SUMMER – 19 EXAMINATION

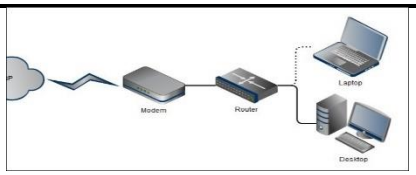
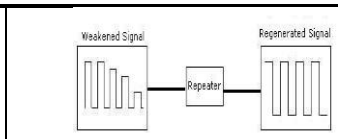
Subject Name: Data Communication Network **Model Answer** **Subject Code: 22414**

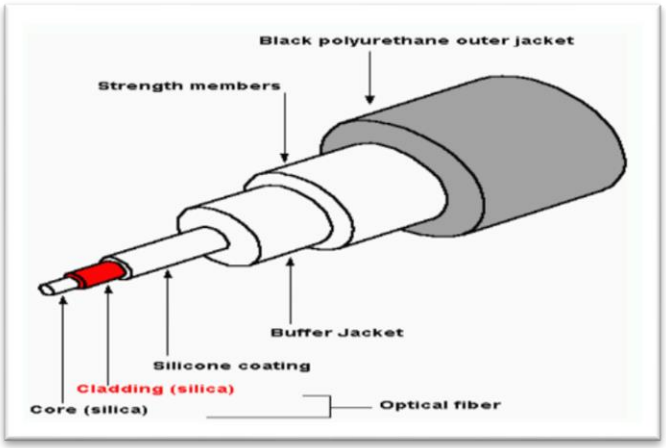
Important Instructions to examiners:

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.

Q. No.	Sub Q. N.	Answer	Marking Scheme
Q.1		**Attempt any five of the following:**	**10 M**
	a	**Define Computer Network and state its types.**	**2 M**
	Ans	Definition: A computer network is a group of computer systems and other computing hardware devices that are linked together through communication channels to facilitate communication and resource sharing among a wide range of users. Types of Computer Networks: • Local Area Networks (LAN) • Personal Area Networks (PAN) • Home Area Networks (HAN) • Wide Area Networks (WAN) • Metropolitan Area Networks (MAN) • The Internet	1 M definition , 1M for types
	b	**State various Computer Network applications**	**2 M**
	Ans	Computer Network Applications: 1. File Sharing	Any Four- 1/2

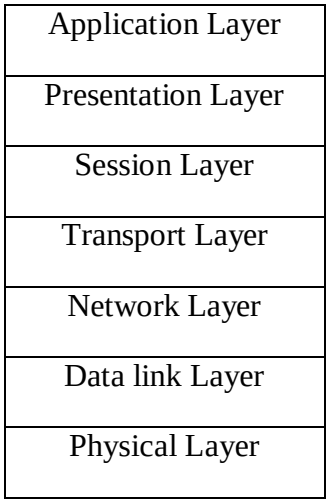
		2. Printer Sharing 3. Application Services 4. E-mail Services 5. Remote access 6. Internet & Intranet	M each
	C	**List any four Unguided Transmission Media.**	**2M**
	Ans	Unguided Media or Wireless media: (a) Radio wave (b) Microwave (c) infrared (d) Satellite	½ M each
	d	**State types of Errors**	
	Ans	Content Error Flow Integrity error	1 M each
	e	**List IEEE 802 X standards for networks**	**2M**
	Ans	1. 802.3: Ethernet 2. 802.4:Token Bus 3. 802.5:Token Ring 4. 802.11:Wi Fi(Wireless Fidelity)	1/2 M each
	f	**Compare Router and Repeater.**	**2M**
	Ans	**Router** / **Repeater** A router is a device like a switch that routes data packets based on their IP addresses. / Repeater regenerates the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network. Router is mainly a Network Layer device. / A repeater operates at the physical layer.	any 2 points 1 M each

		 	
	g	**State functions of Network layer**	**2M**
	Ans	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.	1/2M each
Q2		**Attempt any THREE of the following :**	**12 M**
	a	**Classify the network based on geographical area and transmission technology**	**4 M**
	Ans	**Classification of networks based on geography:** LAN - Local Area Network MAN - Metropolitan Area Network WAN - Wide Area Network CAN - Campus Area Network PAN - Personal Area Network LAN: LAN is local area network. LAN is privately-owned networks covering a small geographic area(less than 1 km), like a home, office, building or group of buildings. LAN transmits data with a speed of several megabits per second. MAN: A Metropolitan Area Network (MAN) is a large computer network that spans a metropolitan area or campus. 2. A MAN typically covers an area up to 10 kms (city). The best example of MAN is the cable Television network, available in many cities.	2 M for geographical area and 2 M for transmission technology. Explanation optional

		WAN: WAN is wide area network. WAN is a long-distance communication network that covers a wide geographic area, such as state or country. The most common example is internet. **The transmission technology can be categorized broadly into two types:** 1. Broadcast networks Broadcast networks have a single communication channel that is shared or used by all the machines on the network. Short messages called packets sent by any machine are received by all the others. Broadcast systems generally use a special code in the address field for addressing a packet to all the concerned computers. This mode of operation is called broadcasting. 2. Point-to-point networks Point to point networks consists of many connections between individual pairs of machines. To go from the source to the destination a packet on these types of network may have to go through intermediate computers before they reach the desired computer.	
	b	**Draw structural diagram of fiber optic cable and write its functions**	**4 M**
	Ans	 Fig. Structural diagram for Fibre Optic Cable Functions of Optical Cable: 1. **Single-mode fibers** - Used to transmit one signal per fiber (used in telephones and cable TV) 2. **Multi-mode fibers** - Used to transmit many signals per fiber (used in computer	2 M for diagram and 2 M for functions

		networks, local area networks)	
	c	**Describe various IEEE standards for network topologies.**	**4 M**
	Ans	A set of network standards developed by the IEEE. They include: • IEEE 802.1: Standards related to network management. • IEEE 802.2: General standard for the data link layer in the OSI Reference Model. The IEEE divides this layer into two sublayers -- the logical link control (LLC) layer and the media access control (MAC) layer. The MAC layer varies for different network types and is defined by standards IEEE 802.3 through IEEE 802.5. • IEEE 802.3: Defines the MAC layer for bus networks that use CSMA/CD. This is the basis of the Ethernet standard. • EEE 802.4: Defines the MAC layer for bus networks that use a token-passing mechanism (token bus networks). • IEEE 802.5: Defines the MAC layer for token-ring networks. • IEEE 802.6: Standard for Metropolitan Area Networks (MANs). • IEEE 802.11 Wireless Network Standards: 802.11 is the collection of standards setup for wireless networking.	1 Mark for 1 standard each
	d	**Draw and explain layered architecture of OSI model.**	**4M**
	Ans	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 Layer, Presentation Layer ,Session Layer ,Transport Layer ,Network Layer ,Data link Layer and Physical Layer **Physical (Layer 1)** 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 2)** 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. The data link layer is divided into two sub layers: The Media Access Control (MAC) layer and the Logical Link Control (LLC) layer. The MAC sub layer controls how a computer on the network gains access to the data and permission to transmit it. The LLC layer controls frame synchronization, flow control and error	1 M diagram and 3 M explanation

checking.



OSI Model

Network (Layer 3) 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 4) Model, Layer 4, 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 5) 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 6) 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 7) OSI Model, Layer 7, supports application and end-user processes. Everything at this layer is application-specific. This layer provides

<table>
<tr><td></td><td></td><td>application services for file.</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Q3</td><td></td><td>Attempt any THREE of the following :</td><td>12 M</td></tr>
<tr><td></td><td>a</td><td>What advantages does TDM have over FDM in a circuit switched network?</td><td>4 M</td></tr>
<tr><td></td><td>Ans</td><td>In TDM, each signal uses all of the bandwidth some of the time, while for FDM, each signal uses a small portion of the bandwidth all of the time.

TDM uses the entire frequency range but dynamically allocates time, certain jobs might require less or more time, which TDM can offer but FDM is unable to as it cannot change the width of the allocated frequency.

TDM provides much better flexibility compared to FDM.

TDM offers efficient utilization of bandwidth

Low interference of signal and minimizes cross talk</td><td>consider 4 points for 4 M</td></tr>
<tr><td></td><td>b</td><td>Compare Analog and Digital signal</td><td>4 M</td></tr>
<tr><td></td><td>Ans</td><td>
<table>
<tr><th>Analog signal</th><th>Digital signal</th></tr>
<tr><td>An analog signal is a continuous wave that changes over a time period.</td><td>A digital signal is a discrete wave that carries information in binary form.</td></tr>
<tr><td>An analog signal is represented by a sine wave.</td><td>A digital signal is represented by square waves.</td></tr>
<tr><td>Analog signal has no fixed range.</td><td>Digital signal has a finite numbers i.e. 0 and 1.</td></tr>
<tr><td>An analog signal is described by the amplitude, period or frequency, and phase.</td><td>A digital signal is described by bit rate and bit intervals.</td></tr>
<tr><td>An analog signal is more prone to distortion.</td><td>A digital signal is less prone to distortion.</td></tr>
<tr><td>An analog signal transmits data in the form of a wave.</td><td>A digital signal carries data in the binary form i.e. 0 and 1.</td></tr>
</table>
</td><td>1 M for each differenc e Consider any 4 valid points</td></tr>
<tr><td></td><td>c</td><td>With suitable diagram describe</td><td></td></tr>
<tr><td></td><td>Ans</td><td>(i) STAR Topology (ii) RING Topology

Star topology is a network topology where each individual piece of a network is</td><td>2M star topology- 1M for</td></tr>
</table>

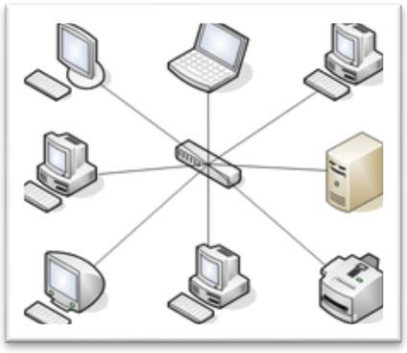
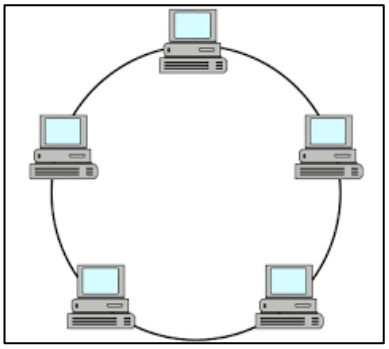
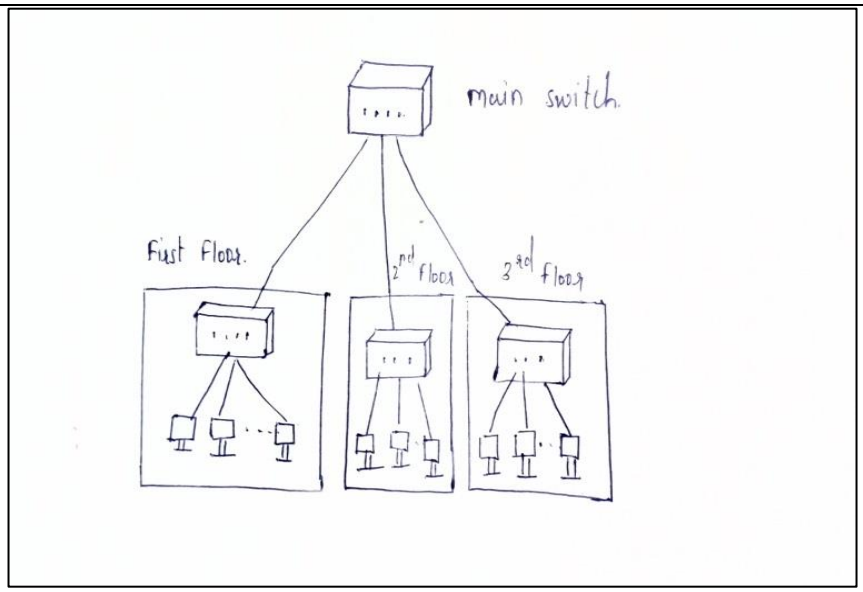
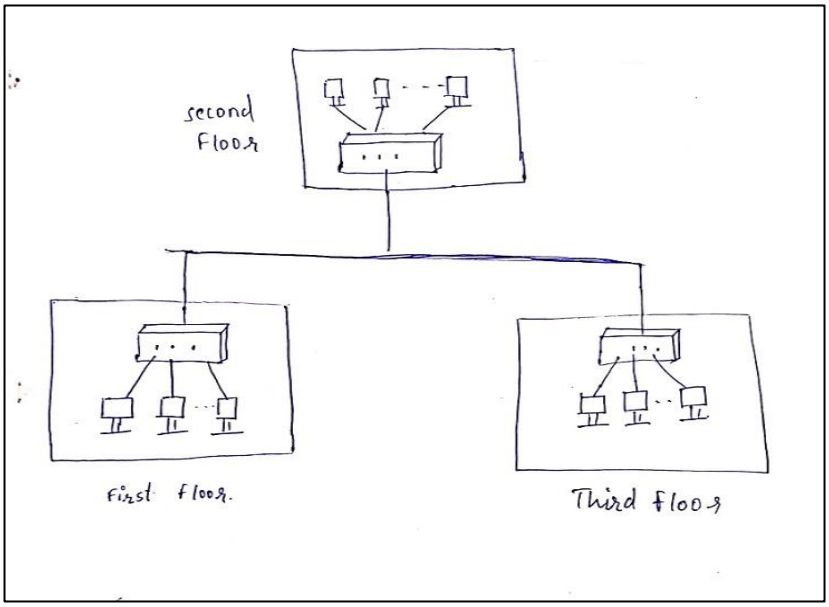
		attached to a central node (often called a hub or switch). The attachment of these network pieces to the central component is visually represented in a form similar to a star. The hub and hosts, and the transmission lines between them, form a graph with the topology of a star. Data on a star network 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 a: Star topology** The star network is one of the most common computer network topologies. (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. 	diagram and 1 mark for description ,2M ring topology- 1 M for diagram and 1 Mark for description

		Fig b: 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. This type of topology is highly efficient and handles heavier loads better than bus topology.	
	d	**Describe the major functions of network layer in TCP/IP protocol suite**	
	Ans	**Internetworking:** This is the main duty of network layer. It provides the logical connection between different types of networks. **Addressing:** Addressing is necessary to identify each device on the internet uniquely. This is similar to telephone system. The address used in the network layer should uniquely and universally define the connection of a computer. **Routing:** In a network, there are multiple roots available from a source to a destination and one of them is to be chosen. The network layer decides the root to be taken. This is called as routing. **Packetizing:** The network layer encapsulates the packets received from upper layer protocol and makes new packets. This is called as packetizing. It is done by a network layer protocol called IP (Internetworking Protocol).	1 M for each function
Q4		**Attempt any Five of the following:**	**12 M**
	a	**Draw and describe architecture for network using tree topology for an office in 3-storeys building.**	**4 M**
	Ans	A tree topology is a special type of structure in which many connected elements are arranged like the branches of a tree Here in the diagram the main switch is connected with three separate switches. For each floor separate switch is connected with multiple terminals.	Explain 1M ,Diagram 3M





	b	**Describe the functions of physical and data link layer of OSI model**	**4 M**
	ans	**Functions of Physical Layer** • Physical layer is the actual carrier of information between computers • Communication between computers happens due to physical layer • Data is actually carried between every adjacent node (computers/routers) by transmission of electromagnetic/optical signals at the physical layer over wired/wireless media	2M for Physical layer Function and 2 M for Data link layer)(4

- Physical layer therefore encompasses the set of all protocols/standards used in different types of Wired/Wireless interfaces and the telecommunication links connecting them
- It also includes the mechanical, electrical and timing specifications for different network interfaces

Functions of Data Link Layer

- Data link layer receives the data from the network layer & divide it into manageable units called frames.
- It then provides the addressing information by adding header to each frame.
- Physical addresses of source & destination machines are added to each frame.
- It provides flow control mechanism to ensure that sender is not sending the data at the speed that the receiver cannot process.
- It also provide error control mechanism to detect & retransmit damaged, duplicate, or lost frame, thus adding reliability to physical layer.
- Another function of data link layer is access control. When two or more devices are attached to the same link, data link layer protocols determine which device has control over the link at any given time.

