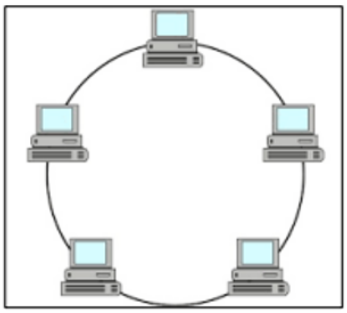


Fig: Ring topology

Ring topology refers to a specific kind of network setup in which devices are connected in a ring and pass information to or from each other according to their adjacent proximity in the ring structure.

b) Ans. **Describe the various IP address classes with suitable example** — **4M**

1M for diagram.

2M for explanation

1M for example

An IP address is a unique address that identifies a device on the internet or a local network. IP stands for "Internet Protocol," which is the set of rules governing the format of data sent via the internet or local network.

There are different types of IP Address classes Class A, Class B, Class C, Class D, Class E.

Class A :

1	2	3	4	5	6	7	8	2nd Byte	3rd Byte	4th Byte
0	Network ID							Host ID	Host ID	Host ID

In this, the first bit is ‘0’. The next 7 bits are used indicate network id. Rest of the 3 bytes are used to indicate host id. Thus the First Byte in Class A type of IP address will have a range from 0 to 126.

Example : 10.1.2.1 In this, the first byte ‘10’ has first bit 0, and hence it belongs to class A IP address.

Class B :
Class B IP address format is given below:

1	2	3	4	5	6	7	8	2nd Byte	3rd Byte	4th Byte
1	0	Network ID						Network ID	Host ID	Host ID

In this, the first two bits are '1 0'. The next 14 bits are used indicate network id. Rest of the 2 bytes are used to indicate host id. Thus, the first byte of class B type of IP address has a range from 128 to 191.
Example : 187.4.5.1
In this address, the first byte '187' has first two bits as 10.

Class C :
Class C IP address format is given below:

1	2	3	4	5	6	7	8	2nd Byte	3rd Byte	4th Byte
1	1	0	Network ID					Network ID	Network ID	Host ID

In this, the first three bits are '1 1 0'. The next 21 bits are used indicate network id. Rest of the One byte is used to indicate host id. Thus the first byte of the IP address in class C has range from 192 to 223.
Example : 192.168.1.2
In this the first three bits are 110, which represents the Class C type IP address.

Class D:
Class D IP address format is given below:

1	2	3	4	5	6	7	8	2nd Byte	3rd Byte	4th Byte
1	1	1	0	Multicast Address						

If first 4 bits are '1 1 1 0' the IP address belongs to class D. The IPv4 networking standard defines Class D addresses as reserved for multicast. Multicast is a mechanism for defining groups of nodes and sending IP messages to that group rather than to every node on the

LAN (broadcast) or just one other node (unicast). Multicast is mainly used on research networks. As with Class E, Class D addresses should not be used by ordinary nodes on the Internet. The range for first byte of class D starts from 224 till 239.
Example: 225.25.2.1
Here, the first 4 bits are 1110

Class E:
Class E IP address format is given below:

1	2	3	4	5	6	7	8	2nd Byte	3rd Byte	4th Byte
1	1	1	1	0	Reserved for future use					

If first 5 bits are '1 1 1 1 0' the IP address belongs to class E. For class E minimum value for reserved address is 240.0.0.0 to 255.255.255.255. These are used for research work in IP addresses.
Example: 245.5.6.2 Here, the first 5 bits are 11110.

c) Ans. **Describe multiplexing techniques** — **4M**

Multiplexing is a technique by which different analog and digital streams of transmission can be simultaneously processed over a shared link. Multiplexing divides the high capacity medium into low-capacity logical medium which is then shared by different streams. Communication is possible over the air (radio frequency), using a physical media (cable), and light (optical fiber). All mediums are capable of multiplexing. When multiple senders try to send over a single medium, a device called Multiplexer divides the physical channel and allocates one to each. On the other end of communication, a De-multiplexer receives data from a single medium, identifies each, and sends to different receivers.

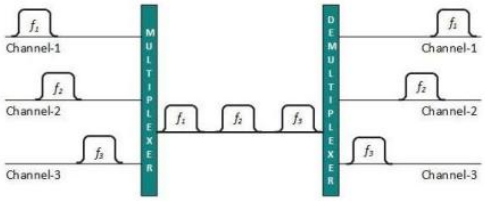
Different multiplexing techniques are

1. Frequency Division multiplexing
2. Time division multiplexing

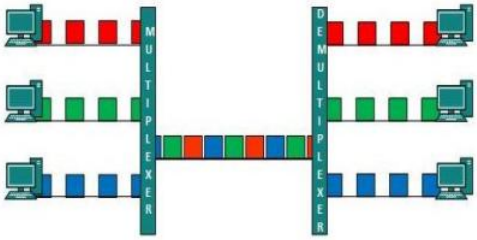
Explanation of multiplexing- 2M

Each technique 1M each

Frequency Division Multiplexing: When the carrier is frequency, FDM is used. FDM is an analog technology. FDM divides the spectrum or carrier bandwidth in logical channels and allocates one user to each channel. Each user can use the channel frequency independently and has exclusive access of it. All channels are divided in such a way that they do not overlap with each other. Channels are separated by guard bands. Guard band is a frequency which is not used by either channel.



Time Division Multiplexing: TDM is applied primarily on digital signals but can be applied on analog signals as well. In TDM the shared channel is divided among its user by means of time slot. Each user can transmit data within the provided time slot only. Digital signals are divided in frames, equivalent to time slot i.e. frame of an optimal size which can be transmitted in given time slot.



When channel A transmits its frame at one end, the De-multiplexer provides media to channel A on the other end. As soon as the channel A's time slot expires, this side switches to channel B. On the other end, the De-multiplexer works in a synchronized manner and provides media to channel B. Signals from different channels travel the path in interleaved manner.

d) Ans. **Compare IPV4 and IPV6 packet format** — **4M**

Any four comparisons 1M each

IPV4	IPV6
Source and destination addresses are 32 bits (4 bytes) in length.	Source and destination addresses are 128Bits (16 bytes) in length.
No. addresses are limited to number of bits (32 bits)	Larger addressing area
Uses broadcast addresses to send traffic to all nodes on a subnet.	There are no IPv6 broadcast addresses. Instead, multicast scoped addresses aroused
Fragmentation is supported at Originating hosts and intermediate routers.	Fragmentation is not supported at routers. It is only supported at the originating host
IP header includes a checksum	IP header does not include a checksum
IP header includes options	All optional data is moved to IPV6extension headers
IPV4 has classful addressing scheme, includes classes like A,B,C,D and E.	Classless addressing scheme.
Uses decimal dotted notation	Uses hexadecimal notation

e) Ans. **Differentiate between Hub and Switch(any four points)** — **4M**

Each correct point 1M

HUB	Switch
Hub is operated on Physical layer of OSI model.	While switch is operated on Data link layer of OSI Model.
Hub have 4/12 ports.	Switch can have 24 to 48 ports.
Hub is not an intelligent device that sends message to all ports hence it is comparatively inexpensive. Hub cannot be used as a repeater	While switch is an intelligent device that sends message to selected destination, so it is expensive. Switch can be used as a repeater

		Speed of original hub 10Mbps and modern internet hub is 100Mbps | Maximum speed is 10Mbps to 100Mbps.	
5.	**a)**	**Attempt any <u>TWO</u> of the following:** **Explain modes of communication** **i) Simplex** **ii) Half-Duplex** **iii) Full-Duplex**	**12** **6M**
	Ans.	Transferring data between two devices is known as Transmission Mode or Communication mode. **Simplex** • In simplex mode, the communication is unidirectional, as on a one-way street. • Only one of the two devices on a link can transmit; the other can only receive. • Keyboards and traditional monitors are examples of simplex devices. **Half-Duplex** • In half-duplex mode, each station can both transmit and receive, but not at the same time. • When one device is sending, the other can only receive, and vice versa. • Walkie-talkies and CB (citizens band) radios are both half-duplex systems. **Full-Duplex** • In full-duplex mode (also called duplex), both stations can transmit and receive simultaneously. • . In full-duplex mode, signals going in one direction share the capacity of the link: with signals going in the other direction. • This sharing can occur in two ways: Either the link must contain two physically separate transmission paths, one for sending and the other for receiving; or the capacity of the channel is divided between signals traveling in both directions. • One common example of full-duplex communication is the telephone network. Communication between two devices can be simplex, half-duplex, or full-duplex as shown in figure below.	***For simplex 2M with Diagram*** ***For half duplex 2M with Diagram*** ***For full duplex 2M with Diagram***

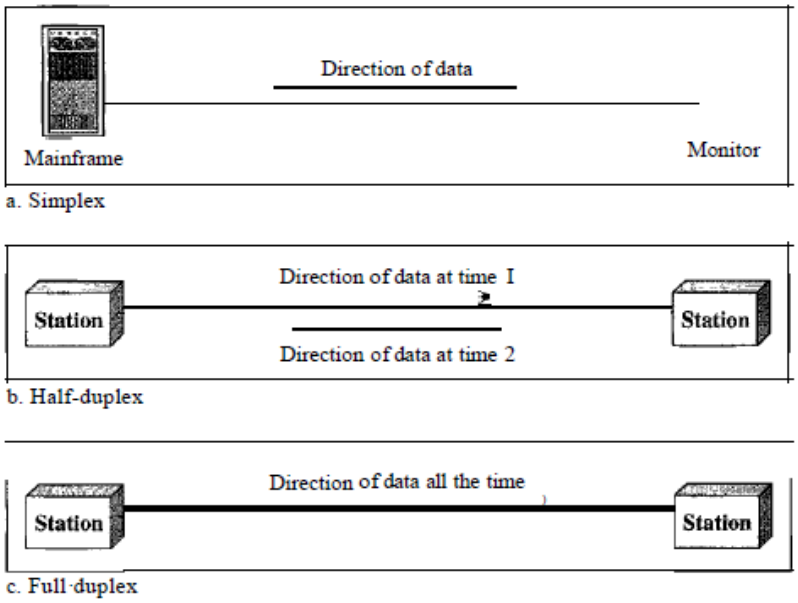


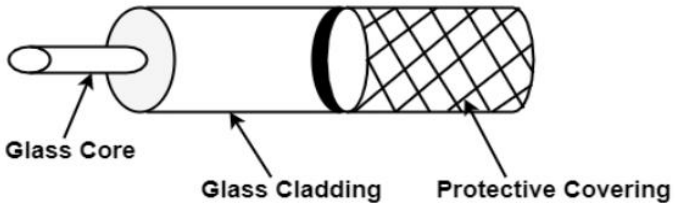
Fig: Data flow (simplex, half-duplex, and full-duplex)

b) Ans. **Draw and explain fiber-optic cable.** **6M**

A fiber-optic cable is made of glass or plastic and transmits signals in the form of light.

Correct labelled Diagram 3M

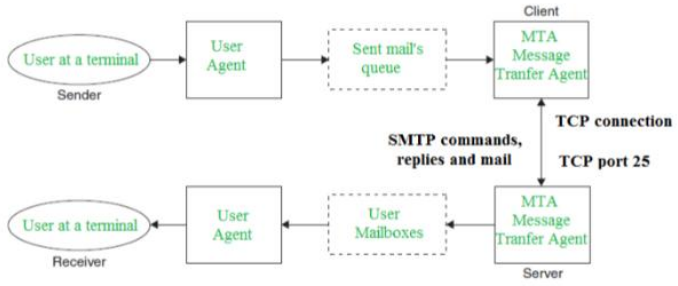
Construction of Optical Fiber Cable



Relevant Explanation 3M

The structure of an optical fibre cable is displayed in the above figure. It involves an inner glass core surrounded by a glass cladding that reflects the light into the core. Each fibre is encircled by a plastic jacket.

In fibre optics, semiconductor lasers transmit data in the form of light along with hair-thin glass (optical) fibres at the speed of light with no significant loss of intensity over very long distances. The system includes fibre optic cables that are made of tiny threads of glass or plastic.

		Current technology supports two modes (multimode and single mode) for propagating light along optical channels, each requiring fiber with different physical characteristics. Multimode can be implemented in two forms: step-index or graded-index.	
	c) Ans.	**Explain SMTP, HTTP, ARP protocol in detail.** **SMTP (Simple Mail Transfer Protocol):** SMTP (Simple Mail Transfer Protocol) is a TCP/IP protocol used in sending and receiving email. SMTP is an application layer protocol. **SMTP Model:**  **Fig: SMTP Model** **Components of SMTP** • Mail User Agent (MUA) • Mail Submission Agent (MSA) • Mail Transfer Agent (MTA) • Mail Delivery Agent (MDA) **Working of SMTP** **1. Communication between the sender and the receiver:** The sender's user agent prepares the message and sends it to the MTA. The MTA's responsibility is to transfer the mail across the network to the receiver's MTA. To send mail, a system must have a client MTA, and to receive mail, a system must have a server MTA. **2. Sending Emails:** Mail is sent by a series of request and response messages between the client and the server. The message which is sent across consists of a header and a body. A null line is used to terminate the mail header and everything after the null line is considered the body of the	**6M** ***Explanation of each protocol 2M***

message, which is a sequence of ASCII characters. The message body contains the actual information read by the receipt.

3. Receiving Emails:
The user agent on the server-side checks the mailboxes at a particular time of intervals. If any information is received, it informs the user about the mail. When the user tries to read the mail it displays a list of emails with a short description of each mail in the mailbox. By selecting any of the mail users can view its contents on the terminal.

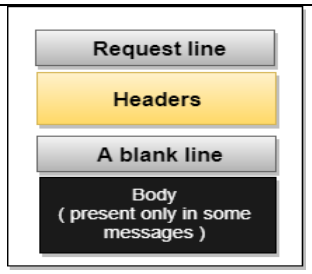
HTTP (Hypertext Transfer Protocol):

- The HTTP protocol can be used to transfer the data in the form of plain text, hypertext, audio, video, and so on.
- HTTP is similar to SMTP as the data is transferred between client and server.
- The HTTP differs from the SMTP in the way the messages are sent from the client to the server and from server to the client.
- SMTP messages are stored and forwarded while HTTP messages are delivered immediately.
- HTTP is an application layer protocol

Features of HTTP:

- **Connectionless protocol:** HTTP is a connectionless protocol. HTTP client initiates a request and waits for a response from the server.
- **Media independent:** HTTP protocol is a media independent as data can be sent as long as both the client and server know how to handle the data content.
- **Stateless:** HTTP is a stateless protocol as both the client and server know each other only during the current request.

HTTP messages are of two types: request and response. Both the message types follow the same message format.
Request Message: The request message is sent by the client that consists of a request line, headers, and sometimes a body.



Response Message: The response message is sent by the server to the client that consists of a status line, headers, and sometimes a body.

ARP(Address Resolution Protocol):
ARP works at Data link layer in the OSI model. It is responsible to find the hardware address of a host from a known IP address. The ARP's main task is to convert the 32-bit IP address (for IPv4) to a 48-bit MAC address.

ARP Packet Format
The ARP packet format is used for ARP requests and replies and consists of multiple fields including hardware type, protocol type, hardware and protocol size, operation, sender and target hardware, and IP addresses.

6		**Attempt any <u>TWO</u> of the following:**	**12**
	a)	**Explain mobile generations.** i. 1G ii. 2G iii. 3G iv. 4G v. 5G	**6M**
	Ans.	Mobile communication generation includes the evolving mobile communications technologies that provide increasing data rates, faster response times and better performance. New Standards are developed from time to time to achieve these characteristics. **First Generation (1G):** In 1979, Nippon Telegraph and Telephone Company (NTTC) launched the first generation mobile network in Tokyo, Japan. It expanded the whole of Japan within five years. Then worldwide, it was known as the 1G Cellular Network.	***Definition of Mobile generation 1M***

		Features: • Analog technology. • Maximum speed 2.4kbps. • Nordic Mobile Telephone System (NMTS). • Advanced Mobile Phone System (AMPS). • Total Access Communication System (TACS). • Only voice service. • 800 & 900 MHz frequency. • 10 MHz bandwidth. • Frequency modulation. • Frequency Division Multiple Access (FDMA) technique. **Limitations:** • Ordinary battery life. • Due to interference, voice quality is poor. • The number of cell coverage and limited users. • Between similar systems, roaming was not possible. • Flawed security system. • Not convenient to carry as it was significant in size. **Second Generation (2G):** In 1991, a second-generation mobile network was launched by Radiolinja based on the GSM. It's a digital network, and providing a reliable & secure communication channel was the 2G network's primary motive. Because of transmitting wireless transmission of 2G mobile network was known as the Global System of Mobile Communication. 2G network also has some features and limitations. **Features:** • Digital technology. • Small data services like SMS and MMS (Multimedia Message System). • Roaming was possible. • First internet system with poor data rate. • Better voice call. • Conference calls are allowed. • Comparatively enhanced security. • Data speed up to 64 Kbps.	***Each generation with any two valid features& limitations 1M***

- 30 to 200 kHz bandwidth.

Limitations:

- Restricted mobility.
- Data rate low.
- Fewer features.
- Less hardware capability.
- User numbers are limited.

Third Generation (3G):

To standardize any generation of mobile networks takes approximately ten years. From this perspective, 3G was commercially introduced in 2001 and first used in Europe, Japan, and China. It is the best popular wireless technology developed by UMTS, which means Universal Mobile Telecommunications System. To facilitate better voice calls and data systems were the main target of the 3G network.
Some unique features and limitations are listed below-

Features:

- High data rates with low cost.
- Email.
- Web browsing.
- Video downloading.
- Picture sharing.
- Better voice call.
- 15 to 20 MHz bandwidth.
- Speed 2 Mbps.
- Much better security system than 1G & 2G.
- Support fire alarms.
- Support mobile app.
- TV streaming.
- 3D quality was high.
- Support multimedia messages.
- Location tracking.
- Map location.

Limitations:

- Mobile devices were costly.
- Spectrum licenses are expensive.
- To support a higher data rate requires higher bandwidth.

Fourth Generation (4G):

According to the ITU (International Telecommunication Union) in December 2010, 4G refers to LTE (Long Term Evolution), HSPA+ (Evolved High-Speed Packet Access), and WiMAX (Worldwide Interoperability for Microwave Access). It is a broadband cellular network different from 1G, 2G, and 3G mobile networks. 4G network was developed by IEEE and here used LTE and LTE advanced technology. It focuses on providing high-speed and quality data rates. This improved data service comes from the most used LTE system. WiMAX increases the network performance of 4G mobile.
Key features and demerits are given below-

Features:

- High data speed.
- The maximum speed is 100 Mbps, which is 1 Gbps.
- Improved security.
- Voice calls service at low cost.
- Multimedia message service.
- Worldwide web access.
- IP telephony.
- Gaming service.
- High-definition mobile TV.
- Video conferencing.
- 3D TV connection without buffering.
- Frequency 1800 MHz.
- Global and scalable mobile networks.
- Ad hoc and multi-hop networks.
- High capacity and low bit per bit.

Limitations:

- Expensive infrastructure.
- Expensive hardware.
- Expensive spectrum.

- A comprehensive upgrade is time-consuming.

Fifth Generation (5G):

5G network is currently under development that began in 2019 by cellular phone companies worldwide. According to the GSM, up to 2025, more than 1.7 billion subscribers would have a 5G mobile network. This network is connected with massive MIMO to improve connection, data speed, and other services. It also provides higher downloading speed and higher bandwidth with the association of different devices. There are several features and due to technical problems also has some limitations. They are-

Features:

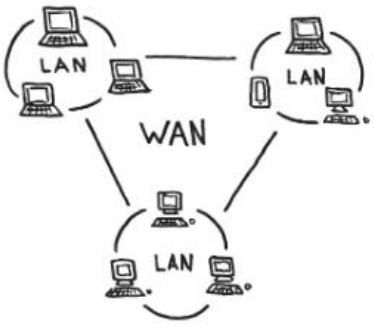
- Deliver ultra-fast data.
- Low latency in milliseconds.
- Reliability of the network.
- Better quality of almost all services.
- Higher security.
- Try to fulfill customer demands.
- Higher connection density.
- Better battery consumption.
- Improved wireless coverage.
- Higher download speed up to 10 Gbps.
- 24 to 47 GHz frequency.
- GPS tracking.
- Multimedia message experience for customers.
- Supercharged system.
- Support massive data rate for the internet of things.
- Cost deduction for data.
- Small cell technologies use.

b) Ans. **Differentiate between OSI and TCP / IP network model.** — **6M**

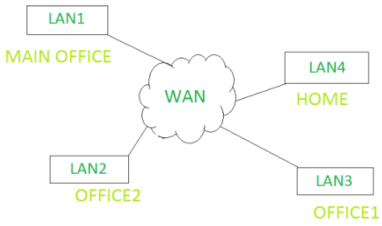
OSI	TCP / IP
OSI represents Open System Interconnection.	TCP/IP model represents the Transmission Control Protocol / Internet Protocol.

Any six valid points 1M each

			OSI is a generic, protocol independent standard. It is acting as an interaction gateway between the network and the final-user.	TCP/IP model depends on standard protocols about which the computer network has created. It is a connection protocol that assigns the network of hosts over the internet.			
			The OSI model was developed first, and then protocols were created to fit the network architecture's needs.	The protocols were created first and then built the TCP/IP model.			
			The OSI model defines administration, interfaces and conventions. It describes clearly which layer provides services.	It does not mention the services, interfaces, and protocols.			
			The protocols of the OSI model are better unseen and can be returned with another appropriate protocol quickly.	The TCP/IP model protocols are not hidden, and we cannot fit a new protocol stack in it.			
			It provides both connection and connectionless oriented transmission in the network layer; however, only connection-oriented transmission in the transport layer.	It provides connectionless transmission in the network layer and supports connecting and connectionless-oriented transmission in the transport layer.			
			It uses a vertical approach.	It uses a horizontal approach.			
			The smallest size of the OSI header is 5 bytes.	The smallest size of the TCP/IP header is 20 bytes.			

			OSI Model Application Layer Presentation Layer Session Layer Transport Layer Network Layer Data Link Layer Physical Layer TCP/IP Model Application Layer Transport Layer Internet Layer Network Access Layer	
	c) **Ans.**	**Explain wide Area Networks along with its advantages and Disadvantages.** • WANs have a large capacity, connecting a large number of computers over a large area, and are inherently scalable. • They facilitate the sharing of regional resources. • They provide uplinks for connecting LANs and MANs to the Internet. • Communication links are provided by public carriers like telephone networks, network providers, cable systems, satellites etc. • Typically, they have low data transfer rate and high propagation delay, i.e. they have low communication speed. **Examples of WAN:** • The Internet • 4G Mobile Broadband Systems • A network of bank cash dispensers.  	**6M** ***Explanation of WAN with diagram 2M*** ***Advantages 2M*** ***Disadvatages -2M***

OR



Advantages of WAN

- **Large area coverage:** WAN covers a large geographical area (1000 km or more than).
- **Higher bandwidth:** WAN networks usually cover large geographical areas.
- **Centralized data:** Using the WAN network you can share the data connected to all the devices in the respective network.

- **Disadvantages of WAN**
- **Security issue:** WAN faces more security problems than LAN and MAN networks since many technologies are merged in WAN networks. It can open a security gap, which paves the way of occurring malicious attacks and identity intruders.
- **Installation cost:** WANs are default complex and complicated because of large geographical area coverage. Hence there is a set-up cost in expensive WAN that also needs routers, switches, and other security solutions.
- **Troubleshooting issues:** Troubleshoot the big challenge on the WAN network and it requires more time. If any issue occurs in the computer network then it is the most difficult part to find out the proper cause due to their broad coverage area.
- **Maintenance issues:** In a WAN network, it is difficult to maintain the network especially a data center that operates 24/7 is the biggest challenge out of all. Here 24/7 needs assistance from network administrators and technicians. In a WAN, maintenance cost is high.