functions each)

c **Differentiate between FDM and TDM** **4 M**

ans

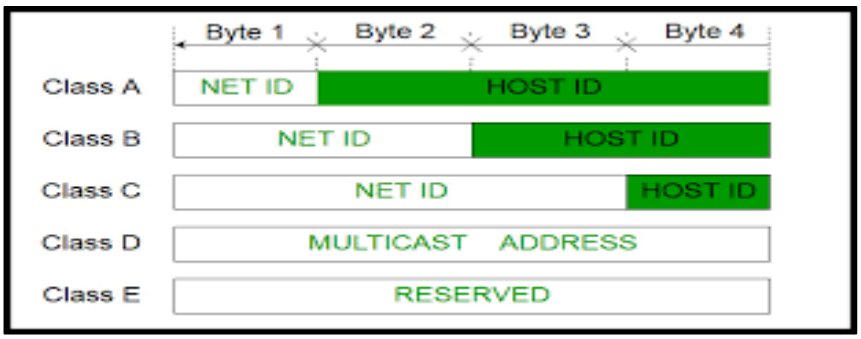
Frequency Division Multiplexing	**Time division Multiplexing**
FDM divides the channel into two or more frequency ranges that do not overlap	TDM divides and allocates certain time periods to each channel in an alternating manner
Frequency is shared	Times scale is shared
Used with Analog signals	Used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

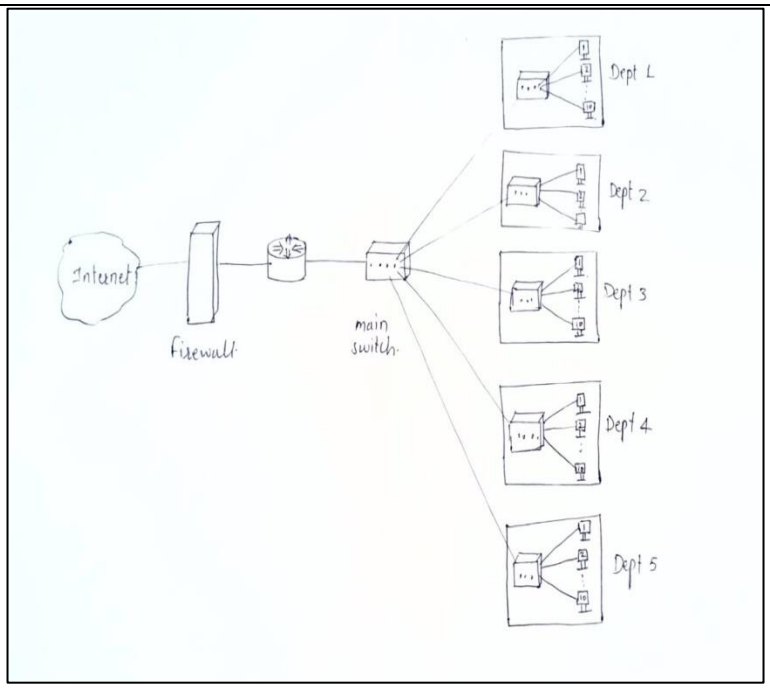
1M for each differenc e

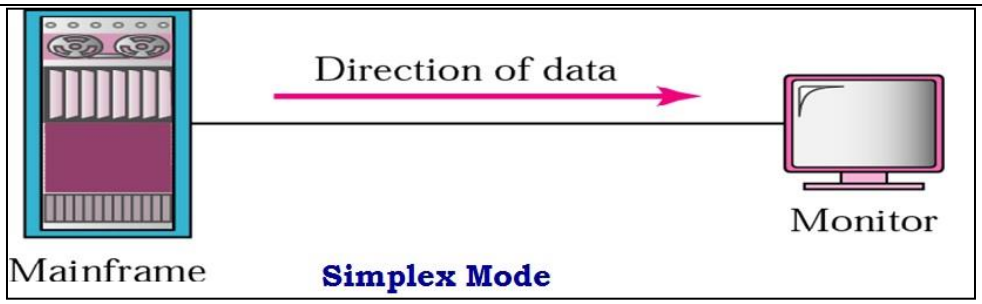
d **Describe types of IP address classes.** **4 M**

ans **Class A**:
Class A range for first byte is 0-127. Class A type of IP addresses have First byte

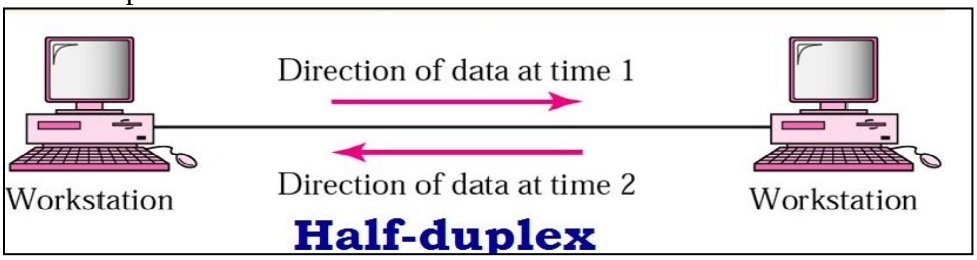
Explain 4 M

		consisting of Network address with first bit as 0 and the next 3 bytes with host id. Hence, number of hosts are more when compared to number of networks. The default subnet masks for class A networks is 255.0.0.0. Class A networks have their network addresses from 1.0.0.0 to 126.0.0.0, with the zero's being replaced by node addresses. **Class B**: Class B range for first byte is 128-191. This type has first two bytes specifying network ID with starting two bits as 10 and last two bytes referring to host ID. The default subnet masks for class B is 255.255.0.0. Network addresses for these ranges from 128.0.0.0 to 191.0.0.0. **Class C**: Class C range for first byte is 192-223. This class has first three bytes referring to network with starting bits as 110 and last byte signifies Host ID. Here, number of networks is more when compared to number of hosts in each network. The default subnet masks for class C is 255.255.255.0 The network IP addresses for these range from 192.0.0.0 to 223.0.0.0. **Class D**: Class D range for first byte is 224-239 Class D is used for multicasting and its starting bits are 1110 **Class E**: Class E range for first byte is 240-255 .Class E is reserved for future use and its starting bits are 1111  Fig : IP address classes	
	e	Design suitable network layout for an organization with five department	**4 M**

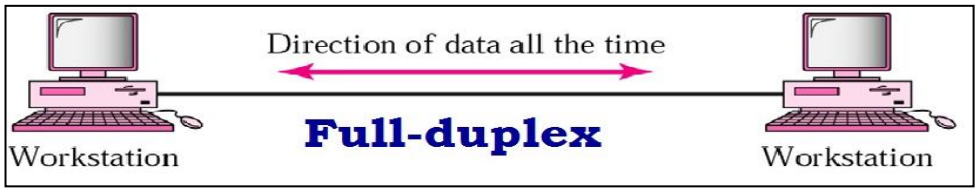
	ans		ten users each) (Correct dia 4M) Consider any suitable diagram
Q5		**Attempt any TWO of the following:**	**12 M**
	a	**Describe the process of data communication in various modes**	**6 M**
	ans	Transmission mode refers to the mechanism of transferring of data between two devices connected over a 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 a. 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.	mode explanation 1 M each & diagram 1 M each



a. 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.



b. 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.



	b	**Why is circuit switching preferred over packet switching in voice communication?**	**6 M**
	ans	Switching is a mechanism by which data/information sent from source towards destination which are not directly connected. Networks have interconnecting devices, which receives data from directly connected sources, stores data, analyse it and then forwards to the next interconnecting device closest to the destination. Switching can be categorized as: • Circuit switching • Packet switching	Any six points 1 M each

		• Message switching Circuit switching is preferred over packet switching in voice communication because: • In circuit switching, a dedicated path is established between sender and receiver which is maintained for entire duration of conversation. • It provides continuous and guaranteed delivery of data. • During the data transfer phase, no addressing is needed. • Delays are small. • It uses connection oriented service. • Message received in order to the destination	
	c	**Your company has the network id 165.130.0.0. You are responsible for creating subnets on the network, and each subnet must provide at least 1000 host ids. What subnet mask meets the requirement for the minimum number of host ids and provides the highest number of subnets?**	**6 M**
	ans	The given network id 165.130.0.0 is class B (Range of class B is 128.0.0.0 to 191.255.255.255) with subnet mask of 255.255.252.0 creates 62 subnets with 1022 host each. In binary format subnet mask reads: 11111111.11111111.11111100.00000000. To calculate the number of host ids available for each subnet is based on the number of digits remaining in the network address. The number of possible host ids in each subnet ranges from 00000001 through 11111110. So, in the network 165.130.0.0/22, host addresses can range from 165.130.0.1 through 165.130.254	Explanation 6 M
Q6		**Attempt any TWO of the following:**	
	a	**A system uses CRC on a block of 8 bytes. How many redundant bits are sent per block? What is the ratio of useful bits to total bits?**	**6 M**
	ans	CRC is one of the most common and powerful error detecting code which can be describe as follows. The polynomial code also known as CRC with co-efficient of 0s and 1s. In this method the sender and receiver must agree upon generator polynomial g(x) in advance. Both the high and low order bits of the generator (divisor) must be 1. To compute the checksum for some frame (data) with m bits, the frame must be longer than generator polynomial. The idea is to append checksum to the end of frame in such a way that the polynomial represented by the checksum frame is divisible by g(x). When the receiver gets the checksum frame it	**Description 6 M *The student may assume a polynomial or a**

		tries dividing it by g(x). If there is remainder there has been a transmission error and zero remainder means no error in the transmission. r is degree of g(x) polynomial. **Step by step procedure:** 1. Append a string of r zero bits to the lower order end of data word(m) where r is less than the number of bits pre-decided divisor by 1 bit i.e. if divisor = 5 bits then r = 4 zeros. Now data word contains m+r bits 2. Divide the newly generated data unit in step 1 by the divisor. It is module – 2 division 3. The remainder obtained after division is the r bit CRC. 4. This CRC will replace the r zeros appended to the data unit to get the code word to be transmitted. **NOTE**: The polynomial code for calculation of redundant bits is not given .hence the data given is insufficient for calculating redundant bits and the ratio of useful bits to total bits.	**divisor and do the problem. Full marks has to be given even if they explain the method or do the problem with assumptions'.**
	b	**Describe the process of DHCP server configuration.**	**6 M**
	ans	DHCP (Dynamic Host Configuration Protocol) is a client-server protocol that uses DHCP servers and DHCP clients. A DHCP server is a machine that runs a service that can lease out IP addresses and other TCP/IP information to any client that requests them. The DHCP server typically has a pool of IP addresses that it is allowed to distribute to clients, and these clients lease an IP address from the pool for a specific period of time, usually several days. Once the lease is ready to expire, the client contacts the server to arrange for renewal. DHCP clients are client machines that run special DHCP client software enabling them to communicate with DHCP server.  DHCP clients obtain a DHCP lease for an IP address, a subnet mask, and various DHCP options from DHCP servers in a four-step process: **DHCP DISCOVER**: The client broadcasts a request for a DHCP server. **DHCPOFFER**: DHCP servers on the network offer an address to the client. **DHCPREQUEST**: The client broadcasts a request to lease an address from one of	Diagram 2M, Explanation 4 M

		the offering DHCP servers. **DHCPACK**: The DHCP server that the client responds to acknowledges the client, assigns it any configured DHCP options, and updates its DHCP database. The client then initializes and binds its TCP/IP protocol stack and can begin network communication.	
	c	**What is the MAC protocol used in TOKEN ring LAN's? What happens if the token is lost?**	**6 M**
	ans	Token ring local area network (LAN) network is a communication protocol for local area networks.it uses special three-byte frame called a "token" that travels around a logical ring of workstations or servers. This token passing is a channel access method providing fair access for all stations, and eliminating the collision of contention-based access methods. Introduced by IBM in 1984, it was then standardized with protocol IEEE 802.5 and was fairly successful, particularly in the corporate environments, but gradually eclipsed by the later versions of Ethernet. The IEEE 802.5 Token ring technology provides for data transfer rates of either 4 or 16 Mbps. It works in the following manner: 1. Empty information frames are continuously circulated on the ring. 2. When a computer has a message to send, it inserts a token in an empty frame (simply changing a 0 to a 1 in the token bit part of the frame) and a message and a destination identifier in the frame. 3. The frame is the examined by each successive workstation. If workstation sees that it is the destination of the message, it copies the message from the frame and changes the token back to 0. 4. When the frame gets back to originator, it sees that message has been copied and received. The Fibre Distributed Data Interface (FDDI) also uses a Token ring protocol. If one device does not receive a token within a specified period, it can issue an alarm. The alarm alerts the network administrator to the problem and its location. Then, network administrator generates a new , free token **OR**	Description of MAC protocol 4 M, Explanation of token lost 2 M

		· There are two error conditions that could cause the token ring to break down. • One is the lost token in which case there is no token in the ring. • Other is the busy token that circulates endlessly. To overcome these problems, the IEEE 802 standard specifies that one of the stations must be designated as "active monitor". The monitor detects the lost condition using a timer by time-out mechanism and recovers by using a new free token	

WINTER – 19 EXAMINATION
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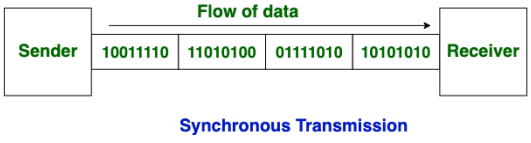
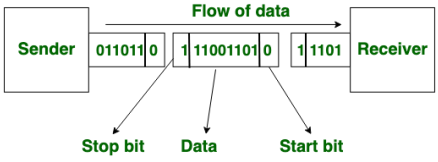
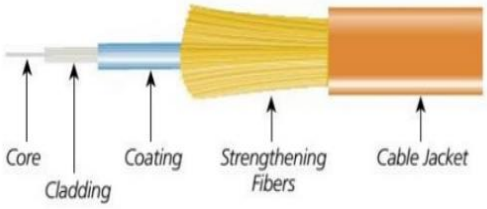
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model 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.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1.		**Attempt any Five of the following:**	**10M**
	a	**Define bit rate and baud rate.**	**2M**
	Ans	Bit Rate: Bit rate is simply the number of bits (i.e., 0's and 1's) transmitted per unit time. Baud Rate: Baud rate is the number of signal units transmitted per unit time that is needed to represent those bits.	1M-Bit rate 1M-Baud Rate
	b	**List different characteristics of data communication system.(Any two)**	**2M**
	Ans	1. Delivery 2. Accuracy 3. Timeliness 4. Jitter	1 M for 1 characteristic
	c	**Define guided and unguided communication media.**	**2M**
	Ans	**Guided communication media:** Guided transmission media are known as the **wired communication**. The electromagnetic signals travel between the communicating devices through a physical medium/conductor. **Unguided communication media:** The unguided media is also called **wireless communication**. It does not require any physical medium to transmit electromagnetic signals. In unguided media, the electromagnetic signals are broadcasted through air to everyone.	1M-Guided media 1M-Unguided media

<table>
<tr><td></td><td>d</td><td>Classify mobile generations.</td><td>2M</td></tr>
<tr><td></td><td>Ans</td><td>First Generation (1G)
Second Generation (2G)
Third Generation (3G)
Fourth Generation (4G) or LTE
Fifth Generation (5G)</td><td>All generations to be mentioned-2M</td></tr>
<tr><td></td><td>e</td><td>Compare LRC and CRC(Any two points each)</td><td>2M</td></tr>
<tr><td></td><td>Ans</td><td><table><tr><th>LRC</th><th>CRC</th></tr><tr><td>Longitudinal Redundancy Check (LRC)is a method in which a block of bits is organized in table(rows and columns)calculate the parity bit for each column and the set of this parity bit is also sending with original data. From the block of parity we can check the redundancy</td><td>Cyclic Redundancy Check (CRC) is one of the most common and powerful error detecting codes in which a sequence of redundant bits, called the CRC is appended to the end of the unit so that the resulting data unit become exactly divisible by a second, predetermined binary number.</td></tr><tr><td>LRC of n bits can easily detect</td><td>CRC is more powerful than</td></tr><tr><td>Burst error of n bits.</td><td>VRC and LRC in detecting errors.</td></tr><tr><td>A longitudinal redundancy check (LRC) is an error-detection method based on binary addition</td><td>CRC is based on binary division.</td></tr></table></td><td>2 M for any relevant 2 points</td></tr>
<tr><td></td><td>f</td><td>State different types of Network topologies.</td><td>2M</td></tr>
<tr><td></td><td>Ans</td><td>1. Mesh Topology
2. Star Topology
3. Bus Topology
4. Ring Topology
5. Hybrid Topology</td><td>Mention of all Topologies-2M</td></tr>
<tr><td></td><td>g</td><td>List classes of IP addressing with their IP address range.</td><td>2M</td></tr>
<tr><td></td><td>Ans</td><td>An IP address is an address used to uniquely identify a device on an IP network.
Classes and range:
Class A- 1.0.0.1 to 126.255.255.254
Class B - 128.1.0.1 to 191.255.255.254
Class C - 192.0.1.1 to 223.255.254.254
Class D- 224.0.0.0 to 239.255.255.255
Class E - 240.0.0.0 to 254.255.255.254</td><td>List1M,correct range 1M</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