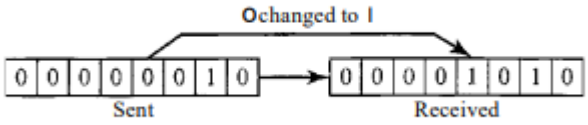
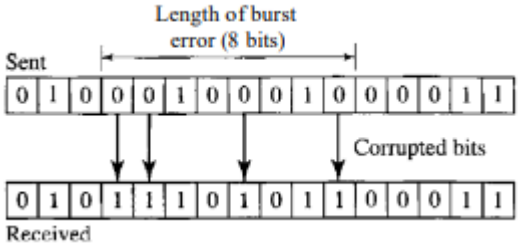
SUMMER – 2023 EXAMINATION
Model Answer – Only for the Use of RAC Assessors

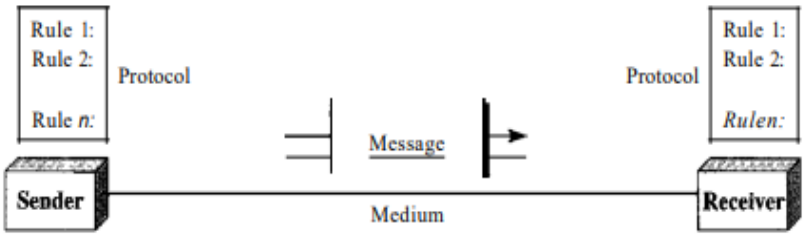
Subject Name: Data Communication and Computer Network **Subject Code:** 22414

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.
8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any FIVE of the following:**	**10 M**
	a)	**Define computer Network.**	**2 M**
	Ans	Computer networking refers to interconnected computing devices that can exchange data and share resources with each other. A network connection between these devices can be established using cable or wireless media.	Correct definition 2 M (other definition of computer network can be considered)
	b)	**Describe date communication standards.**	**2 M**
	Ans	Standards provide guidelines to manufacturers, vendors, government agencies, and other service providers to ensure the kind of interconnectivity necessary in today's marketplace and in international communications. **De Facto Standard :** The meaning of the work " De Facto " is " By Fact " or "By Convention". These standards have not been approved by any Organization, but have been adopted as Standards because of its widespread use. In addition, sometimes Manufacturers often establish these standards. **For example:** Apple and Google are two companies, which established their own	1 M for De Facto Standard and 1 M for De Jure Standard

		rules on their products, which are different. In addition, they use some same standard rules for manufacturing for their products. **De Jure Standard:** The meaning of the word *"De Jure"* is "By Law" or "By Regulations". Thus, these standards have been approved by officially recognized body like ANSI, ISO, and IEEE etc. These are the standard, which are important to follow if it is required or needed. **For example :** All the data communication standard protocols like SMTP , TCP , IP , UDP etc. are important to follow the same when we needed them.	
	c)	**State any two types of unguided media.**	**2 M**
	Ans	1) Radio wave 2) Infrared 3)Microwave	Any 2 types 2 M
	d)	**State any two limitations in Bluetooth**	**2 M**
	Ans	It has low bandwidth as compared to Wi-Fi. It allows only short range communication between devices. Security is a very key aspect as it can be hacked.	Any 2 correct limitations 2 M
	e)	**Describe single Bit error and Burst error.**	**2 M**
	Ans	**Single-Bit Error :** The term single-bit error means that only 1 bit of a given data unit (such as a byte, character, or packet) is changed from 1 to 0 or from 0 to 1.  Fig: Single bit error **Burst Error:** The term burst error means that 2 or more bits in the data unit have changed from 1 to 0 or from 0 to 1.  Fig: Burst Error	1 M for single bit and 1 M for Burst error
	f)	**List any four Network connecting devices.**	**2 M**
	Ans	1) Hub 2) Switch 3) Router 4) Bridge	Any 4 devices

		5) Gateway 6) Modem 7) Repeater 8) Access Point 9) NIC(Network Interface Card)	(½ M for each device)
	g)	**List any four application layer protocol.**	**2 M**
	Ans	1. Simple Mail Transfer Protocol (SMTP) 2. File Transfer Protocol (FTP) 3. Hyper Text Transfer Protocol (HTTP) 4. Trivial File Transfer Protocol (TFTP) 5. **TEL**etype **NET**work (TELNET) 6. Simple Network Management Protocol 7. Dynamic Host Configuration Protocol (DHCP)	Any 4 protocol (½ M for each application layer protocol)
2.		**Attempt any <u>THREE</u> of the following:**	**12 M**
	a)	**Explain the components of Data communication.**	**4 M**
	Ans	A data communications system has five components: 1) Message: The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video. 2) Sender: The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on. 3) Receiver: The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on. 4) Transmission medium: The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves. 5) Protocol: A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating.  Fig: Components of Data Communication	1 M diagram 3 M explanation of components
	b)	**Describe Propagation modes in fibre optic cable.**	**4 M**
	Ans	**A) Multimode:**	2 M for Multimode with

Multimode is so named because multiple beams from a light source move through the core in different paths. How these beams move within the cable depends on the structure of the core.

Multimode having 2 types of modes:

1) Multimode step-index fiber

2) Multimode graded-index fiber

In multimode step-index fiber, the density of the core remains constant from the center to the edges.

The term step index refers to the suddenness of this change, which contributes to the distortion of the signal as it passes through the fiber. (refer fig a)

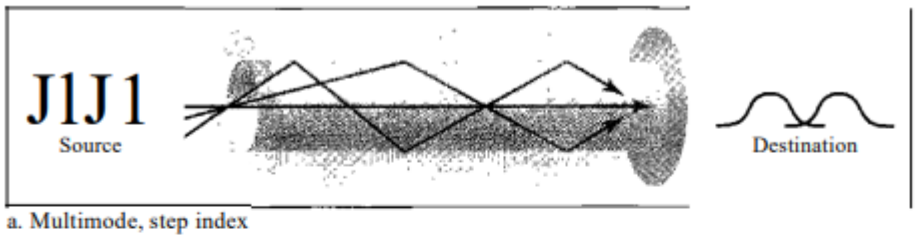
A second type of fiber, called **multimode graded-index fiber**, decreases this distortion of the signal through the cable. The word index here refers to the index of refraction. As we saw above, the index of refraction is related to density. (refer fig b)

B) Single-Mode

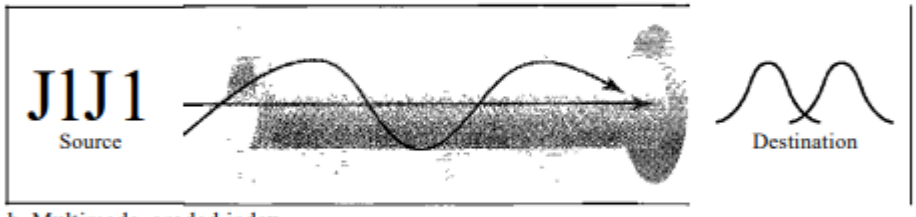
Single-mode uses step-index fiber and a highly focused source of light that limits beams to a small range of angles, all close to the horizontal.

In this case, propagation of different beams is almost identical, and delays are negligible.

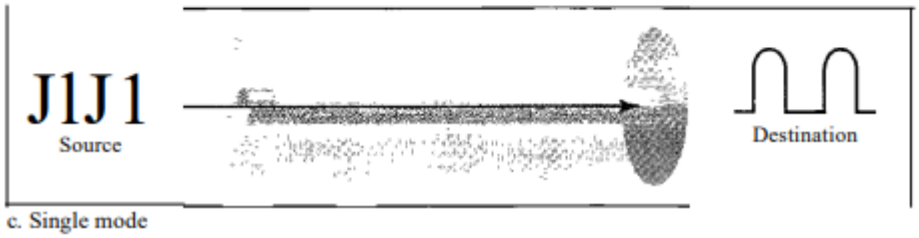
All the beams arrive at the destination "together" and can be recombined with little distortion to the signal. (refer fig c)



a. Multimode, step index



b. Multimode, graded index



c. Single mode

diagram and 2 M for Single mode with diagram

<table>
<tr><td></td><td></td><td>fig: Propagation modes</td><td></td></tr>
<tr><td></td><td>c)</td><td>Compare 3G and 4G mobile Generations on the basis of data speed, technology, standard and services.</td><td>4 M</td></tr>
<tr><td></td><td>Ans</td><td>
<table>
<tr><th>Parameters</th><th>3G</th><th>4G</th></tr>
<tr><td>Data speed</td><td>2 Mbps - 21 Mbps</td><td>2 Mbps - 1 Gbps</td></tr>
<tr><td>Technology</td><td>The technology used in 3G is WCDMA (Wideband Code Division Multiple Access), Digital Broadband Packet Data CDMA 2000, UMTS, EDGE, etc.</td><td>The technology used in 4G is LTE (Long-Term Evolution), and WiMAX (Worldwide Interoperability for Microwave Access).</td></tr>
<tr><td>Standard</td><td>IMT2000
3.5G HSDPA
3.75G HSUPA</td><td>Single Unified standard Wimax and LTE</td></tr>
<tr><td>Services</td><td>CDMA 2000, UMTS, EDGE etc</td><td>Wimax2 and LTE-Advance</td></tr>
</table>
</td><td>For each parameter 1 M</td></tr>
<tr><td></td><td>d)</td><td>Describe the process of DHCP server configuration.</td><td>4 M</td></tr>
<tr><td></td><td>Ans</td><td>A DHCP server (Dynamic Host Configuration Protocol) is a server that automatically assigns IP addresses to computers and other devices on the network. Without a DHCP server, each device on the network would need to be manually configured with an IP address.
Process of DHCP server configuration
<u>Step 1: Open Server Manager</u>
Click the start button then click the Server Manager
<u>Step 2: Add roles and features</u>
On the server manager dashboard click “Add roles and features” This will start the add roles and features wizard.
Click next on the before you begin page.
<u>Step 3: Select Role-based or feature-based installation</u>
Make sure “Role-based or feature-based installation is selected and click next
<u>Step 4: Select destination server</u>
On this page, choose the server you want the DHCP service installed on.</td><td>Correct process of DHCP server configuration 4 M
(any relevant process can be considered)</td></tr>
</table>

Step 5: Select server roles

On this page, you want to select the DHCP server roles and click next.

When you select the roll you will get a pop up asking to add features that are required for DHCP server. Click add features

Back on the select server roles page click next

Step 6: Feature, DHCP Server

On the features, screen click next.

On the DHCP server click next.

Step 7: Confirmation

On the confirmation page, you can select to automatically restart the server if required.

On 2016 server, it does not require a restart.

Configure DHCP Server

If you followed, the steps above you should now have the DHCP service installed.

But, It still needs to be configured.

Step 1: Server Manager

In the server manager dashboard, you will see a yellow notification at the top left.

Click on it

Now click on "Complete DHCP configuration"

Step 2: Post-Install configuration wizard

On the description screen click next

On the authorization page use AD credentials if the server is joined to the domain.

Choose "Skip AD authorization" if the DHCP server is standalone and not joined to the domain.

Click commit

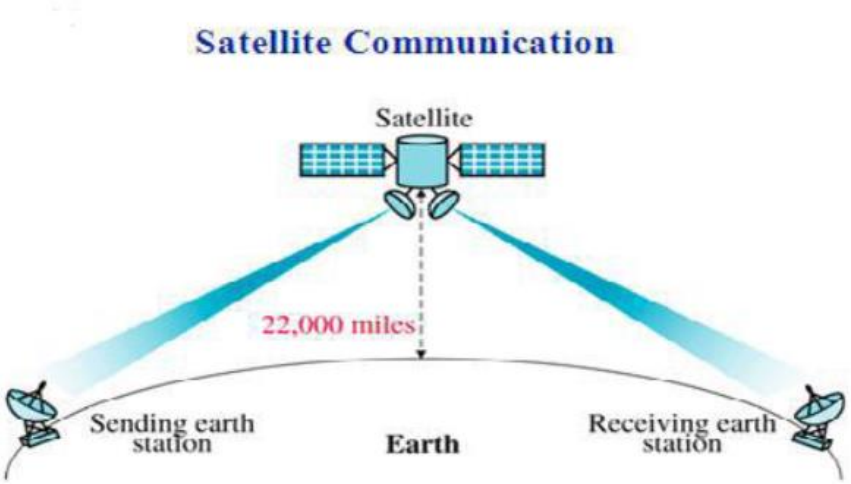
You will see a summary page of the configuration steps

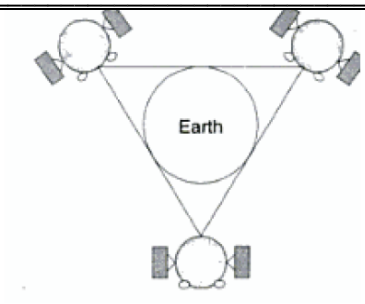
Click close

Now you can open the DHCP management console to configure DHCP scopes and other options.

To access the DHCP management console click start -> Windows Administrative Tool -> DHCP

The next steps are to configure a new scope, configure scope options and ensure clients can access the DHCP server.

3.		**Attempt any <u>THREE</u> of the following:**	**12 M**
	a)	**Describe Satellite communication with neat diagram.**	**4 M**
	Ans	**SATELLITE COMMUNICATION:** In satellite communication, signal transferring between the sender and receiver is done with the help of satellite. In this process, the signal which is basically a beam of modulated microwaves is sent towards the satellite called UPLINK (6 Ghz). Then the satellite amplifies the signal and sent it back to the receiver‟s antenna present on the earth‟s surface called as DOWNLINK (4Ghz), as shown in the diagram given  As the entire signal transferring is happening in space. Thus this type of communication is known as space communication. The satellite does the functions of an antenna and the repeater together. If the earth along with its ground stations is revolving and the satellite is stationery, the sending and receiving earth stations and the satellite can be out of sync over time. Therefore Geosynchronous satellites are used which move at same RPM as that of the earth in the same direction. So the relative position of the ground station with respect to the satellite never changes. However 3 satellites are needed to cover earth‟s surface entirely.	2 M Diagram and 2M Explanation



Frequency band used in satellite communication:

Band	Downlink	Uplink
C	3.7 to 4.2 Ghz	5.925 to 6.425Ghz
Ku	11.7 to 12.2 Ghz	14 to 14.5 Ghz
Ka	17.7 to 21 Ghz	27.5 to 31 Ghz

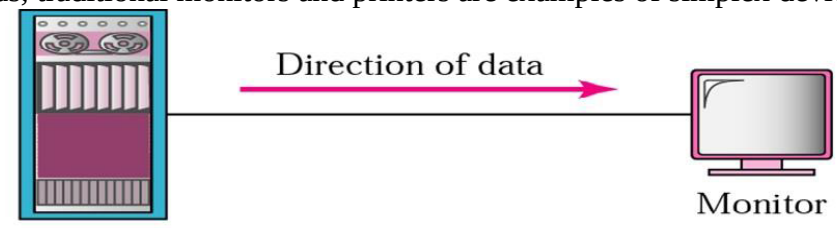
Application of satellite:
Satellite television
digital cinema
satellite radio
satellite internet access

b) Describe modes of communication. **4 M**

Ans Transmission mode refers to the mechanism of transferring of data between two devices connected over a network. It is also called Communication Mode. These modes direct the direction of flow of information. There are three types of transmission modes.
They are:
- Simplex Mode
- Half duplex Mode
- Full duplex Mode

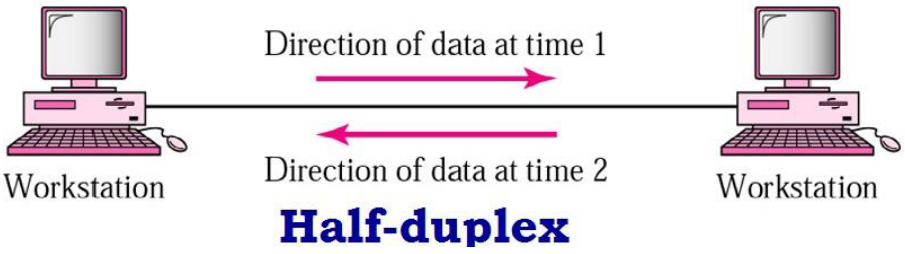
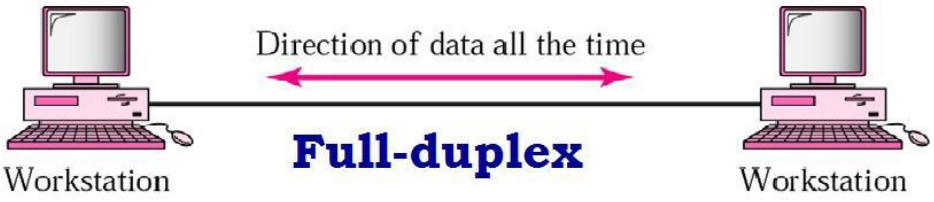
Modes of Communication- 1 M, Diagram and Explanation- 1 M each

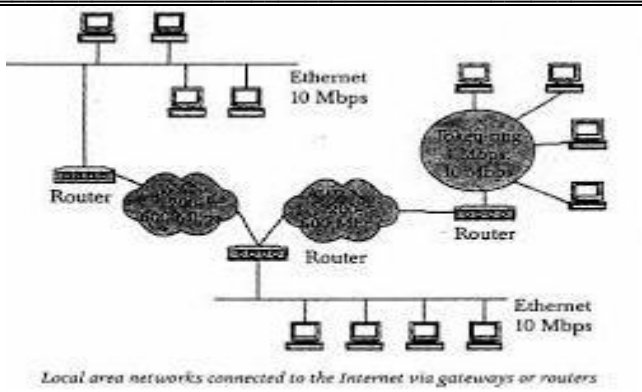
In Simplex mode, the communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit; the other can only receive. The simplex mode can use the entire capacity of the channel to send data in one direction.
-Keyboards, traditional monitors and printers are examples of simplex devices.



Simplex Mode

In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa. The half-duplex mode is used in cases where there is no need for

		communication in both directions at the same time. The entire capacity of the channel can be utilized for each direction -for example :Walkie-talkies.  **Half-duplex** In full-duplex mode both stations can transmit and receive data simultaneously. The transmission medium sharing can occur in two ways, namely, either the link must contain two physically separate transmission paths or the capacity of the channel is divided between signals traveling in both directions. -One common example of full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time.  **Full-duplex**	
	c)	**Describe the working of Router with suitable diagram.**	**4 M**
	Ans	Router is a device that connects 2 or more networks. It consist of hardware and software .hardware includes the physical interfaces to the various networks in the internetwork. Software in a router is OS and routing protocols management software. 1) Router use logical and physical addressing to connect two or more logically separate networks. 2) They accomplish this connection by organizing the large network into logical network called subnets. 3) Each of the subnet is given a logical address. This allows the network to be separate but still access to each other and exchange data. 4) Data is grouped into packets. Each packet has physical device address and logical network address.	2 M Diagram and 2 M Explanation



Local area networks connected to the Internet via gateways or routers

d) Name the Protocols used in — **4 M**

i) **Data Link Layer**
ii) **Network Layer**
iii) **Transport Layer**
iv) **Presentation Layer**

Ans

Data Link Layer: ARP, CSLIP, HDLC, IEEE.802.3, PPP, X-25, SLIP, ATM, SDLS and PLIP. — 1 M each for protocols used in various layer

Network Layer: Internet Protocol (IPv4), Internet Protocol (IPv6), IPX, AppleTalk, ICMP, IPSec and IGMP.

Transport Layer: Transmission Control Protocol (TCP), UDP, SPX, DCCP and SCTP.

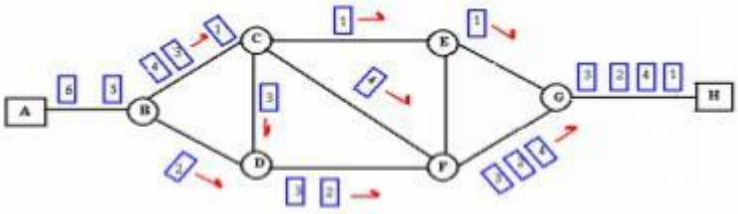
Presentation Layer: XDR, TLS, SSL and MIME.

4. Attempt any <u>THREE</u> of the following: — **12 M**

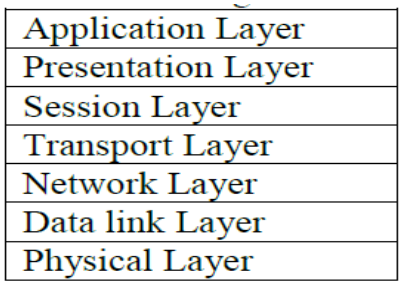
a) Compare FDM and TDM (Any 4 points each) — **4 M**

Ans — 1 M each for correct comparison point

Frequency Division Multiplexing	Time division Multiplexing
FDM divides the channel into two or more frequency ranges that do not overlap	TDM divides and allocates certain time periods to each channel in an alternating manner
Frequency is shared	Times scale is shared
Used with Analog signals	Used with both Digital signals and analog signals
Interference is high	Interference is Low or negligible
Utilization is Ineffective	Efficiently used

	b)	**Define IP addressing. List IP address classes with their range of addresses.**	**4 M**
	Ans	**Internet Protocol IP address** is a number (example shown right) used to indicate the location of a computer or other device on a network using TCP/IP. These addresses are similar to those of your house; they allow data to reach the appropriate destination on a network and the Internet. There are two versions of IP addresses used today, IPv4 and IPv6 **IP address classes**: There are five classes of available IP ranges: Class A, Class B, Class C, Class D and Class E, while only A, B, and C are commonly used. Each class allows for a range of valid IP addresses, shown in the following table. **Class** | **Address Range** **Class A** | 1.0.0.0 to 127.255.255.255 **Class B** | 128.0.0.0 to 191.255.255.255 **Class C** | 192.0.0.0 to 223.255.254.255 **Class D** | 224.0.0.0 to 239.255.255.255 **Class E** | 240.0.0.0 to 254.255.255.255	Define - 1 M; Classes - 1 M; range - 2 M
	c)	**Describe the principles of packet switching techniques with neat diagram.**	**4 M**
	Ans	**Packet Switching:** The entire message is broken down into smaller chunks called packets. The switching information is added in the header of each packet and transmitted independently. It is easier for intermediate networking devices to store small size packets and they do not take much resource either on carrier path or in the internal memory of switches.  Packet switching enhances line efficiency as packets from multiple applications can be multiplexed over the carrier. The internet uses packet switching technique. Packet switching enables the user to differentiate data streams based on priorities. Packets are stored and forwarded according to their priority to provide quality of service.	2 M diagram and 2 M explanation
	d)	**Describe OSI reference model with its Layered structure.**	**4 M**
	Ans	OSI model (open system interconnection) model was developed by ISO (international standard organization) **Function of OSI model:** i. It provides way to understand how internetwork operates.	2 M Diagram and 2 M Explanation

ii. It gives guideline for creating network standard.
OSI model has 7 layers as shown in the figure.



OSI model has following 7 layers as Physical layer, data link layer, Network layer, Transport layer, session layer, presentation layer, application layer.

1. **Physical layer:** It co-ordinates the functions required to transmit bit stream over physical medium. It deals with mechanical and electrical specifications of interface and transmission medium. For transmission it defines procedures and functions that devices and transmission medium has to perform

Physical characteristics of interfaces and media.

Representation of bits: Data rate(transmission rate).

Synchronization of bits.

Line configuration: Point to point or multipoint configuration should be used.

2.**Data link layer:** It is responsible for transmitting group of bits between the adjacent nodes. The group of bits is called as frame. The network layer passes a data unit to the data link layer. Header and trailer is added to the data unit by data link layer. This data unit is passed to the physical layer. Data link layer is responsible for moving frames from one node to the next.

Functions of data link layer are:

1) Framing
2) Physical addressing
3) Flow control
4) Error control
5) Media access control
6) Node to node delivery

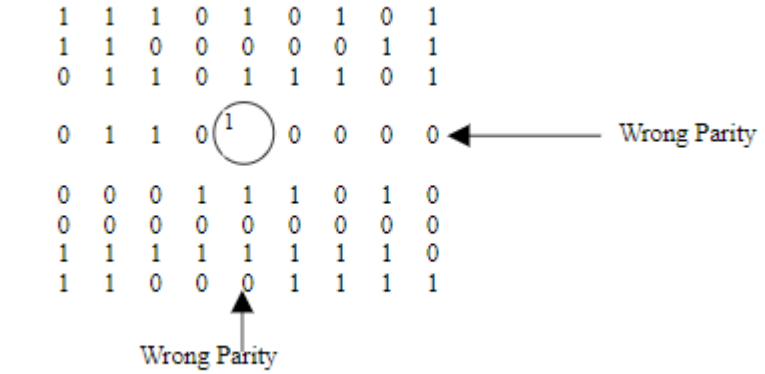
3. **Network layer: It is responsible for routing the packets within the subnet i.e. from source** to destination. It is responsible for source e to destination delivery of individual packets across multiple networks. It ensures that packet is delivered from point of origin to destination.

Functions of network layer:

1) logical addressing
2) Routing.
3) Congestion control
4) Accounting and billing
5) Address transformation
6) Source host to destination host error free delivery of packet.

		4. **Transport layer:** Responsibility of process to process delivery of message Ensure that whole message arrives in order. **Functions of Transport layer:** 1) Service point addressing 2) Segmentation and reassembly 3) Connection control 4) Flow control: Flow control is performed end to end 5) Error control 5. **Session layer:** Establishes, maintains, and synchronizes the interaction among communication systems It is responsible for dialog control and synchronization. **Functionsof Session layer:** 1) Dialog control 2) Synchronization, session and sub session 3) Session closure 6. **Presentation layer:** It is concerned with syntax, semantics of information exchanged between the two systems. **Functions of Presentation layer:** Translation: presentation layer is responsible for converting various formats into required format of the recipient Encryption: Data encryption and decryption is done by presentation layer for security. Compression and Decompression: data to be transform compressed while sending and decompress while receiving for reducing time of transmission. 7. **Application layer:** It enables user to access the network. It provides user interfaces and support for services like email, remote file access. **Functions of Application layer:** Network virtual terminal file transfer access and management mail services and directory services	
	e)	**The following bit stream is encoded with VRC, LRC and even parity. Locate and correct the error if it is present.** **1 1 0 0 0 0 1 1** **1 1 1 1 0 0 1 1** **1 0 1 1 0 0 1 0** **0 0 0 0 1 0 1 0** **0 0 1 0 1 0 1 0** **0 0 1 0 1 0 1 1** **1 0 1 0 0 0 1 1** **0 1 0 0 1 0 1 1** **1 1 1 0 0 0 0 1**	**4 M**
	Ans		4 M for correct Solution

Solution



Fourth bit of the fifth byte is in error. It should be "0".

5. **Attempt any TWO of the following:** **12 M**

a) **Differentiate any six point between LAN and WAN.** **6 M**

Ans Any six points 6 M

Attributes	LAN	WAN
Definition	LAN is a group of devices connected in a small geographic area, such as houses, offices, or buildings.	WAN is an arrangement of several devices attached over a network covering a broad area. A network having communication links crossing the regional, metropolitan, or national boundaries over a large distance is an example of WAN.
Geographical Area	LAN covers a small geographical area, and it does not require any leased telecommunication lines.	WAN covers a large distance geographical area that usually crosses regional or metropolitan boundaries and requires leased telecommunication lines.
Speed	LAN provides a comparatively higher speed.	WAN has a slower speed as compared to LAN.
Data Transfer Rate	LAN provides a high data transfer rate than WAN. It can reach up to 1000 Mbps.	WAN provides a relatively slower data transfer rate. It can reach up to 150mbps.
Ownership	LAN is owned, managed, and used by an individual or an organization. Therefore, it is a private network.	WAN can be either private or public. The Internet is the best example of public WAN.