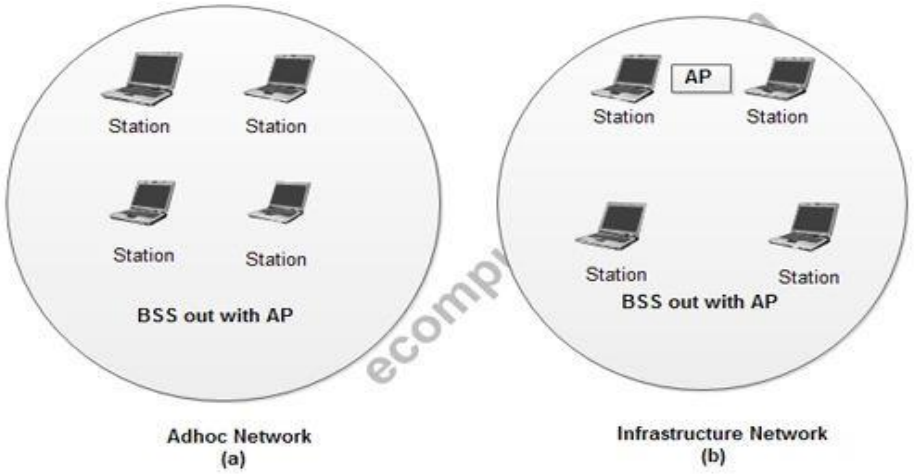
<table>
<tr><td>2.</td><td></td><td>Attempt any Three of the following:</td><td>12M</td></tr>
<tr><td></td><td>a</td><td>Differentiate between synchronous and asynchronous communication.(Any four points)</td><td>4M</td></tr>
<tr><td></td><td>Ans</td><td>
<table>
<tr><th>Synchronous communication</th><th>Asynchronous communication</th></tr>
<tr><td>In Synchronous Transmission, data is sent in form of blocks or frames.</td><td>In Asynchronous Transmission, data is sent in form of byte or character.</td></tr>
<tr><td>Sender and Receiver use the same clock signal</td><td>Does not need clock signal between the sender and the receiver</td></tr>
<tr><td>It is more efficient and more reliable than asynchronous transmission to transfer the large amount of data.</td><td>In this transmission start bits and stop bits are added with data.</td></tr>
<tr><td> 

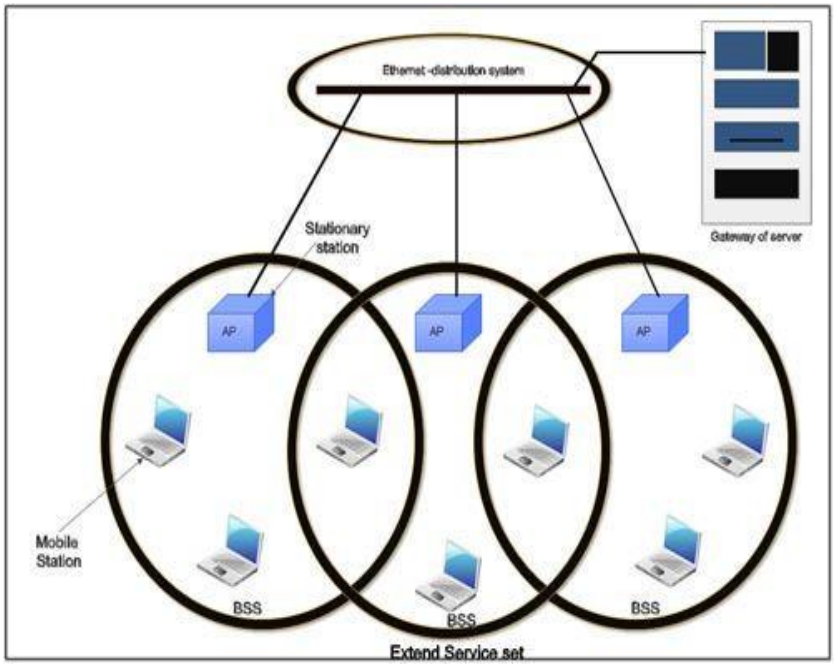
Synchronous Transmission</td><td> 

Asynchronous Transmission</td></tr>
<tr><td>Synchronous transmission is fast.</td><td>Asynchronous transmission is slow.</td></tr>
<tr><td>In Synchronous transmission, time interval of transmission is constant.</td><td>In asynchronous transmission, time interval of transmission is not constant, it is random.</td></tr>
</table>
</td><td>1M for 1 point</td></tr>
<tr><td></td><td>b</td><td>Draw and explain fiber optic cable.</td><td>4M</td></tr>
<tr><td></td><td>Ans</td><td> 

Fiber optic cable:

A fiber-optic cable is made up of glass or plastic.
It transmits signals in the form of light.
The outer jacket is made up of PVC or Teflon.
Kevlar strands are placed inside the jacket to strengthen the cable.
Below the Kevlar strands, there is another plastic coating which acts as a cushion.
The fiber is at the center of the cable, and it consists of cladding and glass core.
The density of the cladding is less than that of the core.
</td><td>2 M Labelled Diagram,2 M explanation</td></tr>
</table>

		• Optical fibers use the principle of 'reflection' to pass light through a channel.	
	c	**Explain wireless LAN 802.17 architecture.**	**4M**
	Ans	**Wireless LAN 802.11:** The IEEE 802.11 standard defines the physical layer and media access control (MAC) layer for a wireless local area network. Wireless LANs transmit and receive data over the atmosphere, using radio frequency (RF) or infrared optical technology, thereby; eliminating the need for fixed wired connections. **802.11 Architecture**: The 802.11architecture defines two types of services: 1. Basic services set (BSS) 2. Extended Service Set (ESS) **1. Basic Services Set (BSS)** • The basic services set contain stationary or mobile wireless stations and a central base station called access point (AP). • The use of access point is optional. • If the access point is not present, it is known as stand-alone network. Such a BSS cannot send data to other BSSs. This type of architecture is known as adhoc architecture. • The BSS in which an access point is present is known as an infrastructure network.  **Basic Service Sets** **2. Extend Service Set (ESS)** An extended service set is created by joining two or more basic service sets (BSS) having access points (APs).	**Consider IEEE 802.11 instead of 802.17** BSS diagram 1M, Explanation - 1M- ESS diagram 1M, Explanation - 1M ***Note:** **If student attempted to solve the answer give appropriate marks.**

		These extended networks are created by joining the access points of basic services sets through a wired LAN known as distribution system.  **There are two types of stations in ESS:** **(i) Mobile stations**: These are normal stations inside a BSS. **(ii) Stationary stations**: These are AP stations that are part of a wired LAN.	
	d	**State the functions of any two layers of OSI Model**	**4M**
	Ans	**The functions of the physical layer are :** 1. **Bit synchronization:** The physical layer provides the synchronization of the bits by providing a clock. This clock controls both sender and receiver thus providing synchronization at bit level. 2. **Bit rate control:** The Physical layer also defines the transmission rate i.e. the number of bits sent per second. 3. **Physical topologies:** Physical layer specifies the way in which the different, devices/nodes are arranged in a network i.e. bus, star or mesh topology. 4. **Transmission mode:** Physical layer also defines the way in which the data flows between the two connected devices. The various transmission modes possible are: Simplex, half-duplex and full-duplex.	Functions of each layer- 2M

Functions of data link layer:

- **Framing:** Data-link layer takes packets from Network Layer and encapsulates them into Frames. Then, it sends each frame bit-by-bit on the hardware. At receiver' end, data link layer picks up signals from hardware and assembles them into frames.
- **Addressing**: Data-link layer provides layer-2 hardware addressing mechanism. Hardware address is assumed to be unique on the link. It is encoded into hardware at the time of manufacturing.
- **Synchronization:** When data frames are sent on the link, both machines must be synchronized in order to transfer to take place.
- **Error Control:** Sometimes signals may have encountered problem in transition and the bits are flipped. These errors are detected and attempted to recover actual data bits. It also provides error reporting mechanism to the sender.
- **Flow Control:** Stations on same link may have different speed or capacity. Data-link layer ensures flow control that enables both machines to exchange data on same speed.
- **Multi-Access:** When host on the shared link tries to transfer the data, it has a high probability of collision. Data-link layer provides mechanism such as CSMA/CD to equip capability of accessing a shared media among multiple Systems.

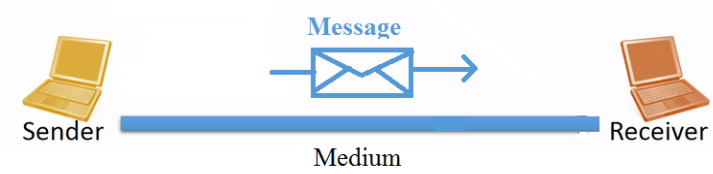
Functions of the Network layer are as follows:

- It is responsible for routing packets from the source host to the destination host. The routes can be based upon static tables that are rarely changed, or they can be automatically updated depending upon network conditions.
- The data link layer assigns the physical address locally. When the data packets are routed to remote locations, a logical addressing scheme is required to differentiate between the source system and the destination system. This is provided by the network layer.
- This layer also provides mechanisms for congestion control.
- The network layer tackles issues like transmission delays, transmission time, avoidance of jitters, etc.

Functions of Transport Layer

- **Service Point Addressing**: Transport Layer header includes service point address which is port address. This layer gets the message to the correct process on the computer unlike Network Layer, which gets each packet to the correct computer.
- **Segmentation and Reassembling**: A message is divided into segments; each segment contains sequence number, which enables this layer in reassembling the message. Message is reassembled correctly upon

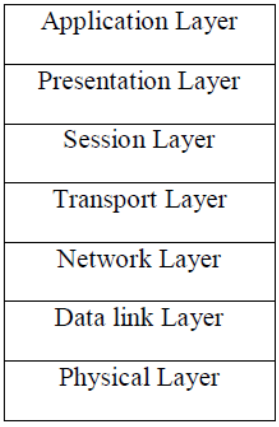
		arrival at the destination and replaces packets which were lost in transmission. • **Connection Control:** It includes 2 types: • **Connectionless Transport Layer**: Each segment is considered as an independent packet and delivered to the transport layer at the destination machine. • **Connection Oriented Transport Layer**: Before delivering packets, connection is made with transport layer at the destination machine. • **Flow Control:** In this layer, flow control is performed end to end. • **Error Control**: Error Control is performed end to end in this layer to ensure that the complete message arrives at the receiving transport layer without any error. Error Correction is done through retransmission. **The functions of the Session layer are :** 1. **Session establishment, maintenance and termination:** The layer allows the two processes to establish, use and terminate a connection. 2. **Synchronization:** This layer allows a process to add checkpoints which are considered as synchronization points into the data. These synchronization point help to identify the error so that the data is re-synchronized properly, and ends of the messages are not cut prematurely and data loss is avoided. 3. **Dialog Controller:** The session layer allows two systems to start communication with each other in half-duplex or full-duplex. **The functions of the presentation layer are :** 1. **Translation:** For example, ASCII to EBCDIC. 2. **Encryption/ Decryption:** Data encryption translates the data into another form or code. The encrypted data is known as the cipher text and the decrypted data is known as plain text. A key value is used for encrypting as well as decrypting data. 3. **Compression:** Reduces the number of bits that need to be transmitted on the network. **The functions of the Application layer are :** 1. Network Virtual Terminal 2. FTAM-File transfer access and management 3. Mail Services 4. Directory Services	
3.		**Attempt any Three of the following:**	**12M**
	a	**State the two advantages and disadvantages of unguided media**	**4M**
	Ans	**Advantages:** 1 .Use for long distance communication.	2 M advantages

		2. High speed data transmission. 3. Many receiver stations can receive signals from same sender station **Disadvantages :1.**.Radio waves travel through Lowest portion of atmosphere which can have lot of noise and interfering signals 2. Radio wave communication through unguided media is an insecure communication. 3.Radio wave propagation is susceptible to weather effects like rain, thunder and storm etc.	1 mark for each advantage 2 M Disadvantages 1mark for each disadvantage
	b	**Draw and explain block diagram of communication system.**	**4M**
	Ans	 Considering the communication between two computers , the communication system is as shown in above diagram **It has following five components:** 1. Message 2. Sender 3. Medium 4. Receiver 5. Protocol **Message:** • Message is the information or data which is to be sent from sender to the receiver • A message can be in the form of sound, text, picture, video or combination of them(multimedia) **Sender:** Sender is device such as host, camera, workstation, telephone etc. which sends the message over medium **Medium:** The message originated from sender needs a path over which it can travel to the receiver. Such path is called as medium or channel	1 M diagram. 3M explanation

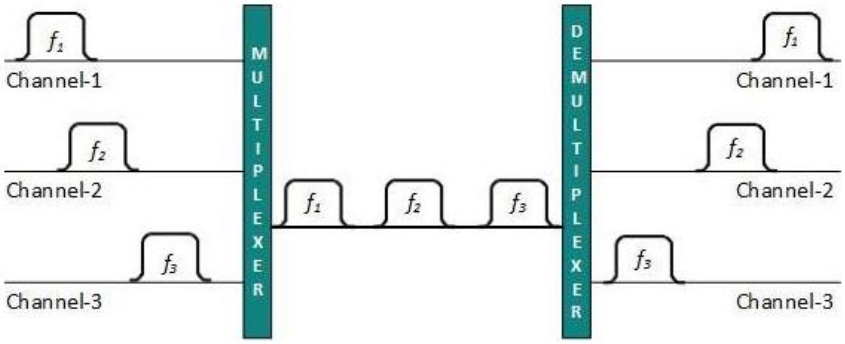
		Receiver: It is the device which receives the message and reproduces it. A receiver can be host, camera, workstation, telephone etc. **Protocol:** A protocol is defined as set of rules agreed by sender and receiver. Protocol governs the exchange of data in true sense.	
	c	**Describe different connecting devices used in computer network.**	**4M**
	Ans	**Network Connecting devices are:** 1. Repeater 2. Hub 3. Switch 4. Bridge 5. Router 6. Gateway 7. Modem **Repeater:** •It is used to take the distorted, weak and corrupt input signal and regenerate this signal at its output. •It ensures that the signals are not distorted or weak before it reaches the destination. •It recreates the bit pattern of the signal, and puts this regenerated signal back on to the transmission medium •It works in the physical layer with no intelligent function. **Hub:** •It is also known as multiport repeater. •It is normally used for connecting stations in a physical star topology. •It is the broadcasting device. •It sends packets to all nodes in the network. **Switch:** It is used to connect multiple computers in which it can direct a transmission toits specific destination. (Unicast the signals).	Any 4 devices. 1 M each

		•It is a unicasting device. •It avoids unnecessary network traffic. •It operates in both the physical and the data link layer. **Bridge:** •It is a device which connects two or more segment of a network. •A bridge filters data traffic at a network boundary. •Bridges reduces the amount of traffic on a LAN by dividing it into two segments. •It inspects incoming traffic and decides whether to forward or discard it. •It sends packets between two networks of same type. •A bridge operates in both the physical and the data link layer. **Gateway:** •It is a node in a computer network, a key stopping point for data on its way to or from other networks. •Gateway is protocol converter. •Gateway enables communication between different network architecture and environments. •It works at all layers of OSI model. **Router:** •It is a device that helps in determining the best and shortest path out of the available paths, for a particular transmission. •Routers use logical and physical addressing to connect two or more logically separate networks. •Router read complex network address in packet and efficiently directs packets from one network to another, reducing excessive traffic. •It works at Physical, Data-Link and Network Layer of OSI model •It Connect dissimilar networks. **Modem:**	

		•Modem works as modulator as well as demodulator. •It is the device used to converts digital signals generated by the computer into analog signals which can be transmitted over a telephone or cable line transforms incoming analog signals into their digital equivalents. •A two way communication is established.	
	d	**Draw and explain OSI reference model.**	**4M**
	Ans	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 Layer, Presentation Layer ,Session Layer, Transport Layer ,Network Layer ,Data link Layer and Physical Layer **Physical (Layer 1)** 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 2)** 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. The data link layer is divided into two sub layers: The Media Access Control (MAC) layer and the Logical Link Control (LLC) layer. The MAC sub layer controls how a computer on the network gains access to the data and permission to transmit it. The LLC layer controls frame synchronization, flow control and error checking. **Network (Layer 3)** 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 4)** Layer 4, 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 5)** 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	1 M diagram and 3 M explanation

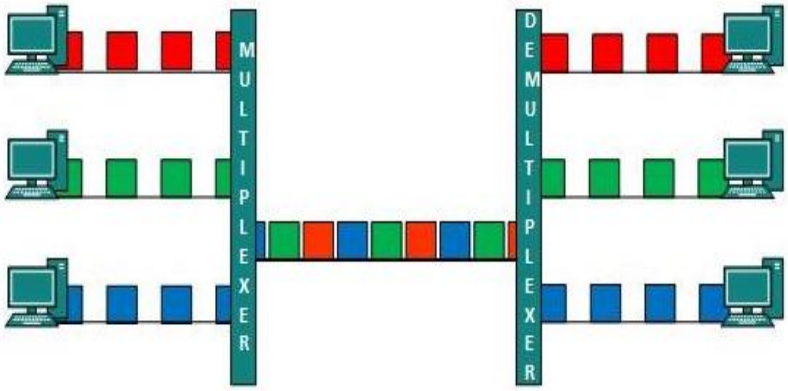
		Presentation (Layer 6) This layer provides independence from differences in data representation (e.g., encryption) by translating from application to network format, and vice versa. The presentation layer works to transform data into the form that the application layer can accept. This layer formats and encrypts data to be sent across a network, providing freedom from compatibility problems. It is sometimes called the syntax & semantics. **Application (Layer 7)** OSI Model, Layer 7, supports application and end-user processes. Everything at this layer is application-specific. This layer provides application services for file.  **OSI Model**	
4.		**Attempt any Three of the following:**	**12M**
	a	**Describe Multiplexing techniques**	**4M**
	Ans	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 **Frequency Division Multiplexing:** When the carrier is frequency, FDM is used. FDM is an analog technology. FDM divides the spectrum or carrier	2 M each technique explanation

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.