		Congestion	LAN has low congestion than WAN.	WAN has relatively higher congestion as compared to LAN.
		Fault Tolerance	LAN has higher fault tolerance.	WAN has a lower fault tolerance as compared to LAN.
		Technologies	LANs tend to use some particular connectivity technologies, mainly Ethernet and Token Ring.	WANs tend to use Frame Relay, MPLS, and ATM along with X.25 for connectivity over larger distances.
		Connection	LANs can be attached over any distance using telephone lines and radio waves. Typically, co-axial or UTP cable is used as the transmission medium.	In WAN, the devices are connected through public networks, such as the telephone system. They can also be connected via leased lined or satellites.
		Components	The main components of LAN include Layer 1 devices (e.g., hubs, repeaters) and Layer 2 devices (e.g., switches, bridges).	The main components of WAN include Layer 3 devices (e.g., Routers, Multi-layer switches) and technology-specific devices (e.g., AM, Frame-relay switches).
		Bandwidth	LAN offers high bandwidth for the transmission.	WAN offers low bandwidth for the transmission.
		Maintenance	Designing and maintenance of LANs are easy.	Designing and maintenance of WAN are complex.
		Core Principle	It works on the principle of broadcasting.	It operates on the principle of point-to-point.
		Cost	Since LAN covers a small area, it can be set up very cheaply.	The setup for WAN is high because of its wider geographical area.
	b)	**Write steps to prepare crossover and straight cable using twisted pair cable.**		**6 M**
	Ans	**Straight cable** In this cable, wires are placed in the same position at both ends. The wire at pin 1 on one end of the cable connects to pin 1 at the other end of the cable. The wire at pin 2 connects to pin 2 on the other end of the cable; and so on. The following table lists the wire positions of the straight-through cable on both sides.		steps to prepare crossover 3 M steps to prepare straight cable 3 M

Side A	Side B
Green White	Green White
Green	Green
Orange White	Orange White
Blue	Blue
Blue White	Blue White
Orange	Orange
Brown White	Brown White
Brown	Brown

A straight-through cable is used to connect the following devices.

1. PC to Switch
2. PC to Hub
3. Router to Switch
4. Switch to Server
5. Hub to Server

cross-over cable

n this cable, transmitting pins of one side connect with the receiving pins of the other side.

The wire at pin 1 on one end of the cable connects to pin 3 at the other end of the cable. The wire at pin 2 connects to pin 6 on the other end of the cable. Remaining wires connect in the same positions at both ends.

The following table lists the wire positions of the cross-over cable on both side

Side A	Side B
Green White	Orange White
Green	Orange
Orange White	Green White
Blue	Blue
Blue White	Blue White
Orange	Green
Brown White	Brown White
Brown	Brown

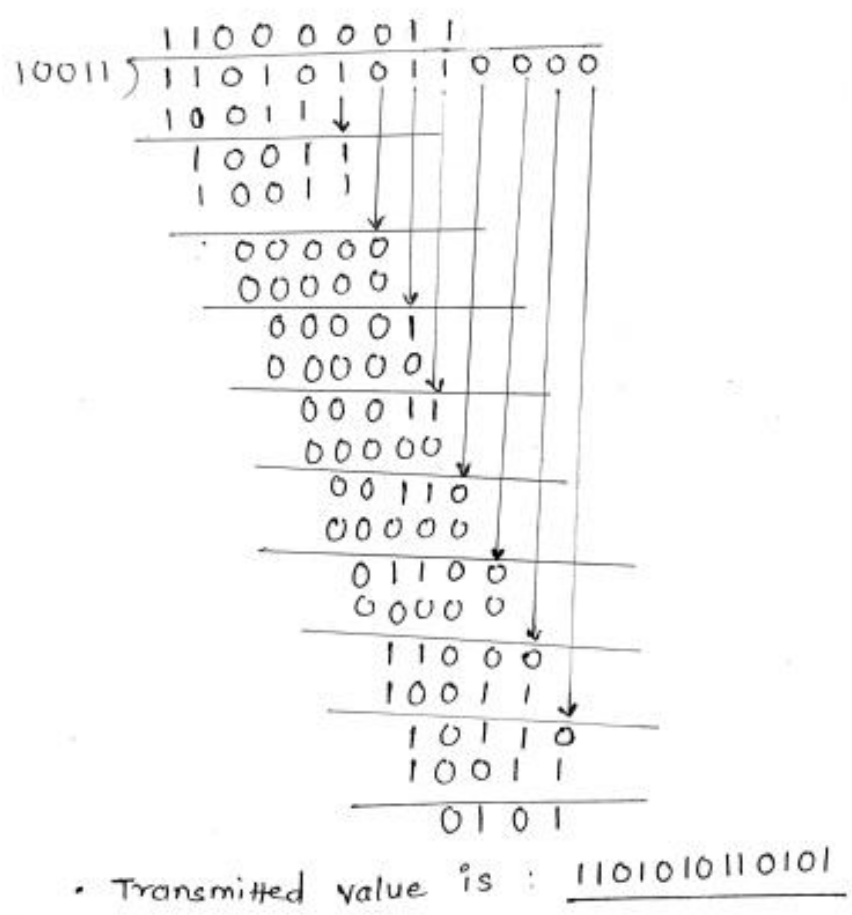
The cross-over cable is used to connect the following devices.

1. Two computers
2. Two hubs
3. A hub to a switch
4. A cable modem to a router
5. Two router interfaces

c) Compare IPv_4 and IPv_6. (Any six point each) **6 M**

Ans Any six points 6 M

Basis for differences	IPv4	IPv6
Size of IP address	IPv4 is a 32-Bit IP Address.	IPv6 is 128 Bit IP Address.
Addressing method	IPv4 is a numeric address, and its binary bits are separated by a dot (.)	IPv6 is an alphanumeric address whose binary bits are separated by a colon (:). It also contains hexadecimal.
Number of header fields	12	8
Length of header filed	20	40
Checksum	Has checksum fields	Does not have checksum fields
Example	12.244.233.165	2001:0db8:0000:0000:0000:ff00:0042:7879
Type of Addresses	Unicast, broadcast, and multicast.	Unicast, multicast, and anycast.
Number of classes	IPv4 offers five different classes of IP Address. Class A to E.	IPv6 allows storing an unlimited number of IP Address.
VLSM support	IPv4 support VLSM (Variable Length Subnet mask).	IPv6 does not offer support for VLSM.
Network Configuration	Networks need to be configured either manually or with DHCP.	IPv6 support auto configuration capabilities.
SNMP	SNMP is a protocol used for system	SNMP does not support IPv6.

			management.	
		Packet size	Packet size 576 bytes required, fragmentation optional	1208 bytes required without fragmentation
6.		**Attempt any <u>TWO</u> of the following:**		**12 M**
	a)	**Calculate CRC for the frame 11010101l and generator Polynomial X^4 +X +1 and write the transmitted frame.**		**6 M**
	Ans	• Given frame for transmission is = 110101011 • Generator Polynomial is x^4+x+1 $= x^4.1+x^3.0+x^2.0+x^1.1+x^0.1 = 10011$ • Append 4 zeros to the frame : 110101011 0000  • Transmitted value is : 110101011 0101		Identifying generator Polynomial= 1 M Calculating CRC for the frame 110101011 = 4 M Identifying the transmitted frame=1 M
	b)	**Compare OSI and TCP/IP network model (any six point each)**		**6 M**
	Ans			Any six points 6 M

OSI Model	TCP/IP Model
OSI model provides a clear distinction between interfaces, services, and protocols.	TCP/IP doesn't have any clear distinguishing points between services, interfaces, and protocols.
OSI refers to Open Systems Interconnection.	TCP refers to Transmission Control Protocol.
OSI uses the network layer to define routing standards and protocols.	TCP/IP uses only the Internet layer.
OSI follows a vertical approach.	TCP/IP follows a horizontal approach.
OSI layers have seven layers.	TCP/IP has four layers.
In the OSI model, the transport layer is only connection-oriented.	A layer of the TCP/IP model is both connection-oriented and connectionless.
In the OSI model, the data link layer and physical are separate layers.	In TCP, physical and data link are both combined as a single host-to-network layer.
Session and presentation layers are a part of the OSI model.	There is no session and presentation layer in the TCP model.
The minimum size of the OSI header is 5 bytes.	The minimum header size is 20 bytes.

c) Draw suitable network layout with star topology for a computer lab with 10 hosts and a wireless printers. List all components in the Layout. **6 M**

Ans

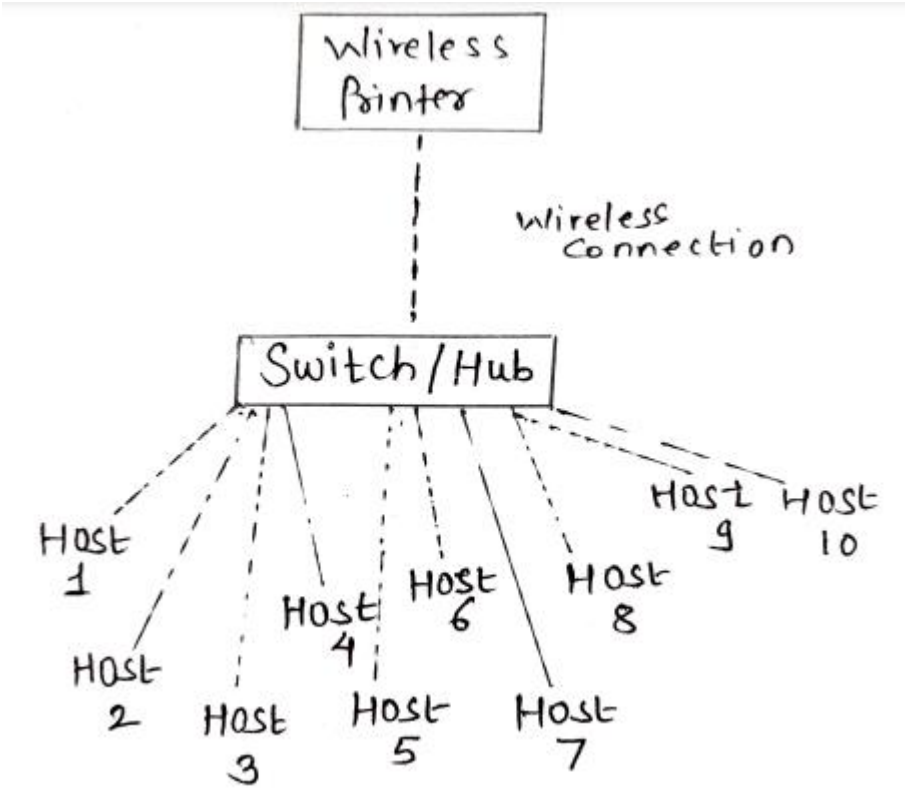


Fig: layout with star topology for a computer lab with 10 hosts

layout with star topology 4 M

List all components in the layout 2 M

		Components required to design above layout: Router/Switch Laptop(10)/computers Cat5/Cat6 cable RJ45 connector	

WINTER – 2022 EXAMINATION
MODEL ANSWER

Subject: Data Communication & Computer Network **Subject Code:** **22414**

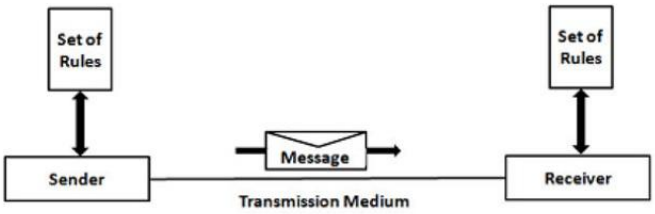
Important Instructions to examiners:

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.
8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q. No	Sub Q.N.	Answer	Marking Scheme
1.	**a)** **Ans.**	**Attempt any FIVE of the following:** **10** **Name the components of data communication.** **2M** There are five main components of data communication and they are explained below – 1. Message 2. Sender 3. Receiver 4. Transmission Medium 5. Protocol **OR** ***(Only diagram can also be considered)***	***All 5 components 2M*** ***Diagram can also be considered.***

WINTER – 2022 EXAMINATION
MODEL ANSWER

Subject: Data Communication & Computer Network **Subject Code:** **22414**

<table>
<tr><td></td><td></td><td> 
</td><td></td></tr>
<tr><td></td><td>b)
Ans.</td><td>State any two needs of Computer Network.
The following are the potential needs for computer networks.
• Information exchange: To exchange data and information between different individual users, it is necessary to interconnect the individual users' computers.
• Resource sharing: The cost of computer has come down. However, the cost of a laser printer, bulk storage, and large enterprise software remains high. When computers are interconnected, there is a possibility that, users connected to the network may share the resources.
• Sharing a single internet connection - it is cost-efficient and can help protect your systems if you properly secure the network.
• Increasing storage capacity –We can access files and multimedia, such as images and music, which you store remotely on other machines or network-attached storage devices.</td><td>2M
Any two needs 1M each</td></tr>
<tr><td></td><td>c)
Ans.</td><td>Compare guided and unguided transmission media
<table>
<tr><th>S.N</th><th>Guided Media</th><th>Unguided Media</th></tr>
<tr><td>1.</td><td>In guided media, the signal energy communicates via wires.</td><td>In unguided media, the signal energy communicates through the air.</td></tr>
<tr><td>2.</td><td>Guided media is generally preferred when we want to execute direct communication.</td><td>Unguided media is generally preferred for radio broadcasting in all directions.</td></tr>
<tr><td>3.</td><td>The guided media formed the different network topologies.</td><td>The unguided media formed the continuous network topologies.</td></tr>
<tr><td>4.</td><td>Here, the signals are in the state of current and voltage.</td><td>Here, the signals are in the state of electromagnetic waves.</td></tr>
<tr><td>5.</td><td>Open Wire, Twisted Pair, Coaxial Cable, and Optical Fiber are the different kinds of guided media.</td><td>Microwave Transmission, Radio Transmission, and Infrared Transmission are the types of unguided media.</td></tr>
</table></td><td>2M
Any two comparison 1M each</td></tr>
</table>

d) Ans. **Enlist types of errors** — **2M** *1M for each error*

Errors may also be classified as

1.Content errors : Refers to error in the data unit sent. They are further classified as

i. Single-bit error

ii. Burst error

2. Flow Integrity errors: Refers to the error caused to flow of data packets from one node to another.

e) Ans. **Compare LRC and VRC.** — **2M** *Any two points 1M each*

S.N	LRC	VRC
1	LRC can detect burst errors.	VRC is not capable of checking the burst error. It is capable of detecting Single bit error
2	LRC is also known as 2Dparity checker.	VRC is also known as odd parity checker
3	The advantage of using LRC over VRC is that it can check all the burst errors.	The advantage of using VRC is that it can checks all single bit errors but can check odd parity only in the case of change of odd bits.

f) Ans. **State the function of repeater and modem.** — **2M** *Each function 1M*

Following are the functions of:

Repeater: Repeater is a network device that amplifies and restores signals for long distance transmission. A repeater operates at physical layer. It is a two port device.

Modem: A modem (modulator-demodulator) is an electronic Device that enables a computer to transmit data over telephone line. A modem converts analog signal to digital signal and digital signal to analog signal and this is called as modulation and demodulation.

g) Ans. **State the services of transport layer in OSI model** — **2M** *Any two functions 1M each*

Functions of Transport Layer In OSI Model:

- The transport layer provides services to the application layer and takes services from the network layer.
- The data in the transport layer is referred to as Segments. It is responsible for the End-to-End Delivery of the complete message.
- The transport layer also provides the acknowledgement of the successful data transmission and re-transmits the data if an error is found.

- Transport layer receives the formatted data from the upper layers, performs Segmentation, and also implements Flow & Error control to ensure proper data transmission.
- It also adds Source and Destination port numbers in its header and forwards the segmented data to the Network Layer.
- Transport Layer reads the port number from its header and forwards the Data which it has received to the respective application. It also performs sequencing and reassembling of the segmented data.

2. **a) Ans.** **Attempt any THREE of the following:** — **12**

Compare LAN and WAN (four points) — **4M** ***Any four points 1M each***

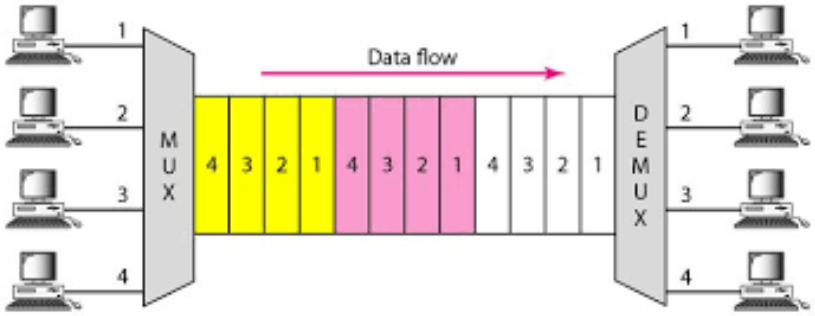
Attributes	LAN	WAN
Definition	LAN is a group of devices connected in a small geographic area, such as houses, offices, or buildings.	WAN is an arrangement of several devices attached over a network covering a broad area. A network having communication links crossing the regional, metropolitan, or national boundaries over a large distance is an example of WAN.
Geographical Area	LAN covers a small geographical area, and it does not require any leased telecommunication lines.	WAN covers a large distance geographical area that usually crosses regional or metropolitan boundaries and requires leased telecommunication lines.
Speed	LAN provides a comparatively higher speed.	WAN has a slower speed as compared to LAN.
Data Transfer Rate	LAN provides a high data transfer rate than WAN. It can reach up to 1000 Mbps.	WAN provides a relatively slower data transfer rate. It can reach up to 150mbps.
Propagation Delay	In LANs, the propagation delay is short.	In WANs, the propagation delay is comparatively long.
Congestion	LAN has low congestion than WAN.	WAN has relatively higher congestion as compared to LAN.

Fault Tolerance	LAN has higher fault tolerance.	WAN has a lower fault tolerance as compared to LAN.		
Technologies	LANs tend to use some particular connectivity technologies, mainly Ethernet and Token Ring.	WANs tend to use Frame Relay, MPLS, and ATM along with X.25 for connectivity over larger distances.		
Connection	LANs can be attached over any distance using telephone lines and radio waves. Typically, co-axial or UTP cable is used as the transmission medium.	In WAN, the devices are connected through public networks, such as the telephone system. They can also be connected via leased lined or satellites.		
Components	The main components of LAN include Layer 1 devices (e.g., hubs, repeaters) and Layer 2 devices (e.g., switches, bridges).	The main components of WAN include Layer 3 devices (e.g., Routers, Multi-layer switches) and technology-specific devices (e.g., AM, Frame-relay switches).		

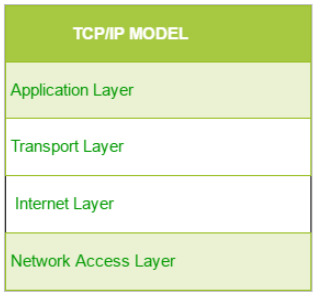
b) Ans. **Explain TDM technique with the help of neat diagram.** — **4M**

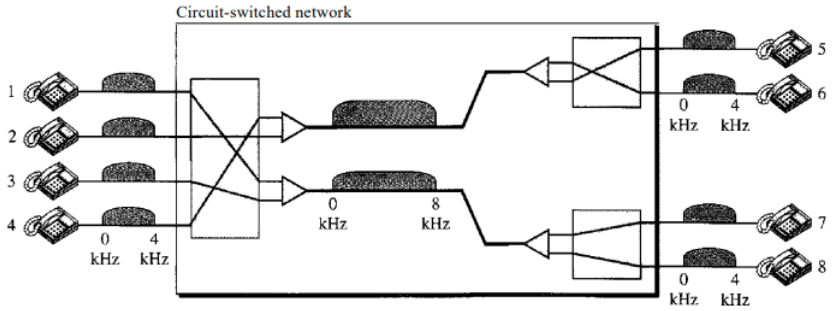
Explanation 2M
Diagram 2M

1. TDM is the digital multiplexing technique.
2. In TDM, the channel/link is not divided on the basis of frequency but on the basis of time.
3. Total time available in the channel is divided between several users.
4. Each user is allotted a particular a time interval called time slot or time slice during which the data is transmitted by that user.
5. Thus each sending device takes control of entire bandwidth of the channel for fixed amount of time.
6. In TDM the data rate capacity of the transmission medium should be greater than the data rate required by sending or receiving devices.
7. In TDM all the signals to be transmitted are not transmitted simultaneously. Instead, they are transmitted one-by-one.
8. Thus each signal will be transmitted for a very short time. One cycle or frame is said to be complete when all the signals are transmitted once on the transmission channel.
9. The TDM system can be used to multiplex analog or digital signals, however it is more suitable for the digital signal multiplexing.

		10. The TDM signal in the form of frames is transmitted on the common communication medium.  Diagram of TDM	
	c) Ans.	**State features of various mobile generations.** Features of various mobile generation are the following: **1G (1st Generation):** • First-time calling was introduced in mobile systems. • It used analog signals. • It used an FDD scheme and typically allocated a bandwidth of 25 Mhz. • The coverage area was small. • No roaming support between various operators. • Low sound quality. • Speed:- 2.4 kbps. **2G (2nd Generation) :** • Shifted from analog to digital. • It supported voice and SMS both. • Supported all 4 sectors of the wireless industry namely Digital cellular, Mobile Data, PCS, WLAN, • Moderate mobile data service. • 2G WLAN provided a high data rate & large area coverage. • Speed:- 64 kbps. **3G (3rd Generation) :** • The Internet system was improved. • Better system and capacity.	**4M** ***Any four generations with two unique features 4M***

		• Offers high-speed wireless internet. • The connection used was UMTS and WCMA. • Speed:- 2mbps. **4G (4th Generation) :** • IP-based protocols. • LTE (Long term evaluation) was mainly for the internet. • Vo-LTE (Voice over LTE) is for both voice and the internet. • Freedom and flexibility to select any desired service with reasonable QoS. • High usability. • Supports multimedia service at a low transmission cost. • HD Quality Streaming. • Speed:-100mbps. **5G (5th Generation):** It is yet to come in many countries but here are some notable points about 5G. • Higher data rates. • Connectivity will be more fast and more secure, • Data Latency will be reduced to a great level. • Massive network capacity. • It is 30 times faster than 4G. • There would be more flexibility in the network.	
	d) Ans.	**Draw and explain TCP/IP protocol suite.** TCP/IP Reference Model is a four-layered suite of communication protocols It is named after the two main protocols that are used in the model, namely, TCP and IP. TCP stands for Transmission Control Protocol and IP stands for Internet Protocol. The four layers in the TCP/IP protocol suite are − 1. Network Access Layer −It is the lowest layer that is concerned with the physical transmission of data. TCP/IP does not specifically define any protocol here but supports all the standard protocols. 2. Internet Layer −It defines the protocols for logical transmission of data over the network. The main protocol in this layer is Internet	**4M** ***Explanation 2M*** ***Diagram 2M***

		Protocol (IP) and it is supported by the protocols ICMP, IGMP, RARP, and ARP. 3. Transport Layer − It is responsible for error-free end-to-end delivery of data. The protocols defined here are Transmission Control Protocol (TCP) and User Datagram Protocol (UDP). 4. Application Layer − This is the topmost layer and defines the interface of host programs with the transport layer services. This layer includes all high-level protocols like Telnet, DNS, HTTP, FTP, SMTP, etc. The following diagram shows the TCP/IP layers 	
3.	**a)** **Ans.**	**Attempt any <u>THREE</u> of the following:** **Explain with neat diagram working of circuit switching in network.** A circuit-switched network is made of a set of switches connected by physical links, in which each link is divided into n channels. In circuit switching, the resources need to be reserved during the setup phase; the resources remain dedicated for the entire duration of data transfer until the teardown phase. Circuit switching takes place at the physical layer. Before starting communication, the stations must make a reservation for the resources to be used during the communication. These resources, such as channels (bandwidth in FDM and time slots in TDM), switch buffers, switch processing time, and switch input/output ports, must remain dedicated during the entire duration of data transfer until the teardown phase.	**12** **4M** ***Diagram 1M*** ***Explanation 3M***

		Data transferred between the two stations are not packetized (physical layer transfer of the signal). The data are a continuous flow sent by the source station and received by the destination station, although there may be periods of silence. There is no addressing involved during data transfer. The switches route the data based on their occupied band (FDM) or time slot (TDM). There is end-to end addressing used during the setup phase. **Example** As a trivial example, let us use a circuit-switched network to connect eight telephones in a small area. Communication is through 4-kHz voice channels. We assume that each link uses FDM to connect a maximum of two voice channels. The bandwidth of each link is then 8 kHz. Figure shows the situation. Telephone 1 is connected to telephone 7; 2 to 5; 3 to 8; and 4 to 6. The switch controls the connections.  **Fig: Circuit-switched network**	
	b) **Ans.**	**Describe the various modes of communication in Computer Network.** The way in which data is transmitted from one device to another device is known as **transmission mode** or **communication mode**. The Transmission mode is divided into three categories: • Simplex mode • Half-duplex mode • Full-duplex mode **Simplex mode** • In Simplex mode, the communication is unidirectional, i.e., the data flow in one direction.	**4M** ***Listing 1M*** ***Explanation of each 3M***

- A device can only send the data but cannot receive it or it can receive the data but cannot send the data.
- The radio station is a simplex channel as it transmits the signal to the listeners but never allows them to transmit back.
- Keyboard and Monitor are the examples of the simplex mode as a keyboard can only accept the data from the user and monitor can only be used to display the data on the screen.