TDM works in synchronized mode. Both ends, i.e. Multiplexer and De-multiplexer are timely synchronized and both switch to next channel simultaneously.



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

b **Compare IPV4 and IPV6 (any four point)** **4M**

Ans Any 4 correct points1M each

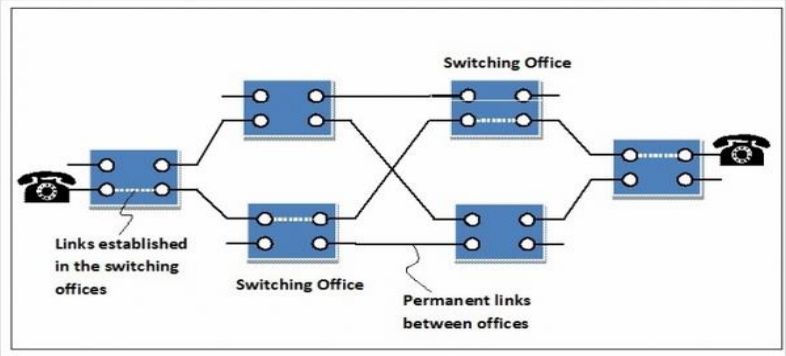
IPV4	IPv6
Source and destination addresses are 32 bits (4 bytes) in length.	Source and destination addresses are 128Bits (16 bytes) in length.
No. addresses are limited to number of bits (32 bits)	Larger addressing area
Uses broadcast addresses to send traffic to all nodes on a subnet.	There are no IPv6 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

c **Explain circuit switching networks with neat sketch.** **4M**

Ans Circuit switching is a connection-oriented network switching technique. Here, a dedicated route is established between the source and the destination and the entire message is transferred through it. 1 M for diagram. 3 M for explaination

Phases of Circuit Switch Connection:

- **Circuit Establishment**: In this phase, a dedicated circuit is established from the source to the destination through a number of intermediate switching centers. The sender and receiver transmits communication signals to request and acknowledge establishment of circuits.

		• **Data Transfer**: Once the circuit has been established, data and voice are transferred from the source to the destination. The dedicated connection remains as long as the end parties communicate. • **Circuit Disconnection**: When data transfer is complete, the connection is relinquished. The disconnection is initiated by any one of the user. Disconnection involves removal of all intermediate links from the sender to the receiver.  The diagram represents circuit established between two telephones connected by circuit switched connection. The blue boxes represent the switching offices and their connection with other switching offices. The black lines connecting the switching offices represent the permanent link between the offices.	
	d	**Draw and explain TCP/IP model.**	**4M**
	Ans	TCP/IP that is Transmission Control Protocol and Internet Protocol has following features ●Support for a flexible architecture. Adding more machines to a network was easy. ●The network is robust, and connections remained intact until the source and destination machines were functioning. The main idea was to allow one application on one computer to talk to (send data packets) another application running on different computer. Different Layers of TCP/IP Reference Model Below:	1 M for diagram. 3 M for explaination

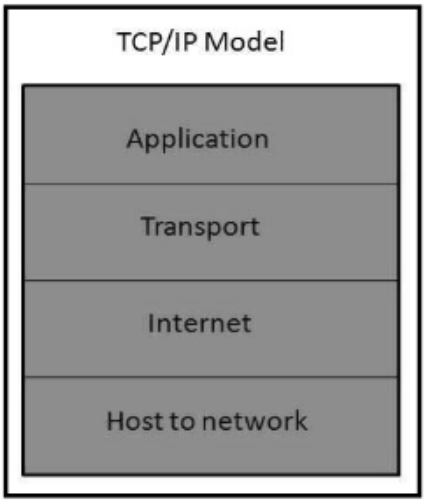


Fig: TCP/IP reference model

Layer 1: Host-to-network Layer

1. Lowest layer of the all.

2. Protocol is used to connect to the host, so that the packets can be sent over it.

3. Varies from host to host and network to network.

Layer 2: Internet layer

1. Selection of a packet switching network which is based on a connectionless internetwork layer is called a internet layer.

2. It is the layer which holds the whole architecture together.

3. It helps the packet to travel independently to the destination.

4. Order in which packets are received is different from the way they are sent.

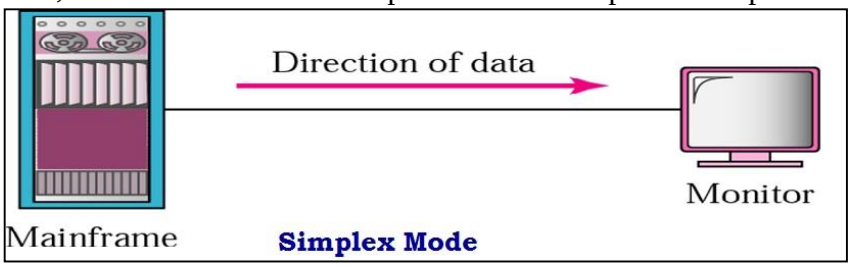
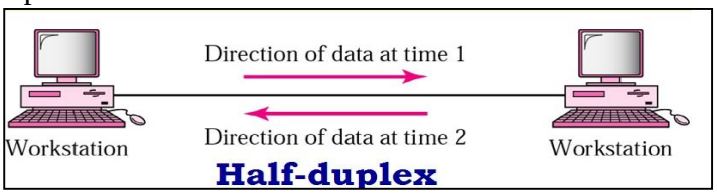
5. IP (Internet Protocol) is used in this layer.

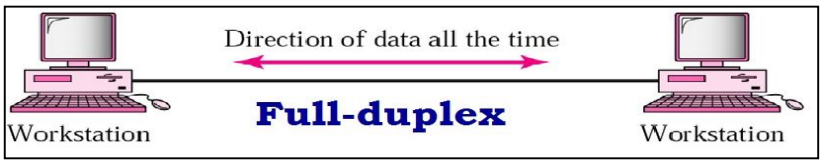
6. **The various functions performed by the Internet Layer are:**

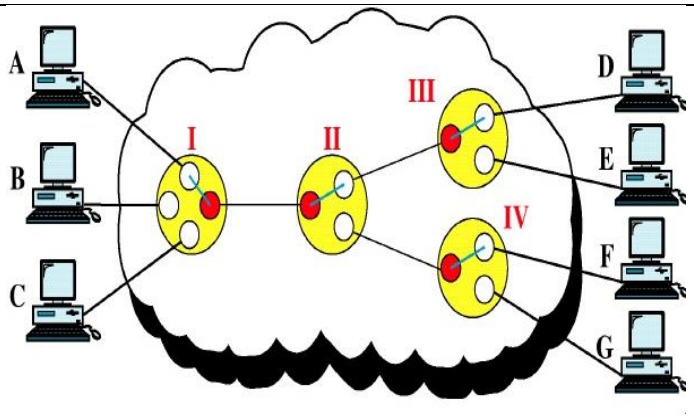
- Delivering IP packets
- Performing routing
- Avoiding congestion

Layer 3: Transport Layer

		1. It decides if data transmission should be on parallel path or single path. 2. Functions such as multiplexing, segmenting or splitting on the data is done by transport layer. 3. The applications can read and write to the transport layer. 4. Transport layer adds header information to the data. 5. Transport layer breaks the message (data) into small units so that they are handled more efficiently by the network layer. 6.Transport layer also arrange the packets to be sent, in sequence **Layer 4: Application Layer** The TCP/IP specifications described a lot of applications that were at the top of the protocol stack. Some of them were TELNET, FTP, SMTP, DNS etc. 1. Telnets a two-way communication protocol which allows connecting to a remote machine and run applications on it. 2. FTP (File Transfer Protocol) is protocol that allows File transfer amongst computer users connected over a network. It is reliable, simple and efficient. 3. SMTP (Simple Mail Transport Protocol) is a protocol, which is used to transport electronic mail between a source and destination, directed via a route. 4. DNS (Domain Name Server) resolves an IP address into a textual address for Hosts connected over a network. 5. It allows peer entities to carry conversation.6.It defines two end-to-end protocols: TCP and UDP.	
	e	**Explain various IEEE communication standards.**	**4M**
	Ans	A set of network standards developed by the IEEE. They include: • IEEE 802.1: Standards related to network management. • IEEE 802.2: General standard for the data link layer in the OSI Reference Model. The IEEE divides this layer into two sublayers -- the logical link control (LLC) layer and the media access control (MAC) layer. The MAC layer varies for different network types and is defined by standards IEEE 802.3 through IEEE 802.5. • IEEE 802.3: Defines the MAC layer for bus networks that use CSMA/CD. This is the basis of the Ethernet standard. IEEE 802.4: Defines the MAC layer for bus networks that use a token passing mechanism (token bus networks).	1 M for 1 standard each

		• IEEE 802.5: Defines the MAC layer for token-ring networks. • IEEE 802.6: Standard for Metropolitan Area Networks (MANs). • IEEE 802.11 Wireless Network Standards: 802.11 is the collection of standards setup for wireless networking.	
5.		**Attempt any Two of the following:**	**12M**
	a	**Explain simplex, half duplex and full duplex modes in data communication.**	**6M**
	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 **1.** 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.  **2.** 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.  **3**. In full-duplex mode both stations can transmit and receive data simultaneously. The transmission medium sharing can occur in two ways,	for each mode 1M for diagram 1M for explanation

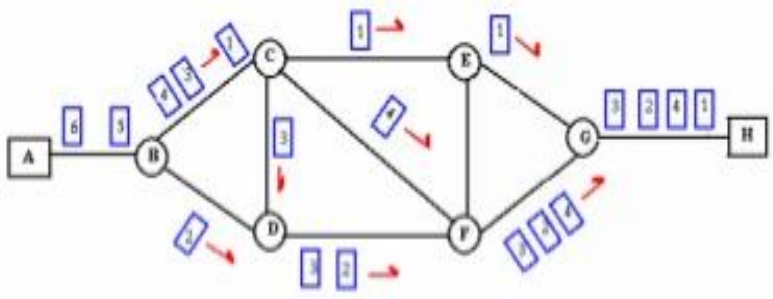
		namely, either the link must contain two physically separate transmission paths or the capacity of the channel is divided between signals traveling in both directions .One common example of full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time.  	
	b	**Describe the principles of packet switching and circuit switching techniques with neat diagram.**	**6M**
	Ans	**Circuit Switching:** When two nodes communicate with each other over a dedicated communication path, it is called circuit switching. There 'is a need of pre-specified route from which data will travels and no other data is permitted. In circuit switching, to transfer the data, circuit must be established so that the data transfer can take place. Circuits can be permanent or temporary. Applications which use circuit switching may have to go through three phases: ● Establish a circuit ● Transfer the data ● Disconnect the circuit	Circuit switching-3M 1 M –diagram, 2M explanation: Packet switching-3 M 1M- diagram, 2M explanation



Circuit switching was designed for voice applications. Telephone is the best suitable example of circuit switching. Before a user can make a call, a virtual path between callers and called is established over the network.

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.

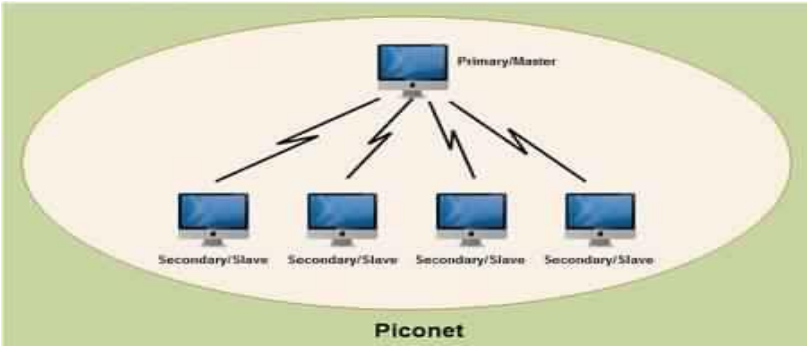
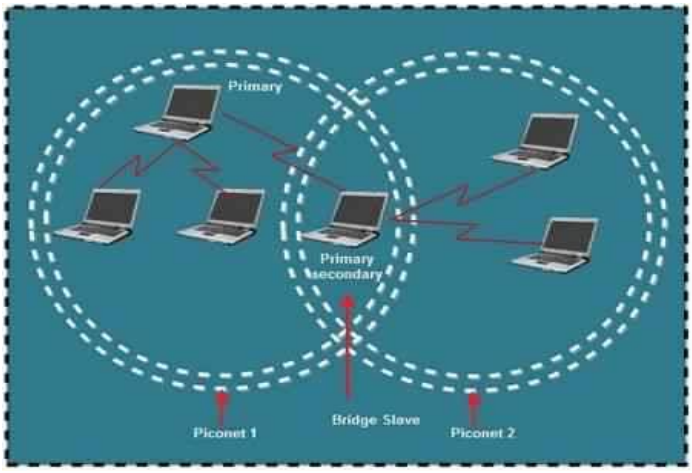
It is easier for intermediate networking devices to store small size packets and they do not take much resource either on carrier path or in the internal memory of switches.



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.

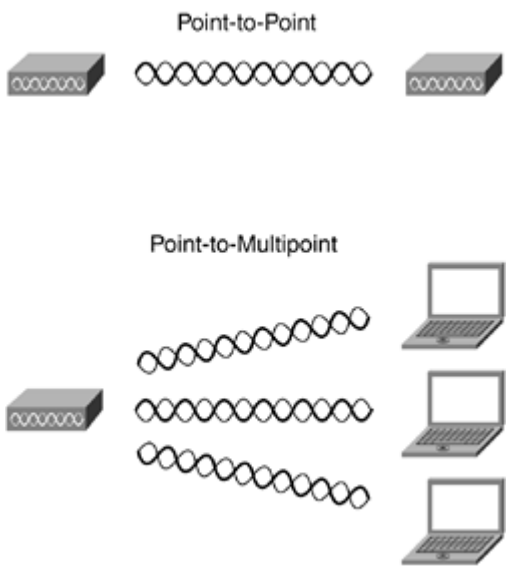
	c	**Explain configuration of TCP/IP protocol in network.**	**6M**
	Ans	Before beginning configuration procedure, the following are the prerequisites. ● Network hardware is installed and cabled. . ● TCP/IP software is installed. To configure your TCP/IP network, the following steps are followed: ● Read TCP/IP protocols for the basic organization of TCP/IP.	Step by step procedure -6M

		● 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 your network. For background information on these tasks, refer to TCP/IP network interfaces, TCP/IP addressing, and Naming hosts on your network. ● 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. ● Configure each host machine to perform either local name resolution or to use a name server. If a hierarchical Domain Name networks being set up, configure at least one host to function as a name server. ● 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. ● Decide which services each host machine on the network will use. By default, all services are available. Follow the instructions in Client network services if you wish to make a particular service unavailable. ● 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 you wish to run. ● Configure any remote print servers that are needed. ● Optional: If desired, configure a host to use or to serve as the master time server for the network.	
6.		**Attempt any Three of the following:**	**12M**
	a	**Describe Bluetooth architecture technologies.**	**6M**
	Ans	Bluetooth Architecture Bluetooth architecture defines two types of networks: 1. Piconet 2. Scatternet **1. 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.	Piconet 3M (1M diagram, 2M for explanation); Scatternet-3M(1M diagram, 2M for explanation

		• 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. **2. Scatternet** • Scattemet is formed by combining various piconets. • A slave in one piconet can act as a master or primary in other piconet. • Such a station or node can receive messages from the master in the first piconet and deliver the message to its slaves in other piconet where it is acting as master. This node is also called bridge slave. • Thus a station can be a member of two piconets. • A station cannot be a master in two piconets.  	
	b	**Explain the process of DHCP server configuration.**	**6M**

	Ans	**Configuring the DHCP Server** To configure the DHCP server: **1. From the Control Panel, go to Administrative Tools >> Computer Management >> Services and Application >> DHCP.** **2. From the Action menu, select New Scope.** The New Scope wizard is displayed. **3. Enter the following information as prompted:** ▪ Scope name and description: ▪ IP address range (for example, 192.168.0.170 to 192.168.0.171) ▪ Subnet mask (for example, 255.255.255.0) ▪ Add exclusions (do not exclude any IP addresses) ▪ Lease duration (accept the default of 8 days) ▪ Router (default gateway) of your subnet (for example, 192.168.0.1) ▪ Domain name, WINS server (these are not needed) ▪ Activate Scope? (select "Yes, I want to activate this scope now") **4. Click Finish to exit the wizard.** The contents of the DHCP server are listed. **5. Right-click Scope [**iPad dress**] scope-name and select Properties.** **6. In the Scope Properties box, click the Advanced tab.** **7. Select BOOTP only, set the lease duration to Unlimited, and click OK.** **8. Right-click Reservations.** The Controller A Properties box is displayed. **9. Enter the IP address and the MAC address for Controller A. Click Add.** The Controller B Properties box is displayed.	Step by step procedure- 6M

		10. Enter the IP address and the MAC address for Controller B. Click Add. The controllers are added to the right of the Reservations listing. **11. Right-click Scope [**iPad dress**] scope-name to disable the scope.** **12. Click Yes to confirm disabling of the scope.** **13. Right-click Scope and select Activate.**	
	c	**Describe wireless infrastructure components in detail.**	**6M**
	Ans	**Wireless Network Infrastructures** The infrastructure of a wireless network interconnects wireless users and end systems. The infrastructure might consist of base stations, access controllers, application connectivity software, and a distribution system. These components enhance wireless communications and fulfill important functions necessary for specific applications. **1. Base Stations** The base station is a common infrastructure component that interfaces the wireless communications signals traveling through the air medium to a wired network? Often referred to as a distribution system. Therefore, a base station enables users to access a wide range of network services, such as web browsing, e-mail access, and database applications. A base station often contains a wireless NIC that implements the same technology in operation by the user's wireless NIC. Residential gateways and routers are more advanced forms of base stations that enable additional network functions. As show in Figure a base station might support point-to-point or point-to-multipoint communications.	4 components-11/2M each



Base Stations Support Different Configurations

Access Controllers

In the absence of adequate security, quality of service (QoS), and roaming mechanisms in wireless network standards, companies offer access-control solutions to strengthen wireless systems. The key component to these solutions is an access controller, which is typically hardware that resides on the wired portion of the network between the access points and the protected side of the network. Access controllers provide centralized intelligence behind the access points to regulate traffic between the open wireless network and important resources. In some cases, the access point contains the access control function.