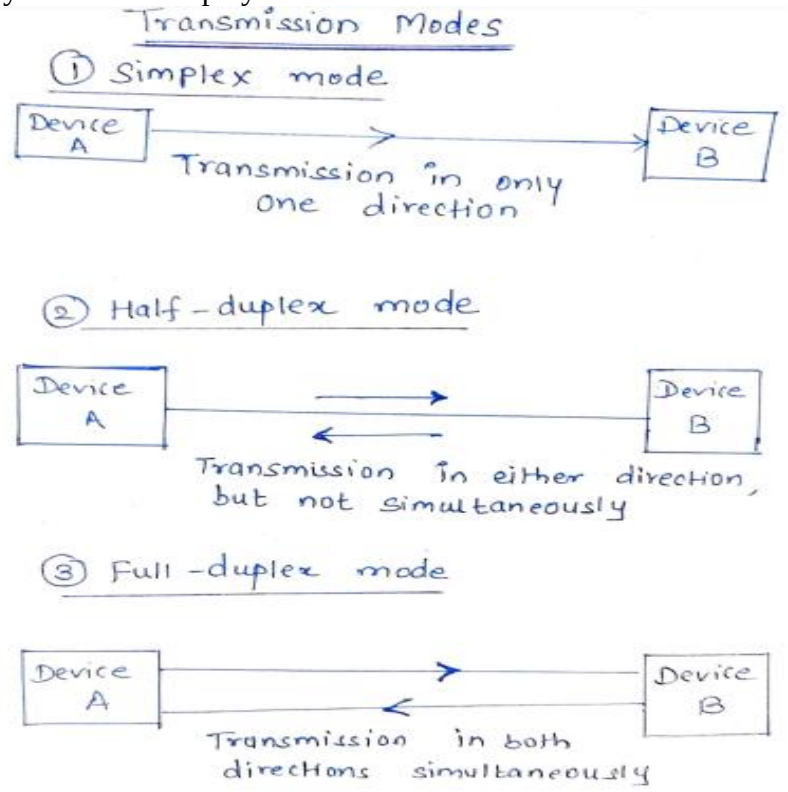


Fig: Transmission modes

Half-duplex mode

- In a Half-duplex channel, direction can be reversed, i.e., the station can transmit and receive the data as well.
- Messages flow in both the directions, but not at the same time.
- The entire bandwidth of the communication channel is utilized in one direction at a time.
- In half-duplex mode, it is possible to perform the error detection, and if any error occurs, then the receiver requests the sender to retransmit the data.

- A **Walkie-talkie** is an example of the Half-duplex mode. In Walkie-talkie, one party speaks, and another party listens. After a pause, the other speaks and first party listens.

Full-duplex mode

- In Full duplex mode, the communication is bi-directional, i.e., the data flow in both the directions.
- Both the stations can send and receive the message simultaneously.
- Full-duplex mode has two simplex channels. One channel has traffic moving in one direction, and another channel has traffic flowing in the opposite direction.
- The Full-duplex mode is the fastest mode of communication between devices.

The most common example of the full-duplex mode is a telephone network.

c) Differentiate between HUB and Switch with respect to Layer, Port, device type, speed. — **4M** *1M for each differentiation as per parameter*

Ans.

Parameter	HUB	Switch
Layer	Hub is operated on **Physical layer of OSI model**.	While switch is operated on **Data link layer of OSI Model**.
Port	Hub have 4/12 ports.	Switch can have 24 to 48 ports.
Device Type	Hub is not an intelligent device that sends message to all ports hence it is comparatively inexpensive. Hub cannot be used as a repeater.	While switch is an intelligent device that sends message to selected destination, so it is expensive. Switch can be used as a repeater.
Speed	Speed of original hub 10Mbps and modern internet hub is 100Mbps.	Maximum speed is 10Mbps to 100Mbps.

	d) Ans.	**State the OSI models Layer and give its functions.** **Physical Layer of OSI Model** The physical layer coordinates the functions required to carry a bit stream over a physical medium. It deals with the mechanical and electrical specifications of the interface and transmission medium. It also defines the procedures and functions that physical devices and interfaces have to perform for transmission to Occur. **Data Link Layer of OSI Model** The data link layer transforms the physical layer, a raw transmission facility, to a reliable link. It makes the physical layer appear error-free to the upper layer (network layer). **Network Layer of OSI Model** The network layer is responsible for the source-to-destination delivery of a packet, possibly across multiple networks (links). Whereas the data link layer oversees the delivery of the packet between two systems on the same network (links), the network layer ensures that each packet gets from its point of origin to its final destination. **Transport Layer of OSI Model** The transport layer is responsible for process-to-process delivery of the entire message. A process is an application program running on a host. Whereas the network layer oversees source-to-destination delivery of individual packets, it does not recognize any relationship between those packets. It treats each one independently, as though each piece belonged to a separate message, whether or not it does. The transport layer, on the other hand, ensures that the whole message arrives intact and in order, overseeing both error control and flow control at the source-to-destination level. **Session Layer of OSI Model** The services provided by the first three layers (physical, data link, and network) are not sufficient for some processes. The session layer is the network dialog controller. It establishes, maintains, and synchronizes the interaction among communicating systems	**4M** ***Listing 1M*** ***All layer function 3M***

Presentation layer of OSI Model
The presentation layer is concerned with the syntax and semantics of the information exchanged between two systems.

Application layer of OSI Model
The application layer enables the user, whether human or software, to access the network. It provides user interfaces and support for services such as electronic mail, remote file access and trans

4. **Attempt any THREE of the following:** **12**

a) **State the physical and transmission characteristics of twisted pair cable along with its applications.** **4M**

Ans.

Characteristics	UTP	STP
Bandwidth	10 Mbps - 100 Mbps	10 Mbps - 100 Mbps
Maximum cable segment	100 meters	100 meters
Interference rating	Poor	Better than UTP
Installation cost	Cheap	Costly than UTP
Bend radius	360 degrees / feet	360 degrees / feet
Security	Low	Low

3 Physical and transmission characteristics 3M

Applications:
- telephone lines
- Digital Subscriber Line
- local area networks.

Any 2 Applications 1M

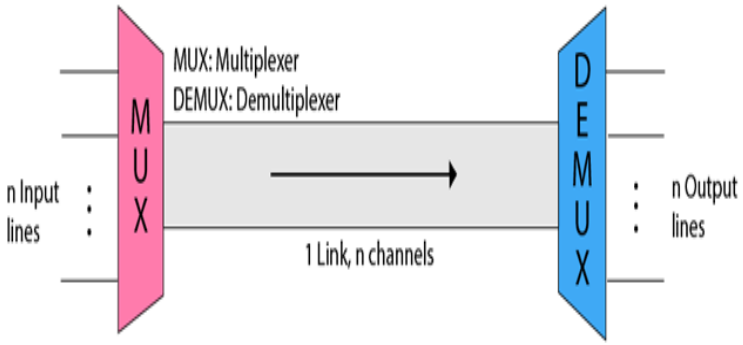
b) **Describe various IP address classes with suitable example.** **4M**

Ans.

Class	Address Range	Example IP	Application
IP Class A	1 to 126	1.1.1.1	Used for large number of hosts.
IP Class B	128 to 191	128.1.1.1	Used for medium size network.
IP Class C	192 to 223	192.1.11.	Used for local area network.
IP Class D	224 to 239	NA	Reserve for multi-tasking.
IP Class E	240 to 254	NA	This class is reserved for research and Development Purposes.

IP address classes-3M

Example of each class-1M

	c) Ans.	**Define multiplexing. Compare FDM and TDM.** **Multiplexing** is the set of techniques that allows the simultaneous transmission of multiple signals across a single data link.  • The 'n' input lines are transmitted through a multiplexer and multiplexer combines the signals to form a composite signal. • The composite signal is passed through a Demultiplexer and demultiplexer separates a signal to component signals and transfers them to their respective destinations. **FDM-Frequency division multiplexing** / **TDM- Time division multiplexing.** FDM is an analog multiplexing technique that combines analog signals. / TDM is a digital multiplexing technique for combining several low-rate channels into one high-rate one. TDM works with analog as well as digital signals. Frequency is shared in FDM. / Time is shared in TDM. Synchronization pulse is not mandatory. Guard band is necessary. / Synchronization pulse is mandatory in TDM. FDM suffers the crosstalk problem. / The problem of crosstalk is not that prominent.	**4M** ***Definition 1M*** ***Compare FDM & TDM -3M (any 3Points)***

d) Ans. **Compare IPv4 and IPv6.** — **4M** *Any four points 1M each*

IPv4	IPv6
IPv4 uses 32-bit addresses, which means that the address space is 232	IPv6 has a much larger address space; 2128 addresses are available.
Binary Notation 01110101 10010101 00011101 00000010 Internet addresses are usually written in decimal form with a decimal point (dot) separating the bytes. 117.149.29.2	IPv6 specifies hexadecimal colon notation Original FDEC: 0074 : 0000 : 0000 : 0000 : BOFF : 0000
IPv4's IP addresses are divided into five different classes. Class A , Class B, Class C , Class D , Class E.	IPv6 does not have any classes of IP address.
IPv4 has a header of 20-60 bytes	IPv6 has header of 40 bytes fixed
In IPv4 Encryption and Authentication facility not provided	In IPv6 Encryption and Authentication are provided
In IPv4 checksum field is available.	In IPv6 checksum field is not available

e) Ans. **Draw the architecture of Bluetooth and explain.** — **4M**

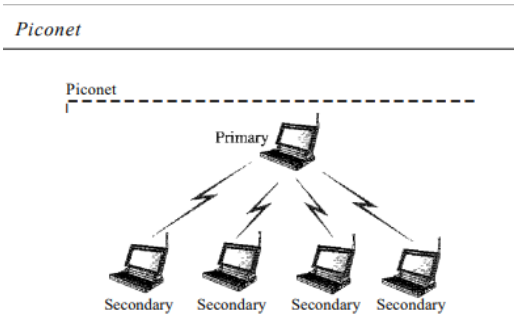
Piconet diagram 1M

Explanation 1M

Architecture Bluetooth defines two types of networks:
Piconet and Scatternet

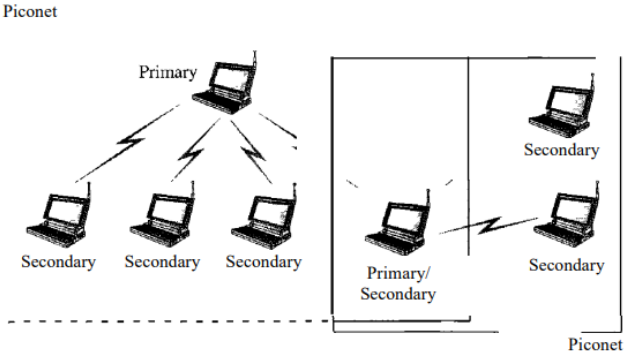
Piconets
A Bluetooth network is called a piconet, or a small net. A piconet can have up to eight stations, one of which is called the primary, the rest are called secondaries. All the secondary stations synchronize their clocks and hopping sequence with the primary.

A piconet can have only one primary station. The communication between the primary and the secondary can be one-to-one or one-to-many. Figure shows a piconet.
Although a piconet can have a maximum of seven secondaries, an additional eight secondaries can be in the parked state. A secondary in a parked state is synchronized with the primary, but cannot take part in communication until it is moved from the parked state. Because only eight stations can be active in a piconet, activating a station from the parked state means that an active station must go to the parked state.



Scatternet

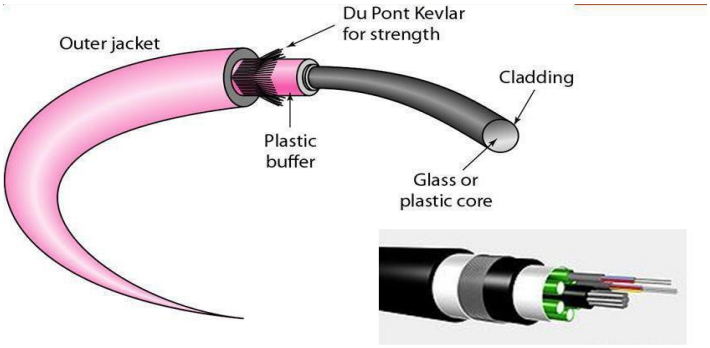
Piconets can be combined to form what is called a scatternet. A secondary station in one piconet can be the primary in another piconet. This station can receive messages from the primary in the first piconet (as a secondary) and, acting as a primary, deliver them to secondaries in the second piconet. A station can be a member of two piconets.
Figure illustrates a scatternet.

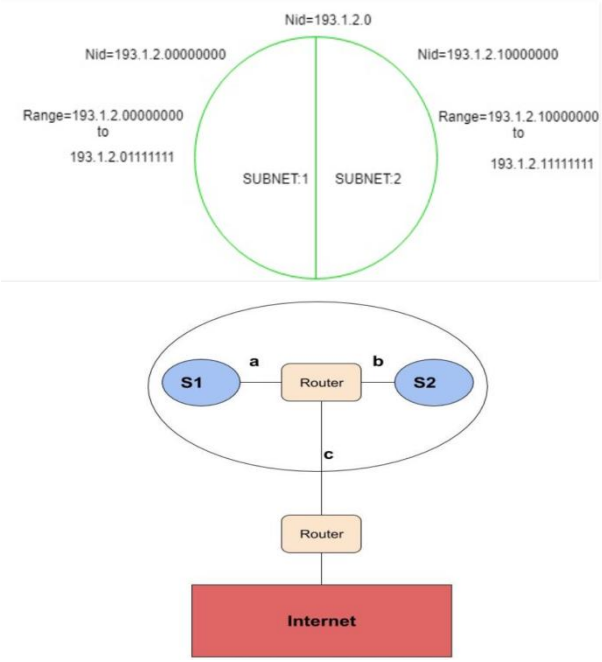


Scatternet diagram 1M

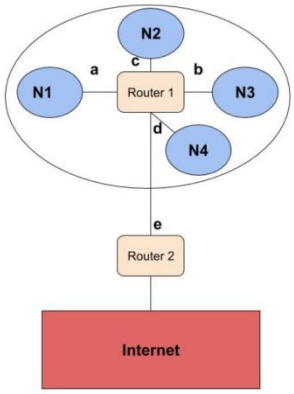
Explanation 1M

5.	**a)** **Ans.**	**Attempt any <u>TWO</u> of the following:** **Explain with diagram the process of client-server and peer to peer network architecture?** **Client server network**  **Figure: client /server architecture** **Client/Server Architecture** is one in which the client (personal computer or workstation) is the requesting machine and the server is the supplying machine, both of which are connected via a local area network (LAN) or wide area network (WAN). The client contains the user interface and may perform some or all of the application processing. Servers can be high-speed microcomputers, minicomputers or even mainframes. A database server maintains the databases and processes requests from the client to extract data from or update the database. An application server provides additional business processing for the clients. **Peer-to-Peer Architecture**  **Figure : peer-to –peer architecture**	**12** **6M** ***Diagram of each architecture 1M*** ***Explanation of each architecture 2M***

		A type of network in which each workstation has equal capabilities and responsibilities is called peer-to-peer network. Figure above shows the arrangement of computers in a peer-to-peer environment. Here each workstation acts as both a client and a server. There is no central repository for information and there is no central server to maintain. Data and resources are distributed throughout the network, and each user is responsible for sharing data and resources connected to their system.	
	b) **Ans.**	**Draw the neat sketch of fiber optical cable.Give the transmission characteristics of fiber optical cable .State its application**.  **Transmission Characteristics of Optical Fibers** • Fiber attenuation • Absorption – Extrinsic and Intrinsic • Scattering • Coupling Loss • Bending • Dispersion • Group velocity • Polarization-maintaining fibers **Applications**- • Fiber-optic cable is often found in backbone networks because its wide bandwidth is cost-effective. • **High speed**- with wavelength-division multiplexing (WDM), we can transfer data at a rate of 1600 Gbps.	**6M** ***Labelled Diagram 2M*** ***Any four Characteristics 2M*** ***Any two Applications 2M***

		• The SONET network provides such a backbone. • Some cable TV companies use a combination of optical fiber and coaxial cable, thus creating a **hybrid network**.	
	c) **Ans.**	**Describe the terms with suitable example –** **i) Subnetting** **ii) Supernetting** **iii)Masking** **Subnetting:** When a bigger network is divided into smaller networks, in order to maintain security, then that is known as Subnetting. So, maintenance is easier for smaller networks. In supernetting, Host addresses's bits are increased. For example, if we consider a class A address, the possible number of hosts is 224 for each network, it is obvious that it is difficult to maintain such a huge number of hosts, but it would be quite easier to maintain if we divide the network into small parts.  **Figure : Subnet**	**6M** ***Explanation of each term with suitable example 2M***

		In the above diagram, there are two Subnets. Note: It is a class C IP so, there are 24 bits in the network id part and 8 bits in the host id part. Subnetting for a network should be done in such a way that it does not affect the network bits. In class C the first 3 octets are network bits so it remains as it is. **ii) Supernetting** Supernetting is the procedure to combine the small networks into larger space. In subnetting, Network addresses's bits are increased. Supernetting is implemented via Classless interdomain routing. **Example:** Suppose we have four small networks with network ID as **201.1.0.0, 201.1.1.0, 201.1.2.0, 201.1.3.0.** The ability to aggregate these networks can be assessed based on the following 1. **Contiguous:** As we can see that all the four networks are Class C networks. The range of the first network is from 201.1.0.0 to 201.1.0.255. The range of the second network start from 201.1.1.0. If we add 1 to the last IP address of the first network we get the starting IP address of the second network. Similarly, we can check that all the networks are contiguous. 2. **Same Size: A**ll the networks are of class C. *3.* **Divisibility:** The first IP address should be divisible by the total size of the networks. *First IP address binary representation:* *11001001.00000001.000000* ***00.00000000*** The last 10 bits are zero. Hence it divisible by the size of the network. Hence, all three conditions are satisfied. These four networks can be combined to form a supernet. The **supernet ID or the network ID** for all the four networks will be **201.1.0.0** .	



iii) Masking

A subnet mask is a 32-bit number which is used to identify the subnet of an IP address. The subnet mask is combination of 1's and 0's. 1's represents network and subnet ID while 0's represents the host ID. For the IP address 255.255.255.192, subnet mask is,
11111111.11111111.11111111.11000000

6. **Attempt any TWO of the following:** **12**

a) Ans. **Draw the architecture of wireless LAN 802.11 and explain?** **6M**

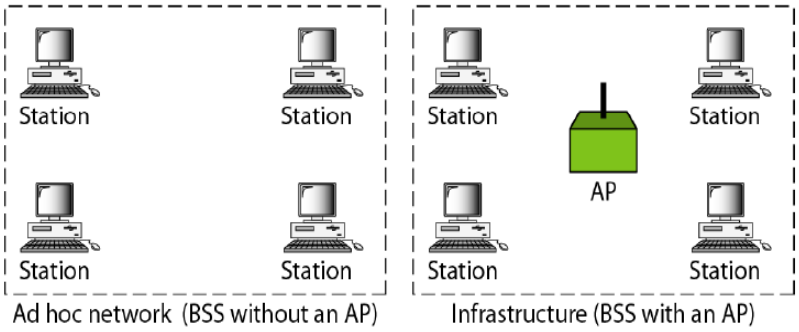
IEEE 802.11 Architecture

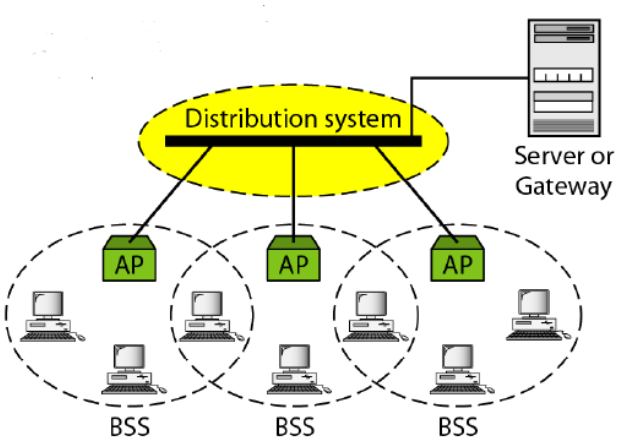
IEEE 802.11 defines two types of services which are
1) Basic Service Set (BSS)
2) Extended Service Set (ESS)

BSS Diagram & explanation 3M

1) Basic Service Set (BSS) −A basic service set is a group of stations communicating at physical layer level. BSS can be of two categories depending upon mode of operation:

ESS Diagram & explanation 3M



		• **Infrastructure BSS** − Here, the devices communicate with other devices through access points. When two or more stations come together to communicate with each other, they form a Basic Service Set (BSS) • **Ad-Hoc BSS** − Here, the devices communicate in peer-to-peer basis in an ad hoc manner. A BSS that stands alone is called an Ad-Hoc Network. **2) Extended Service Set (ESS)** − It is a set of all connected BSS. Creating large and complex networks using BSS's and Distribution System leads us to the next level of hierarchy, the Extended Service Set or ESS. 	
	b) Ans.	**Describe procedure to configure TCP/IP network layer services.** Before beginning configuration procedure, the following are the prerequisites. • Network hardware is installed and cabled. . • TCP/IP software is installed. To configure TCP/IP network, the following steps are followed: 1. Read TCP/IP protocols for the basic organization of TCP/IP. 2. Minimally configure each host machine on the network. This means adding a network adapter, assigning an IP address, and assigning a host name to each host, as well as defining a default route to the network.	**6M** ***Step by step procedure 6M***

		3. Configure and start the intend daemon on each host machine on the network. Read TCP/IP daemons and then follow the instructions in Configuring the intend daemon. 4. Configure each host machine to perform either local name resolution or to use a name server. If a hierarchical Domain Name network is being set up, configure at least one host to function as a name server. 5. If the network needs to communicate with any remote networks, configure at least one host to function as a gateway. The gateway can use static routes or a routing daemon to perform inters network routing. 6. Decide which services each host machine on the network are to be used. By default, all services are available. Follow the instructions in Client network services to make a particular service unavailable. 7. Decide which hosts on the network will be servers, and which services a particular server will provide. Follow the instructions in Server network services to start the server daemons to be run. 8. Configure any remote print servers that are needed.	
	c) Ans.	**Explain with the neat sketch the working of Router and switch** **Router:** • It operates at the network layer. • A router normally connects LANs and WANs in the Internet and has a routing table that is used for making decisions about the route. The routing tables are normally dynamic and are updated using routing protocols. • Routers are devices that help in determining the best path out of the available paths, for a particular transmission. They consist of a combination of hardware and software. • The two main kinds of software in a router are the operating system and the routing protocol. • Routers use logical and physical addressing to connect two or more logically separate networks. • Messages are stored in the routers before re-transmission, routers are said to implement a store-and-forward technique.	**6M** ***Diagram Of router 1M Explanation 2M*** ***Diagram Of switch 1M Explanation 2M***

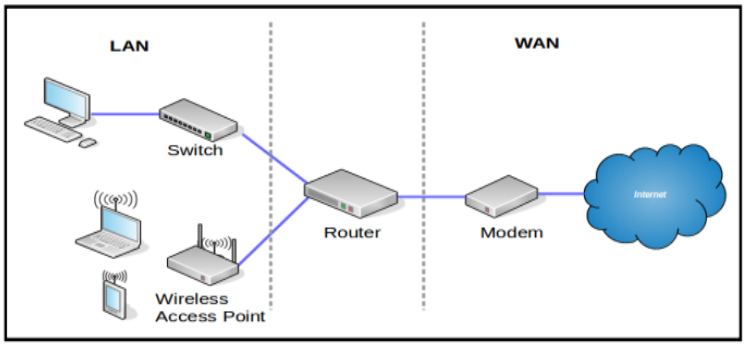


Fig: Router

Switch :

Switch is used to connect the multiple devices together in a LAN segment.

Switches are network devices used to connect multiple computers in which it can direct a transmission to its specific destination. (Unicast the signals).

There are two types of switches namely, Layer-2 and Layer-3 switches. They can be used to connect single or multiple networks.

Layer 2 Switches operate in the data link layer (layer 2) using the MAC addresses.

Layer 3 Switches operate in the network layer (layer 3) using the IP address

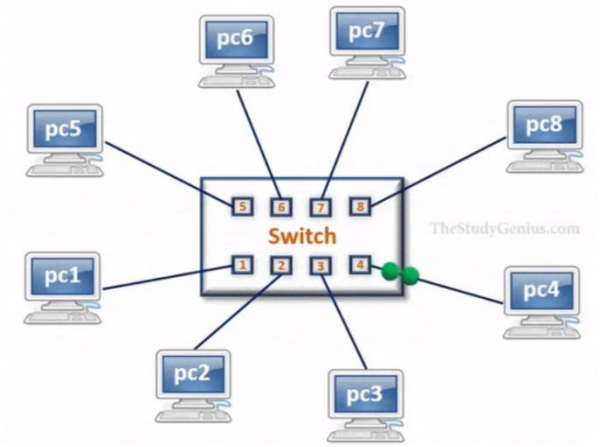


Figure: Switch