Application Connectivity Software

Web surfing and e-mail generally perform well over wireless networks. All it takes is a browser and e-mail software on the client device. Users might lose a wireless connection from time to time, but the protocols in use for these relatively simple applications are resilient under most conditions.

Special application connectivity software is necessary as an interface between a user's computer device and the end system hosting the application's software or database.

		Distribution System A wireless network is seldom entirely free of wires. The distribution system, which often includes wiring, is generally necessary to tie together the access points, access controllers, and servers. In most cases, the common Ethernet comprises the distribution system.	

SUMMER – 2022 EXAMINATION

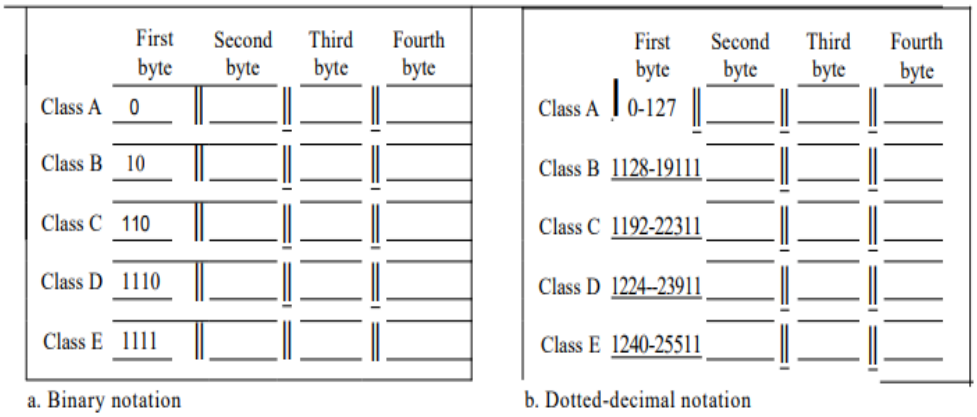
Subject Name:Data Communication & Computer Network **Model Answer** **Subject Code:** 22414

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	A computer network is a system that connects various independent computers in order to share information (data) and resources. OR A computer network is a collection of two or more computer systems that are linked together. A network connection can be established using either cable or wireless media. OR A computer network is defined as a system that connects two or more computing devices for transmitting and sharing information.	Correct definition-2 M
	b)	**List types of multiplexing.**	**2 M**

	Ans	Following are the types of multiplexing: 1. Frequency-Division Multiplexing 2. Wavelength-Division Multiplexing 3. Time-Division Multiplexing a) Synchronous Time-Division Multiplexing b) Asynchronous Time-Division Multiplexing	Correct types-2 M
	c)	**List different types of errors**	**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. **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.	2 types-2 M
	d)	**List different types of network connecting devices.**	**2 M**
	Ans	1. Hub a. Passive Hubs b. Active Hubs 2. Bridges 3. Two-Layer Switches 4. Routers 5. Three-Layer Switches 6. Gateway 7. Modem 8. Repeaters	Any 4 devices-2 M
	e)	**Define:** **(i) Bit rate** **(ii) Baud rate**	**2 M**
	Ans	i. <u>Bit rate:</u> Bit rate is defined as the transmission of a number of bits per second. Bit Rate cannot determine the bandwidth. ii. <u>Baud rate:</u> Baud rate is defined as the number of signal units per second. Baud rate can determine the amount of bandwidth necessary to send the signal.	Correct definition -1 M each
	f)	**List classes of IP addresses.**	**2 M**
	Ans	Class A, Class B, Class C, class D and Class E	Correct types-2 M

			
	g)	**Define following terms: -** **(i) Protocol** **(ii) Bandwidth**	**2 M**
	Ans	**i) <u>Protocol:</u>** 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, just as a person speaking French cannot be understood by a person who speaks only Japanese. **ii) <u>Bandwidth:</u>** The bandwidth of a composite signal is the difference between the highest and the lowest frequencies contained in that signal. For example, if a composite signal contains frequencies between 1000 and 5000, its bandwidth is 5000 - 1000, or 4000.	Correct definition- 1 M each
2.		**Attempt any <u>THREE</u> of the following:**	**12 M**
	a)	**Describe modes of communication.**	**4 M**
	Ans	○ The way in which data is transmitted from one device to another device is known as **transmission mode**. ○ The transmission mode is also known as the communication mode. The Transmission mode is divided into three categories: ○ Simplex mode ○ Half-duplex mode ○ Full-duplex mode **Simplex mode**	List-1M All 3 modes Explanation with figure- 3M

- In Simplex mode, the communication is unidirectional, i.e., the data flow in one direction.
- A device can only send the data but cannot receive it or it can receive the data but cannot send the data.
- This transmission mode is not very popular as mainly communications require the two-way exchange of data. The simplex mode is used in the business field as in sales that do not require any corresponding reply.
- 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.

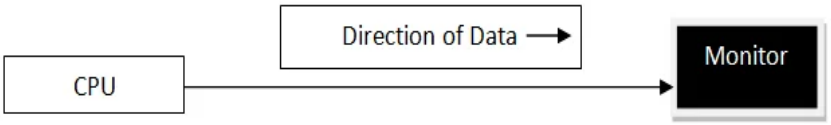


Fig: Simplex mode

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. Speaking simultaneously will create the distorted sound which cannot be understood.

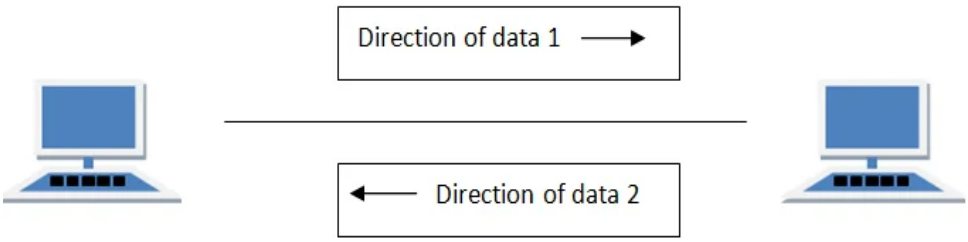


Fig: Half-Duplex mode

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. When two people are communicating with each other by a telephone line, both can talk and listen at the same time.

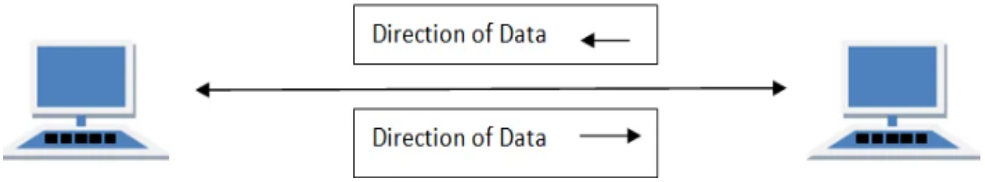


Fig: Full -Duplex mode

	b)	**Explain 802.11 Architecture.**	**4 M**
	Ans	**<u>IEEE 802.11</u>** IEEE has defined the specifications for a wireless LAN, called IEEE 802.11, which covers the physical and data link layers **<u>Architecture:</u>** The standard defines two kinds of services: the basic service set (BSS) and the extended service set (ESS). **<u>Basic Service Set</u>** IEEE 802.11 defines the basic service set (BSS) as the building block of a wireless LAN.	**BSS:** explanation with fig:2M **ESS:** explanation with fig:2M

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 and cannot send data to other BSSs. It is called an ad hoc architecture.

In this architecture, stations can form a network without the need of an AP; they can locate one another and agree to be part of a BSS. A BSS with an AP is sometimes referred to as an infrastructure network.

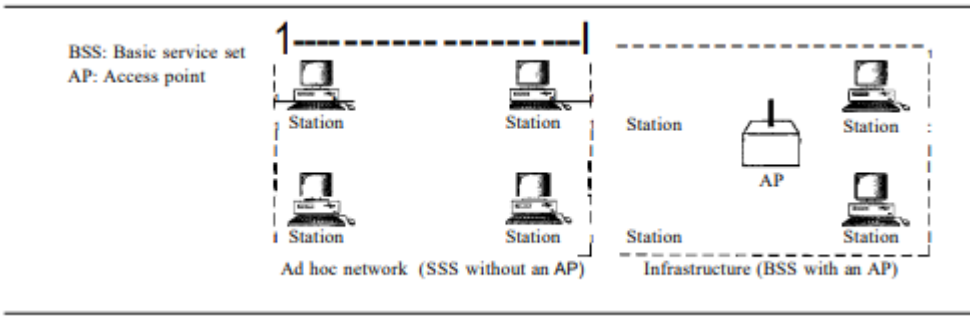


Fig:basic service set (BSS)

Extended Service Set

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. IEEE 802.11 does not restrict the distribution system; it can be any IEEE LAN such as an Ethernet. 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.

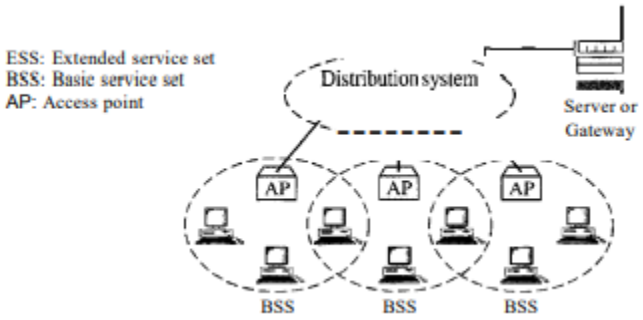


Fig: Extended service set (ESS)

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. The idea is similar to communication in a cellular network if we consider each BSS to be a cell and each AP to be a base station. Note that a mobile station can belong to more than one BSS at the same time.

	c)	**Explain Bluetooth Architecture.**	**4 M**
	Ans	Bluetooth technology is the implementation of a protocol defined by the IEEE 802.15 standard.	Explanation of Piconet

Architecture

Bluetooth defines two types of networks: piconet and scatternet.

with diagram-2M

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;t the rest are called secondaries. All the secondary stations synchronize their clocks and hopping sequence with the primary. Note that 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.

Explaination of Scatternet with diagram-2M

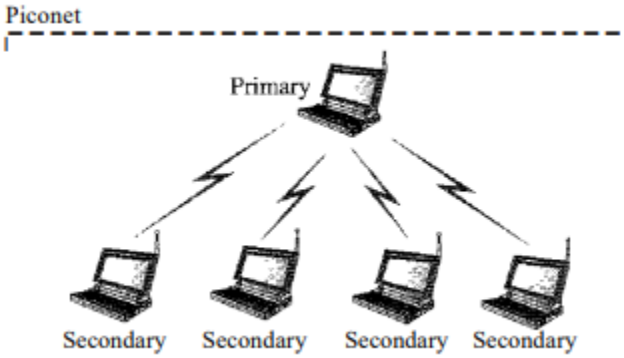


Fig: Piconet

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.

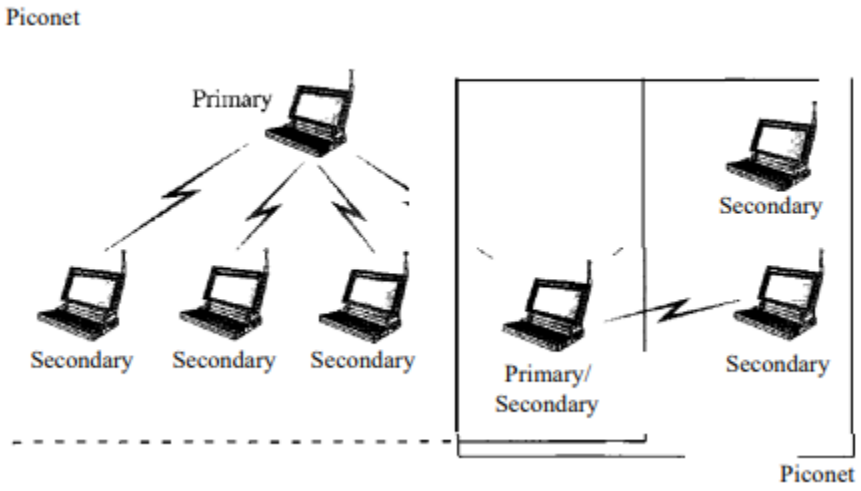


Fig: Scatternet

	d)	**Draw a neat diagram of twisted pair cable and state its types.**	**4 M**
	Ans	A twisted pair consists of two conductors (normally copper), each with its own plastic insulation, twisted together, as shown in Figure.	Diagram with naming-2 m All types -2M

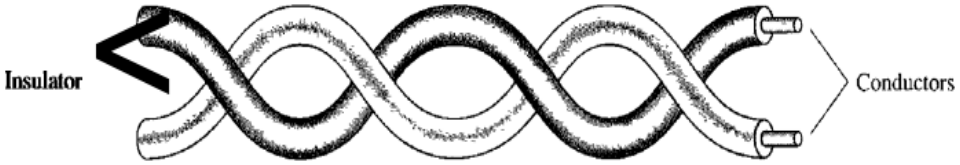


Fig: Twisted pair cable

<u>Types of Twisted–Pair Cables</u>

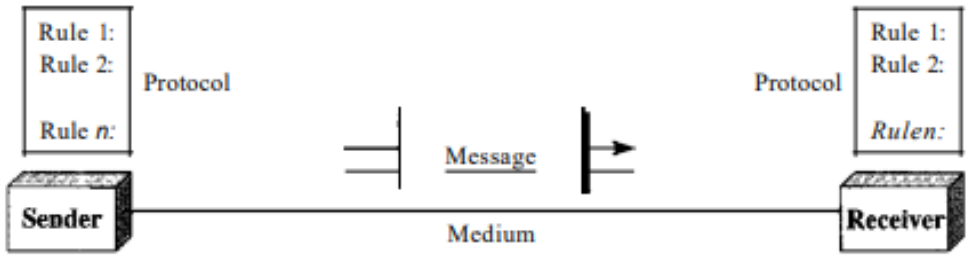
There are two types of twisted pair cables −

- Unshielded Twisted Pair (UTP): These generally comprise of wires and insulators.

Unshielded twisted pair cables are classified into seven categories −

- Category 1 − UTP used in telephone lines with data rate < 0.1 Mbps
- Category 2 − UTP used in transmission lines with a data rate of 2 Mbps
- Category 3 − UTP used in LANs with a data rate of 10 Mbps
- Category 4 − UTP used in Token Ring networks with a data rate of 20 Mbps
- Category 5 − UTP used in LANs with a data rate of 100 Mbps
- Category 6 − UTP used in LANs with a data rate of 200 Mbps
- Category 7 − STP used in LANs with a data rate of 10 Mbps

- Shielded Twisted Pair (STP): STP cable has a metal foil or braided mesh covering

		that encases each pair of insulated conductors.	
3.		**Attempt any THREE of the following:**	**12 M**
	a)	**Describe the components of data communication with neat diagram.**	**4 M**
	Ans	**Components of data communication: -**  Figure: components of data communication. 1. **Message** - It is the information to be communicated. Popular forms of information include text, pictures, audio, video etc. Text is converted to binary, number doesn't converted, image is converted to pixels, etc. 2. **Sender** - It is the device which sends the data messages. It can be a computer, workstation, telephone handset etc. 3. **Receiver** - It is the device which receives the data messages. It can be a computer, workstation, telephone handset etc. 4. **Transmission Medium** - It is the physical path by which a message travels from sender to receiver. Some examples include twisted-pair wire, coaxial cable, radio waves etc. 5. **Protocol** - It is a set of rules that governs the data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating.	2M for block diagram 2M for explanations
	b)	**Explain LRC with example.**	**4 M**
	Ans	Longitudinal redundancy check • Longitudinal Redundancy Check (LRC) is the error detection method which is used by upper layers to detect error in data. • The other name for LRC is 2-D parity check. In this method, data which the users want to send is organized into tables of rows and columns. • To detect an error, a redundant bit is added to the whole block after addition this block is transmitted to receiver side. • This redundant bit is used by receiver to detect error. If there is no error, receiver accepts the data and discards the redundant row of bits.	2M for explanation and 2M for example

Example

If a block of 32 bits is to be transmitted, it is divided into matrix of four rows and eight columns which as shown in the following figure:

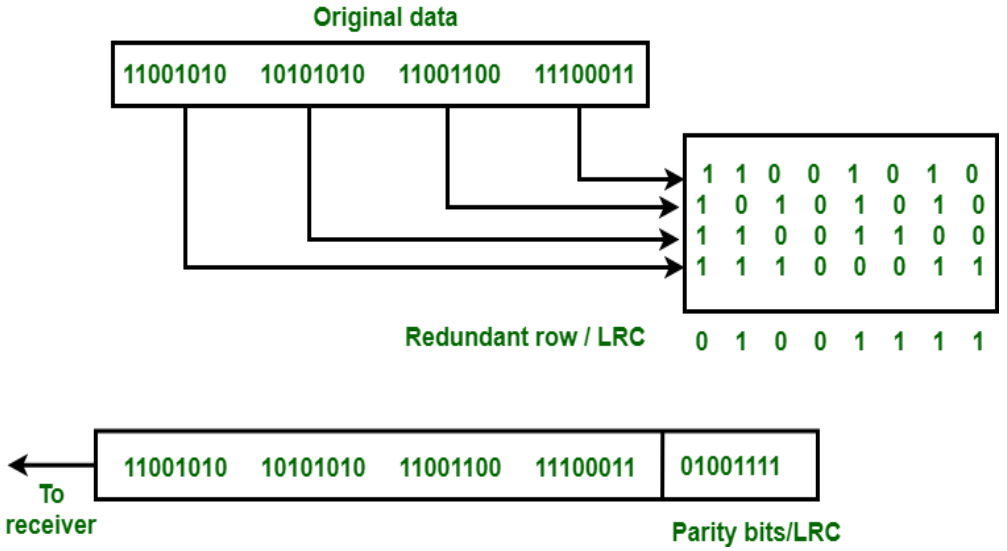
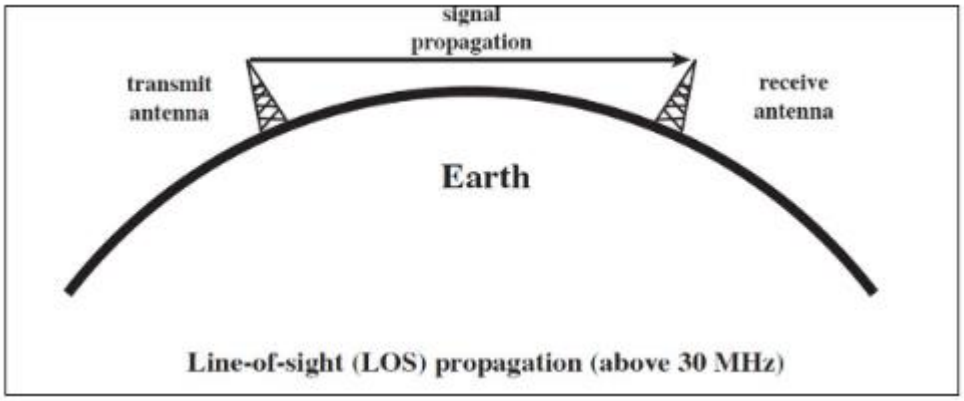


Figure: LRC

In this matrix of bits, a parity bit (odd or even) is calculated for each column. It means 32 bits data plus 8 redundant bits are transmitted to receiver. Whenever data reaches at the destination, receiver uses LRC to detect error in data.

Advantage:
LRC is used to detect burst errors.

	c)	**Describe line of sight transmission.**	**4 M**
	Ans	**Line of sight communication** • Line of sight (LoS) is a type of communication that can transmit and receive data only where transmit and receive stations are in view of each other without any sort of an obstacle between them. • Transmitting and receiving media should be in line of sight. • In line of sight communication, very high frequency signals are transmitted in straight lines directly from antenna to antenna. • Antenna must be directional, facing each other, and either tall enough or close enough together not to be effected by the curvature of earth. • Above 30 MHz, neither ground wave nor sky wave propagation modes operate, and communication must be by line of sight • For satellite communication, a signal above 30 MHz is not reflected by the ionosphere and therefore a signal can be transmitted between an earth station and a satellite overhead that is not beyond the horizon. For ground-based communication,	Explanation-3M Diagram-1M

		the transmitting and receiving antennas must be within an effective line of sight of each other. This is better understood with the help of the following diagram:  Line-of-sight (LOS) propagation (above 30 MHz) The figure depicts this mode of propagation very clearly. The line-of-sight propagation will not be smooth if there occurs any obstacle in its transmission path. As the signal can travel only to lesser distances in this mode, this transmission is used for infrared or microwave transmissions.	
	d)	**Describe various mobile generations in detail.**	**4 M**
	Ans	**1G – First generation** 1G refers to the first generation of wireless mobile communication where analog signals were used to transmit data. It was introduced in the US in early 1980s and designed exclusively for voice communication. **Features:** • Speeds up to 2.4 kbps • Poor voice quality • Large phones with limited battery life • No data security • Used analog signals **2G-Second generation** 2G refers to the second generation of mobile telephony which used digital signals for the first time. It was launched in Finland in 1991 and used GSM technology. 2G networks used digital technology. It implemented the concept of CDMA and GSM. Provided small data services like sms and mms. 2G capabilities are achieved by allowing multiple users on a single channel via multiplexing.	1M for any four correct generations along with two features

Features:

- Data speeds up to 64 kbps
- Text and multimedia messaging possible
- Better quality than 1G
- 2G requires strong digital signals to help mobile phones work. If there is no network coverage in any specific area, digital signals would weak.
- These systems are unable to handle complex data such as Videos.

When GPRS technology was introduced, it enabled web browsing, e-mail services and fast upload/download speeds. 2G with GPRS is also referred as 2.5G, a step short of next mobile generation

3G- Third generations

Third generation (3G) of mobile telephony began with the start of the new millennium and offered major advancement over previous generations.

3G has multimedia services support along with streaming. In 3G universal access and portability across different devices types are made possible.

3G increased the efficiency of frequency spectrum by improving how audio is compressed during a call. so more simultaneous calls can take place in same frequency range.

Like 2G, 3G evolved into 3.5G and 3.75G as more features were introduced in order to bring about 4G.

Features:

- Data speeds of 144 kbps to 2 Mbps
- High speed web browsing
- Running web based applications like video conferencing, multimedia e-mails, etc.
- Fast and easy transfer of audio and video files
- 3D gaming
- TV Streaming/ Mobile TV/ Phone Calls MUM1 Large Capacities and Broadband Capabilities
- Expensive fees for 3G Licenses Services

4G- Fourth generation

The main purpose of 4G is to provide high speed, high quality and high capacity to users while improving security and lower the cost of voice and date services, multimedia and internet over IP.

Fourth Generation (4G) mobile phones provides broadband cellular network services and is successor to 3G mobile networks. It provides an all IP based cellular communications. The capabilities provided adhere to IMT-Advanced specifications as laid down by International Telecommunication Union (ITU).

Features

- It provides an all IP packet switched network for transmission of voice, data, signals and multimedia.
- It aims to provide high quality uninterrupted services to any location at any time.
- As laid down in IMT-Advanced specifications, 4G networks should have peak data rates of 100Mbps for highly mobile stations like train, car etc., and 1Gbps for low mobility stations like residence etc.
- It also lays down that 4G networks should make it possible for 1 Gbps downlink over less than 67 MHz bandwidth.
- They provide have smooth handoffs across heterogeneous network areas.

5G- Fifth generation

- 5G is the 5th generation mobile network. It is a new global wireless standard after 1G, 2G, 3G, and 4G networks. 5G enables a new kind of network that is designed to connect virtually everyone and everything together including machines, objects, and devices.
  5G wireless technology is meant to deliver higher multi-Gbps peak data speeds, ultra low latency, more reliability, massive network capacity, increased availability, and a more uniform user experience to more users. Higher performance and improved efficiency empower new user experiences and connects new industries.
  Features
- High Speed, High Capacity 5G technology providing large broadcasting of data in Gbps.
- Multi - Media Newspapers, watch T. V pro clarity as to that of an HD Quality.
- Faster data transmission that of the previous generations.
- Large Phone Memory, Dialing Speed, clarity in Audio/Video.
- Support interactive multimedia, voice, streaming video, Internet and other
- 5G is More Effective and More Attractive.

4.		**Attempt any <u>THREE</u> of the following:**	**12 M**
	a)	**Consider a network with 8 computers, which network architecture should be used peer to peer or Client Server? Justify the answer**	**4 M**
	Ans	In the question it is given that we are supposed to consider eight computers. Both architecture can be considered depending upon the requirement. for eight computers I would like to prefer Peer to Peer network architecture. Because	For valid explanation 4M : either peer to peer or client-

- The number of computers or devices in the network is less than 15. For peer to peer network less than 10 devices shows good performance.
- Data security is not the top priority
- Networking is mainly required for hardware sharing.
- Advanced sharing is not required.
- Additional networking features are not required.
- The administrator personally knows all users of the network.
- The above conditions are usually fulfilled in home and small office networks. Thus, peer-to-peer networking is mostly used in home and small office networks.
- Less costly

Also if security is in priority and cost is not the consideration then I would prefer client server network it will provide a stable network.

server

b) Compare packet switched and circuit switched network. **4 M**

Ans **Packet switching and circuit switching comparison**

1 mark for each difference: any

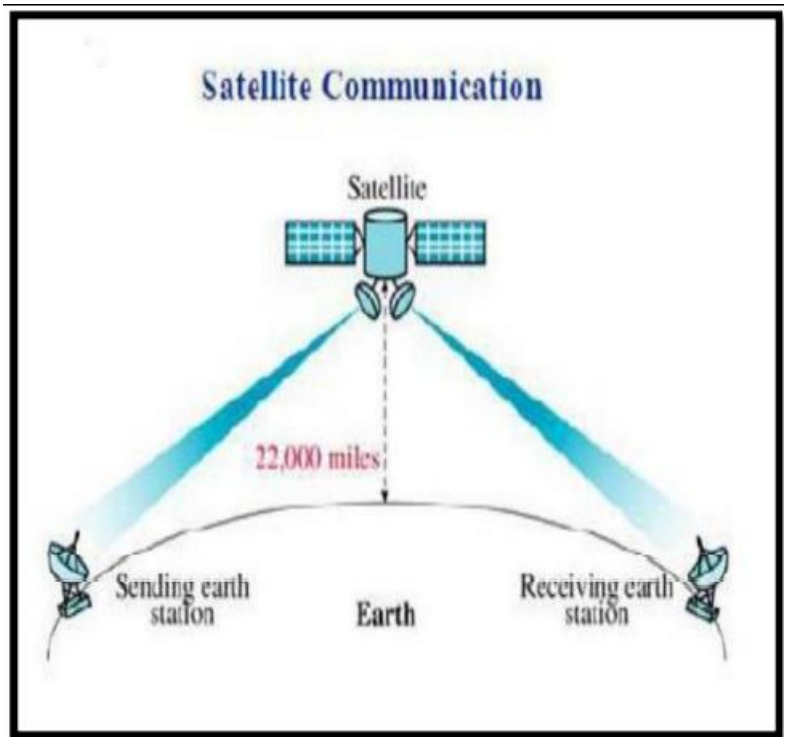
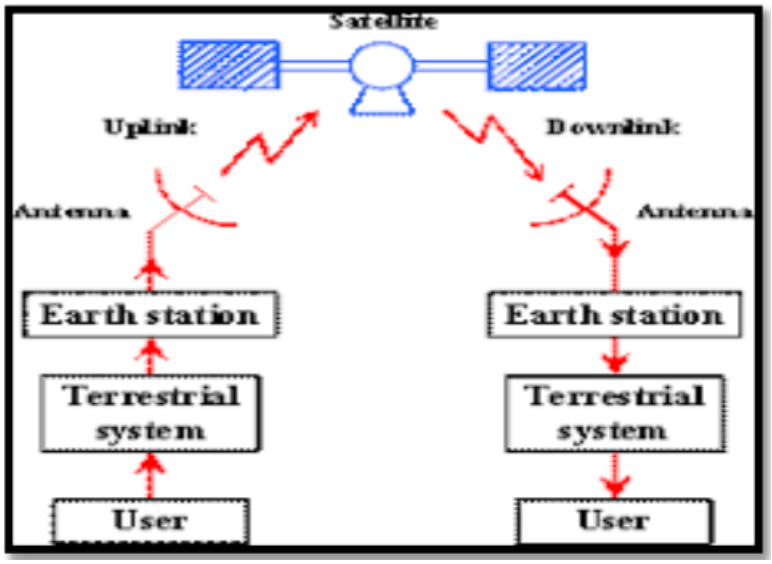
4 points 4 M

Packet switching	**circuit switching**
In-circuit switching has there are 3 phases: i)Connection Establishment. ii) Data Transfer. iii) Connection Released.	In Packet switching directly data transfer takes place.
In-circuit switching, each data unit knows the entire path address which is provided by the source.	In Packet switching, each data unit just knows the final destination address intermediate path is decided by the routers.
In-Circuit switching, data is processed at the source system only	In Packet switching, data is processed at all intermediate nodes including the source system.
Resource reservation is the feature of circuit switching because the path is fixed for data transmission.	There is no resource reservation because bandwidth is shared among users.
Wastage of resources is more in Circuit Switching	Less wastage of resources as compared to Circuit Switching
Transmission of the data is done by the source.	Transmission of the data is done not only by the source but also by the intermediate routers.
Congestion can occur during the connection establishment phase because there might be a case where a request is being made for a channel but the channel is already occupied.	Congestion can occur during the data transfer phase; a large number of packets comes in no time.
Circuit switching is not convenient for	Packet switching is suitable for handling

		handling bilateral traffic.	bilateral traffic.	
		In-Circuit switching, the charge depends on time and distance, not on traffic in the network.	In Packet switching, the charge is based on the number of bytes and connection time.	
		Recording of packets is never possible in circuit switching.	Recording of packets is possible in packet switching.	
		In-Circuit Switching there is a physical path between the source and the destination	In Packet Switching there is no physical path between the source and the destination	
		Circuit Switching does not support store and forward transmission	Packet Switching supports store and forward transmission	
		Call setup is required in circuit switching.	No call setup is required in packet switching.	
		In-circuit switching each packet follows the same route.	In packet switching packets can follow any route.	
		The circuit switching network is implemented at the physical layer.	Packet switching is implemented at the datalink layer and network layer	
		Circuit switching requires simple protocols for delivery.	Packet switching requires complex protocols for delivery.	
	c)	**List the protocols related to all layers of OSI reference model**		**4 M**
	Ans			1 M for two protocol each layer. consider any four layer in case of all correct.

OSI MODEL	PROTOCOLS
Application Layer	FTP,HTTP,Telnet
Presentation Layer	JPEG,MPEG
Session Layer	NFS,SQL,PAP
Transport Layer	TCP,UDP
Network Layer	IPv4,IPv6
Data Link Layer	ARP,CDP,STP
Physical Layer	Ethernet,Wi-Fi

	d)	**Explain satellite communication.**	**4 M**

	Ans	1. Satellite is a manmade 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). **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   5 . 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	2M diagram 2M for explanation

		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. 6. Therefore Geosynchronous satellites are used which move at same RPM as that of the earth in the same direction. 7. So the relative position of the ground station with respect to the satellite never changes. 8. However 3 satellites are needed to cover earth's surface entirely.	
	e)	**Describe the process of DHCP server configuration.**	**4 M**
	Ans	**Configuring the DHCP Server** To configure the DHCP server: 1. **From the Control Panel, go to Administrative Tools >> Computer Management >> Services and Application >> DHCP.** 2. **From the Action menu, select New Scope**. The New Scope wizard is displayed. 3. **Enter the following information as prompted**: • Scope name and description: • IP address range (for example, 192.168.0.170 to 192.168.0.171) • Subnet mask (for example, 255.255.255.0) • Add exclusions (do not exclude any IP addresses) • Lease duration (accept the default of 8 days) • Router (default gateway) of your subnet (for example, 192.168.0.1) • Domain name, WINS server (these are not needed) • Activate Scope? (select "Yes, I want to activate this scope now") 4. **Click Finish to exit the wizard.** The contents of the DHCP server are listed. 5. **Right-click Scope [iPad dress] scope-name and select Properties.** 6. **In the Scope Properties box, click the Advanced tab.** 7. **Select BOOTP only**, set the lease duration to Unlimited, and click OK. 8**. Right-click Reservations**. The Controller A Properties box is displayed. 9. Enter the IP address and the MAC address for Controller A. Click Add. The Controller B Properties box is displayed 10. **Enter the IP address and the MAC address for Controller B. Click Add**. The controllers are added to the right of the Reservations listing.	Step by step procedure 4M

		11. **Right-click Scope [iPad dress] scope-name to disable the scope.** **12. Click Yes to confirm disabling of the scope.** **13. Right-click Scope and select Activate.**	
5.		**Attempt any <u>TWO</u> of the following:**	**12 M**
	a)	**Explain the working of hub, switch and bridge.**	**6 M**
	Ans	**I. Hub:** Hubs are networking devices operating at a physical layer of the OSI model that are used to connect multiple devices in a network. They are generally used to connect computers in a LAN. **Working:** A hub has many ports in it. A computer which intends to be connected to the network is plugged in to one of these ports. When a data frame arrives at a port, it is broadcast to every other port, without considering whether it is destined for a particular destination device or not. Features of Hubs • A hub operates in the physical layer of the OSI model. • A hub cannot filter data. It is a non-intelligent network device that sends message to all ports. • It primarily broadcasts messages. So, the collision domain of all nodes connected through the hub stays one. • Transmission mode is half duplex.	2M each for Hub, switch and Bridge

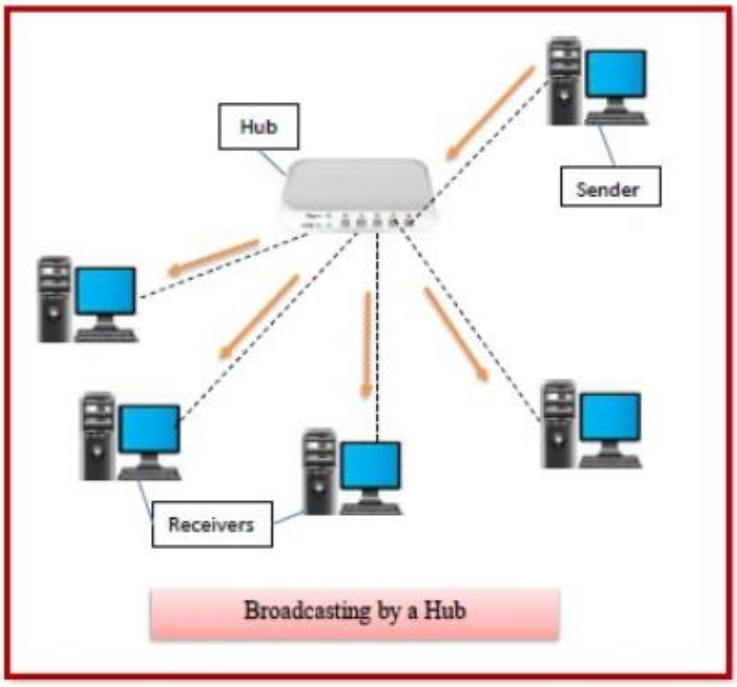


Fig: working of Hub

II. Switch:

Switches are networking devices operating at layer 2 or a data link layer of the OSI model. They connect devices in a network and use packet switching to send, receive or forward data packets or data frames over the network.

Working:
A switch has many ports, to which computers are plugged in. When a data frame arrives at any port of a network switch, it examines the destination address, performs necessary checks and sends the frame to the corresponding device(s). It supports unicast, multicast as well as broadcast communications.

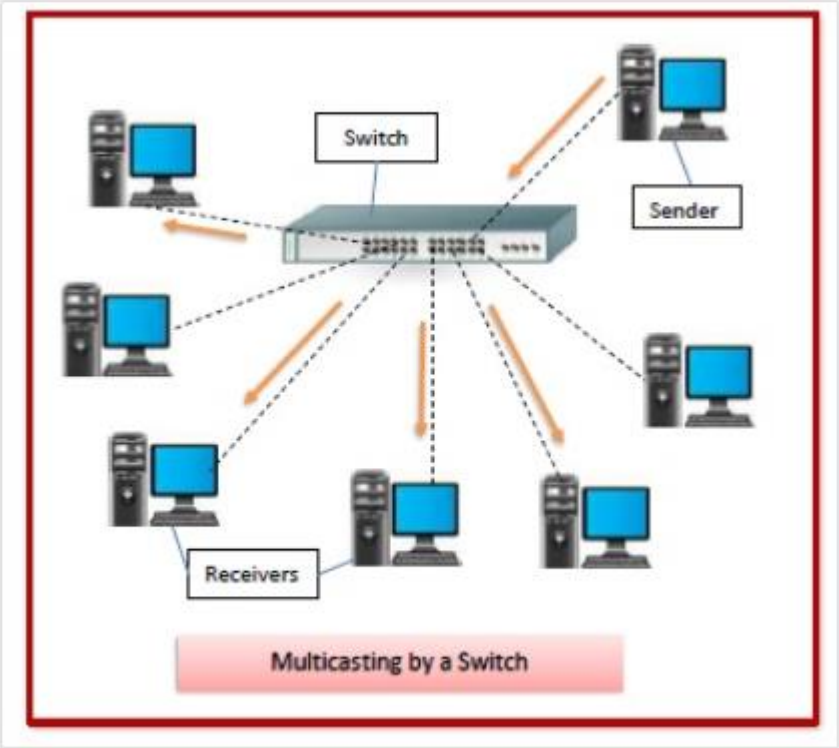


Fig: working of Switch

Features of Switches

- It is an intelligent network device that can be conceived as a multiport network bridge.
- It uses MAC addresses (addresses of medium access control sublayer) to send data packets to selected destination ports.
- It uses packet switching technique to receive and forward data packets from the source to the destination device.
- It is supports unicast (one-to-one), multicast (one-to-many) and broadcast (one-to-all) communications

III. Bridge:

Bridges are used to connect similar network segments.
It combines two LANs to form an extended LAN.

Working:

A bridge accepts all the packets and amplifies all of them to the other side. The bridges are intelligent devices that allow the passing of only selective packets from them. A bridge only passes those packets addressed from a node in one network to another node in the other network.

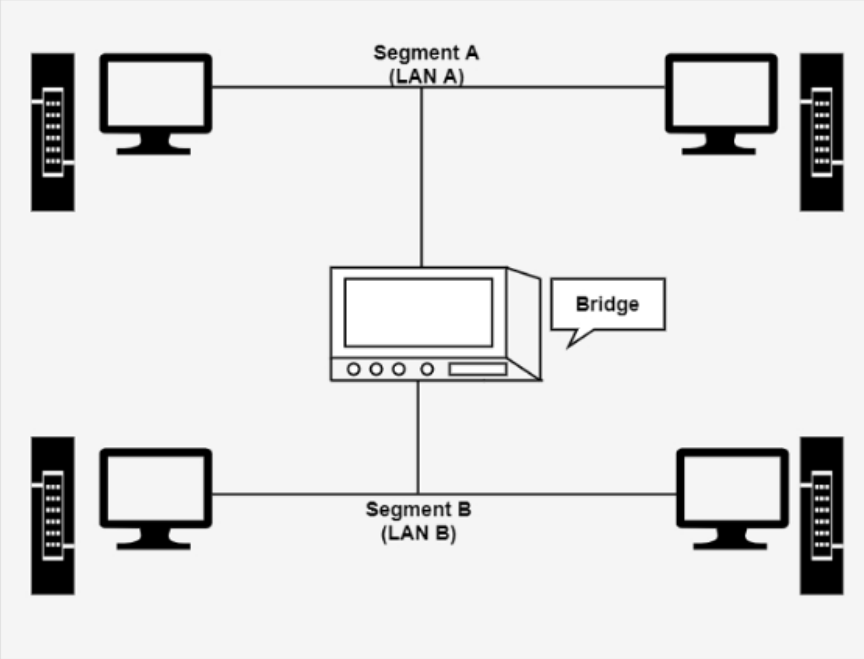
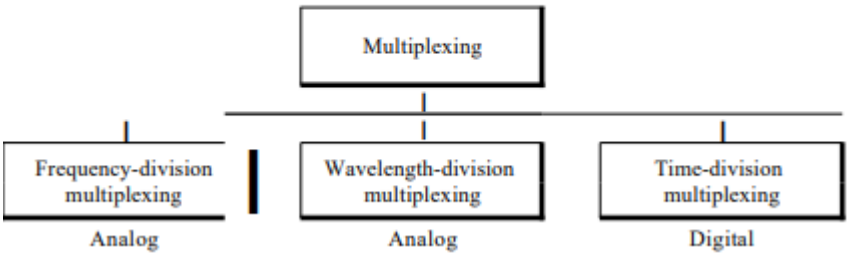


Figure – Bridge combines two LANs to form an extended LAN

	b)	**Describe the procedure to configure the TCP/IP network layer services.**	**6 M**
	Ans	Before beginning configuration procedure, the following are the prerequisites. • Network hardware is installed and cabled. • TCP/IP software is installed. To configure your 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 your network. For background information on these tasks, refer to TCP/IP network interfaces, TCP/IP addressing, and Naming hosts on your network. 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 networks 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 internetwork routing.	Step by step procedure - 6M

		6) Decide which services each host machine on the network will use. By default, all services are available. Follow the instructions in Client network services if you wish 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 you wish to run. 8) Configure any remote print servers that are needed. 9) Optional: If desired, configure a host to use or to serve as the master time server for the network.	
	c)	**Explain multiplexing techniques.**	**6 M**
	Ans	Multiplexing is the set of techniques that allows the simultaneous transmission of multiple signals across a single data link. *Categories ofmultiplexing*  **Frequency-Division Multiplexing** Frequency-division multiplexing (FDM) is an analog technique that can be applied when the bandwidth of a link (in hertz) is greater than the combined bandwidths of the signals to be transmitted. In FOM, signals generated by each sending device modulate different carrier frequencies. These modulated signals are then combined into a single composite signal that can be transported by the link. Carrier frequencies are separated by sufficient bandwidth to accommodate the modulated signal. These bandwidth ranges are the channels through which the various signals travel. Channels can be separated by strips of unused bandwidth-guard bands-to prevent signals from overlapping. In addition, carrier frequencies must not interfere with the original data frequencies.	2 M for 3 multiplexing technique with diagram

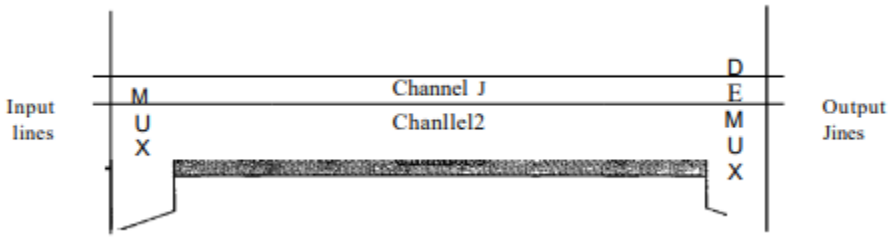


Fig: Frequency-Division Multiplexing

In above figure, the transmission path is divided into three parts, each representing a channel that carries one transmission.

Wavelength-Division Multiplexing

Wavelength-division multiplexing (WDM) is designed to use the high-data-rate capability of fiber-optic cable. The optical fiber data rate is higher than the data rate of metallic transmission cable. Using a fiber-optic cable for one single line wastes the available bandwidth. Multiplexing allows us to combine several lines into one.

WDM is conceptually the same as FDM, except that the multiplexing and de-multiplexing involve optical signals transmitted through fiber-optic channels. The idea is the same: We are combining different signals of different frequencies. The difference is that the frequencies are very high.

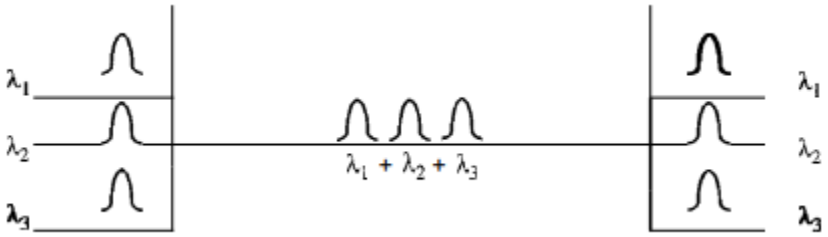
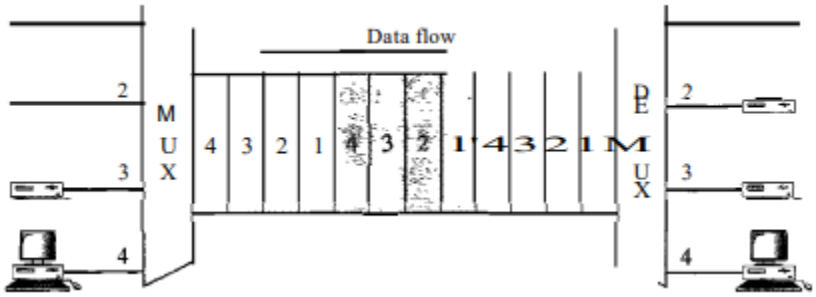


Fig: Wavelength-Division Multiplexing

Time-Division Multiplexing

Time-division multiplexing (TDM) is a digital process that allows several connections to share the high bandwidth of a linle Instead of sharing a portion of the bandwidth as in FDM, time is shared. Each connection occupies a portion of time in the link.

Figure gives a conceptual view of TDM. Note that the same link is used as in FDM; here, however, the link is shown sectioned by time rather than by frequency. In the figure, portions of signals 1,2,3, and 4 occupy the link sequentially.

		 Fig: Time-Division Multiplexing We also need to remember that TDM is, in principle, a digital multiplexing technique. Digital data from different sources are combined into one timeshared link. However, this does not mean that the sources cannot produce analog data; analog data can be sampled, changed to digital data, and then multiplexed by using TDM.	
6.		**Attempt any <u>TWO</u> of the following:**	**12 M**
	a)	**Explain the working of following topologies:** **1) Bus 2) Ring 3) Tree**	**6 M**
	Ans	**Bus Topology:** In networking, a topology that allows all network nodes to receive the same message through the network cable at the same time is called as bus topology. In this type of network topology, all the nodes of a network are connected to a common transmission medium having two endpoints. All the data that travels over the network is transmitted through a common transmission medium known as the bus or the backbone of the network. When the transmission medium has exactly two endpoints, the network topology is known by the name, 'linear bus topology'. A network that uses a bus topology is referred to as a “Bus Network”. **Working of Bus Topology:** Fig.shows bus topology. The central cable is the backbone of the network and is known as Bus (thus the name). Every workstation or node communicates with the other device through this Bus. A signal from the source is broadcasted and it travels to all workstations connected to bus cable. Although the message is broadcasted but only the intended recipient, whose MAC	2M each for each topology

address or IP address matches, accepts it.

If the MAC/IP address of machine does not match with the intended address, machine discards the signal. A terminator is added at ends of the central cable, to prevent bouncing of signals. A barrel connector can be used to extend it.

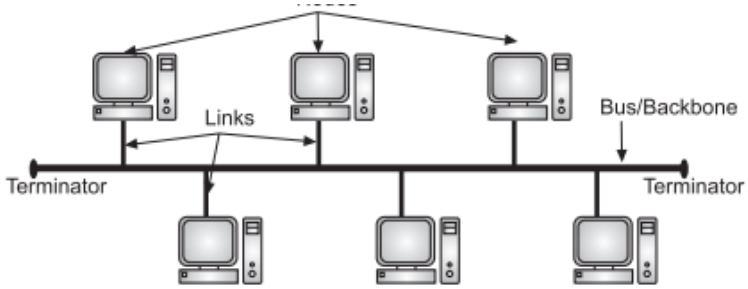


Fig: Bus Topology

II.Ring Topology:

Ring topology is a network topology that is set-up in circular fashion. It is called ring topology because it forms a ring as each computer is connected to another computer, with the last one connected to the first. Exactly two neighbors for each device.

Each node in this topology contains repeater. A signal passes node to node, until it reaches its destination. If a node receives a signal intended for another node its repeater regenerates the signal and passes it.

Token is a special three-byte frame that travels around the ring network. It can flow clockwise or anticlockwise. Ring topology is a point to point network.

The transmission is unidirectional, but it can be made bidirectional by having 2 connections between each network node, it is called Dual Ring Topology.

In dual ring topology, two ring networks are formed, and data flow is in opposite direction in them. Also, if one ring fails, the second ring can act as a backup, to keep the network up.

In a ring network, the data and the signals that pass over the network travel in a single direction. In ring topology network arrangement, a signal is transferred sequentially using a ‘token’ from one node to the next.

Fig. shows a ring topology. The token travels along the ring until it reaches its destination. Once, token reaches destination, receiving computer acknowledges receipt with a return message to the sender. The sender then releases the token for the token for use by another computer.

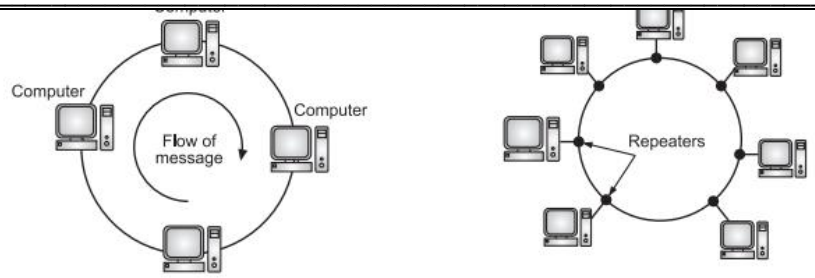


Fig: Ring Topology

Tree Topology:

As its name implies in this topology devices make a tree structure. Tree topology integrates the characteristics of star and bus topology.

• In tree topology, the number of star networks are connected using Bus. This main cable seems like a main stem of a tree, and other star networks as the branches.

• It is also called expanded star topology. Ethernet protocol is commonly used in this type of topology.

• Fig. shows tree topology. A tree topology can also combine characteristics of linear bus and star topologies. It consists of groups of star configure workstations connected to a linear bus backbone cable.

• Tree topologies allow for the expansion of an existing network and enable schools to configure a network to meet their needs.

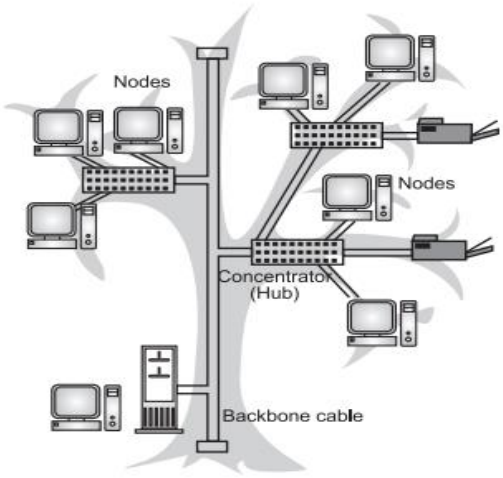
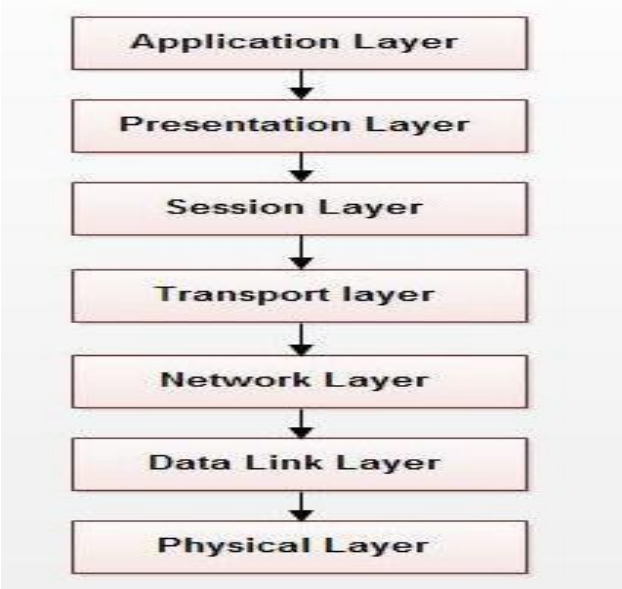


Fig: Tree Topology

	b)	**Explain the working of OSI model layers.**	**6 M**

	Ans	**Layered Architecture of ISO-OSI Model:** 1. The basic idea of a layered architecture is to divide the ISO-OSI model into small pieces. Each layer adds to the services provided by the lower layers in such a manner that the highest layer is provided a full set of services to manage communications and run the applications. 2. A basic principle is to ensure independence of layers by defining services provided by each layer to the next higher layer without defining how the services are to be performed. 3. In an n-layer architecture, layer n on one machine carries on conversation with the layer n on other machine. The rules and conventions used in this conversation are collectively known as the layer-n protocol.  **7 Layers of OSI reference Model** ISO-OSI model has 7 layered architectures. Functions of each layer are given below **Layer1: Physical Layer** 1. It activates, maintains and deactivates the physical connection. 2. It is responsible for transmission and reception of the unstructured raw data over network. 3. Voltages and data rates needed for transmission is defined in the physical layer. 4. It converts the digital/analog bits into electrical signal or optical signals. 5. Data encoding is also done in this layer.	1M for Diagram and 5M for explanation

Layer2: Data Link Layer

1. Data link layer synchronizes the information which is to be transmitted over the physical layer.

2. The main function of this layer is to make sure data transfer is error free from one node to another, over the physical layer.

3. Transmitting and receiving data frames sequentially is managed by this layer.

4. This layer sends and expects acknowledgements for frames received and sent respectively. Resending of no acknowledgement received frames is also handled by this layer.

Layer3: The Network Layer

1. Network Layer routes the signal through different channels from one node to other.

2. It acts as a network controller. It manages the Subnet traffic.

3. It decides by which route data should take.

4. It divides the outgoing messages into packets and assembles the incoming packets into messages for higher levels.

Layer 4: Transport Layer

1. Transport Layer decides if data transmission should be on parallel path or single path.

2. Functions such as Multiplexing, Segmenting or Splitting on the data are done by this layer

3. It receives messages from the Session layer above it, converts the message into smaller units and passes it on to the Network layer.

4. Transport layer can be very complex, depending upon the network requirements.

Transport layer breaks the message (data) into small units so that they are handled more efficiently by the network layer.

Layer 5: The Session Layer

1. Session Layer manages and synchronizes the conversation between two different applications.

2. Transfer of data from source to destination session layer streams of data are marked and are resynchronized properly, so that the ends of the messages are not cut prematurely and data loss is avoided.

Layer 6: The Presentation Layer

1. Presentation Layer takes care that the data is sent in such a way that the receiver will understand the information (data) and will be able to use the data.

2. While receiving the data, presentation layer transforms the data to be ready for the application layer.

3. Languages(syntax) can be different of the two communicating systems. Under this condition presentation layer plays a role of translator.

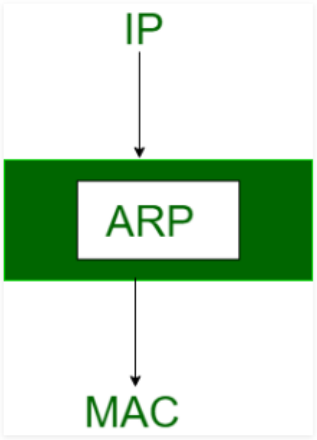
4. It performs Data compression, Data encryption, Data conversion etc.

Layer 7: Application Layer

1. Application Layer is the topmost layer.

2. Transferring of files disturbing the results to the user is also done in this layer. Mail services, directory services, network resource etc are services provided by application layer.

3. This layer mainly holds application programs to act upon the received and to be sent data.

	c)	**Explain ARP, subnetting and supernetting with example.**	**6 M**
	Ans	**ARP:** Most of the computer programs/applications use **logical address (IP address)** to send/receive messages, however, the actual communication happens over the **physical address (MAC address)** i.e from layer 2 of the OSI model. So our mission is to get the destination MAC address which helps in communicating with other devices. This is where ARP comes into the picture, its functionality is to translate IP address to physical addresses.  ARP finds the hardware address, also known as Media Access Control (MAC) address, of a host from its known IP address. It is responsible to find the hardware address of a host from a know IP address there are three basic ARP terms.	2M each for ARP, subnetting and supernetting with example

The important terms associated with ARP are:
(i) Reverse ARP
(ii) Proxy ARP
(iii) Inverse ARP

Subnetting:

Dividing the network into smaller contiguous networks or subnets is called subnetting. Suppose we take a network of class A. So, in class A, we have 2^{24} hosts. So to manage such a large number of hosts is tedious. So if we divide this large network into the smaller network then maintaining each network would be easy.

Suppose we have a class C network having network ID as 201.10.1.0(range of class C 192–223). So the total number of hosts is 256(for class C host is defined by last octet i.e. 2^8). But, the total usable host is 254. This is because the first IP address is for the network ID and the last IP address is Direct Broadcast Address (for sending any packet from one network to all other hosts of another network).

So, in subnetting we will divide these 254 hosts logically into two networks. In the above class C network, we have 24 bits for Network ID and the last 8 bits for the Host ID.

Supernetting:

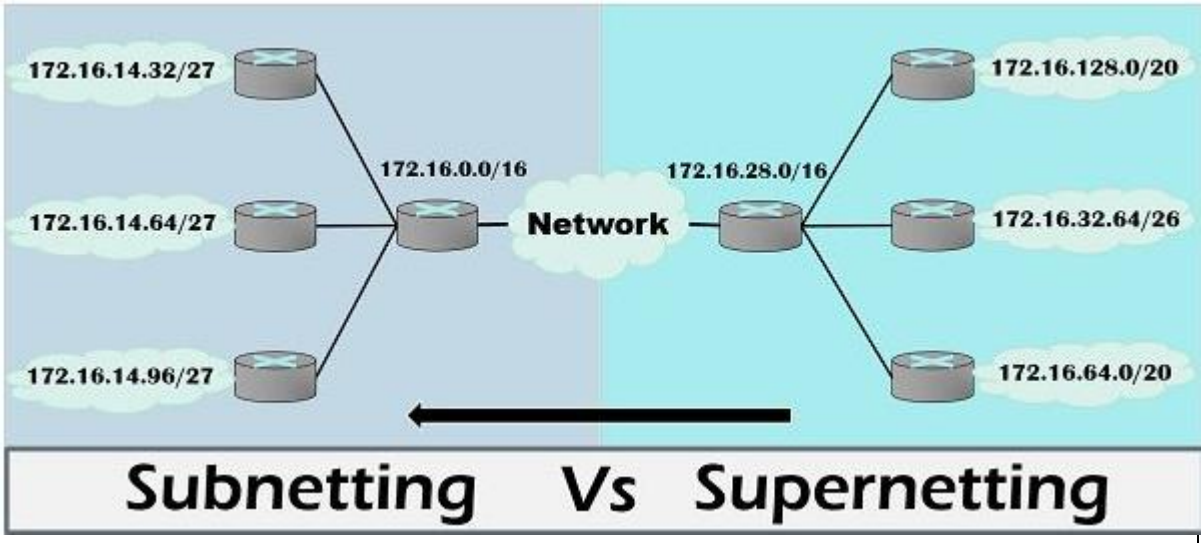
Supernetting is the opposite of Subnetting. In subnetting, a single big network is divided into multiple smaller subnetworks. In Supernetting, multiple networks are combined into a bigger network termed as a Supernetwork or Supernet.
Supernetting is mainly used in Route Summarization, where routes to multiple networks with similar network prefixes are combined into a single routing entry, with the routing entry pointing to a Super network, encompassing all the networks. This in turn significantly reduces the size of routing tables and also the size of routing updates exchanged by routing protocols.

More specifically, when multiple networks are combined to form a bigger network, it is termed as **super-netting**

Super netting is used in route aggregation to reduce the size of routing tables and routing table updates
There are some points which should be kept in mind while supernetting:

All the IP address should be contiguous.
Size of all the small networks should be equal and must be in form of 2n.
First IP address should be exactly divisible by whole size of supernet.

For example:


172.16.14.32/27
172.16.14.64/27
172.16.14.96/27
172.16.0.0/16
Network
172.16.28.0/16
172.16.128.0/20
172.16.32.64/26
172.16.64.0/20
Subnetting Vs Supernetting

22414

22223

3 Hours / 70 Marks Seat No. | | | | | | | | |

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any FIVE of the following: **10**

a) Define computer Network.

b) Describe date communication standards

c) State any two types of unguided media

d) State any two limitations in Bluetooth

e) Describe single Bit error and Burst error.

f) List any four Network connecting devices.

g) List any four application layer protocol.

Marks

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

a) Explain the components of Data communication.

b) Describe Propagation modes in fibre optic cable.

c) Compare 3G and 4G mobile Generations on the basis of data speed, technology, standard and services.

d) Describe the process of DHCP server configuration.

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

a) Describe Satellite communication with neat diagram.

b) Describe modes of communication

c) Describe the working of Router with suitable diagram.

d) Name the Protocols used in

i) Data Link Layer

ii) Network Layer

iii) Transport Layer

iv) Presentation Layer

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

a) Compare FDM and TDM (Any 4 points each)

b) Define IP addressing. List IP address classes with their range of addresses

c) Describe the principles of packet switching techniques with neat diagram.

d) Describe OSI reference model with its Layered structure.

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	

Marks

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

a) Differentiate any six point between LAN and WAN.

b) Write steps to prepare crossover and straight cable using twisted pair cable.

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

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

a) Calculate CRC for the frame 110101011 and generator Polynomial $X^4 + X + 1$ and write the transmitted frame.

b) Compare OSI and TCP/IP network model (any six point each)

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.

22414

23124

3 Hours / 70 Marks Seat No. | | | | | | | | |

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any FIVE of the following: **10**

a) List advantages of Computer Networks. (any two)

b) Draw process of Data Communication.

c) List Networking Topologies.

d) State types of errors.

e) Draw a neat labeled diagram of co-axial cable.

f) Compare LRC and VRC.

g) List any four networking connecting devices.

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

a) Compare client-server and peer-to-peer networks.

b) Draw a neat labeled diagram of twisted pair cable and state its types.

c) Explain wireless LAN 802.11 architecture.

d) Explain OSI reference model in detail.

P.T.O.

Marks

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

a) Draw and explain piconet bluetooth architecture.

b) Explain satellite communication with the help of neat diagram.

c) Compare circuit switching and packet-switching, consider following parameter orientation, flexibility, technology and layer.

d) Explain the function of presentation layer and network layer.

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

a) With suitable diagram describe

i) STAR Topology

ii) RING Topology

b) Describe the various IP address classes with suitable example.

c) Describe multiplexing technique.

d) Compare IPV4 and IPV6 packet format.

e) Differentiate between Hub and switch. (any four points)

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

a) Explain modes of communication

i) Simplex

ii) Half-Duplex

iii) Full-Duplex

b) Draw and explain fiber-optic cable

c) Explain SMTP, HTTP, ARP protocol in detail.

Marks

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

a) Explain mobile generations.

i) 1 G

ii) 2 G

iii) 3 G

iv) 4 G

v) 5 G

b) Differentiate between OSI and TCP/IP network model.

c) Explain wide Area Networks along with its advantages and disadvantages.

22414

23242

3 Hours / 70 Marks Seat No. | | | | | | | | |

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any FIVE of the following: **10**

a) Define following terms

i) Protocol

ii) Peer

b) List any two advantages of computer network.

c) List guided transmission media.

d) List IEEE 802·X standards for network.

e) Define error and state it's types.

f) Define the term 'Topology'. List the names of any two network topologies.

g) Name the layer which is associated with transmission media.

Marks

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

a) Explain modes of communication.

b) Draw and explain constructional diagram of fiber optic cable.

c) Explain ESS architecture of IEEE 802·11 with neat diagram.

d) Compare IPV4 and IPV6.

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

a) Describe multiplexing techniques with the help of diagram.

b) Describe the components of data communication with neat diagram.

c) Explain Mesh topology with suitable diagram.

d) Explain data encapsulation in OSI reference model.

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

a) Compare wired and wireless transmission media.

b) Explain OSI reference model with its layered architecture.

c) Explain satellite communication with the help of neat diagram.

d) Describe different IP address classes.

e) A system uses CRC on a block of 8 bytes. How many redundant bits are sent per block? What is the ratio of useful bits to total bits.

Marks

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

a) For the following situation state which type of network architecture is appropriate and justify your answer.

i) Number of user 50

ii) Data and resources need to be restricted

iii) No network administrator required

iv) All user with equal priority.

b) Why circuit switching is preferred over packet switching in voice communication?

c) For the classless address 129·65·33·01/24. Find the following -

i) Number of address in the block (N)

ii) The first address

iii) The last address

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

a) Describe bluetooth architecture technologies.

b) Describe the process of DHCP server configuration.

c) Draw with neat labelled sketch of star-bus topology connecting three star networks, having three computers in two stars and two computers in one star.

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