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SUMMER – 19 EXAMINATION

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

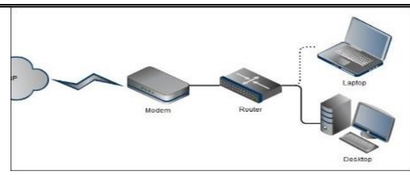
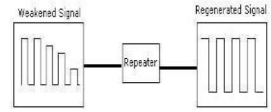
Important Instructions to examiners:

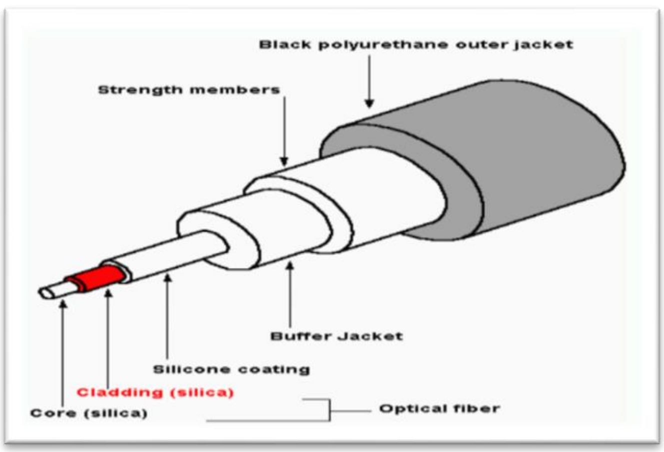
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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	(see table below)	any 2 points 1 M each

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.

		 	
	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.

Application Layer
Presentation Layer
Session Layer
Transport Layer
Network Layer
Data link Layer
Physical Layer

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

		application services for file.	
Q3		**Attempt any THREE of the following :**	**12 M**
	a	**What advantages does TDM have over FDM in a circuit switched network?**	**4 M**
	Ans	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	consider 4 points for 4 M
	b	**Compare Analog and Digital signal**	**4 M**
	Ans	(see table below)	1 M for each differenc e Consider any 4 valid points

Analog signal	**Digital signal**
An analog signal is a continuous wave that changes over a time period.	A digital signal is a discrete wave that carries information in binary form.
An analog signal is represented by a sine wave.	A digital signal is represented by square waves.
Analog signal has no fixed range.	Digital signal has a finite numbers i.e. 0 and 1.
An analog signal is described by the amplitude, period or frequency, and phase.	A digital signal is described by bit rate and bit intervals.
An analog signal is more prone to distortion.	A digital signal is less prone to distortion.
An analog signal transmits data in the form of a wave.	A digital signal carries data in the binary form i.e. 0 and 1.

	c	**With suitable diagram describe**	
	Ans	**(i) STAR Topology (ii) RING Topology** Star topology is a network topology where each individual piece of a network is	2M star topology- 1M for

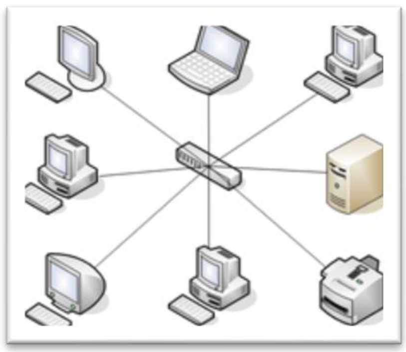
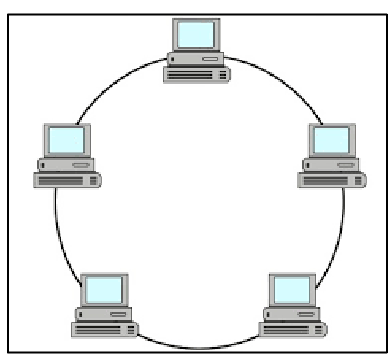
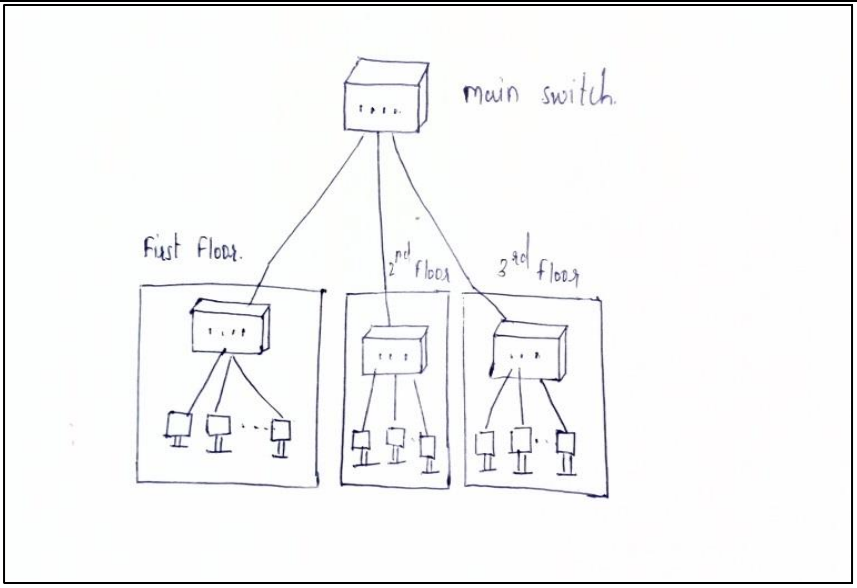
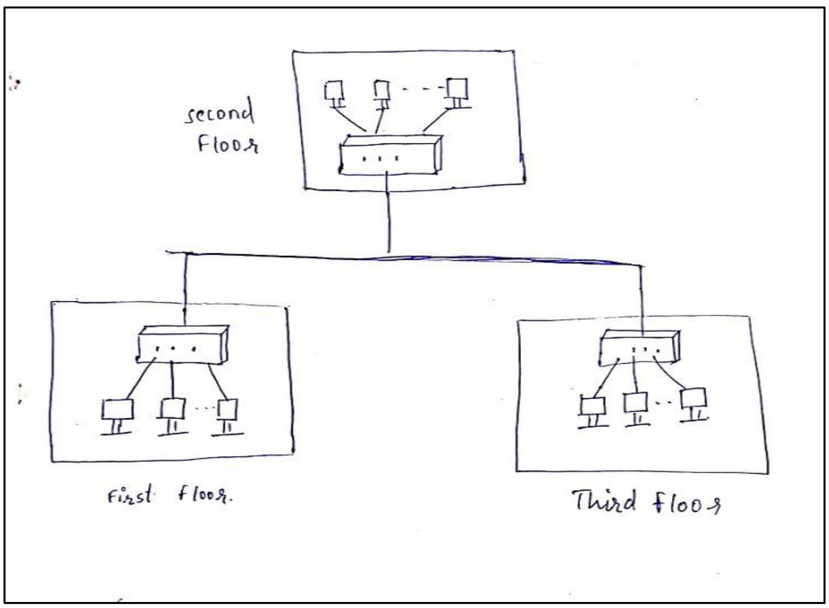
		attached to a central node (often called a hub or switch). The attachment of these network pieces to the central component is visually represented in a form similar to a star. The hub and hosts, and the transmission lines between them, form a graph with the topology of a star. Data on a star network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

		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	(see table below)	1M for each difference

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

	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

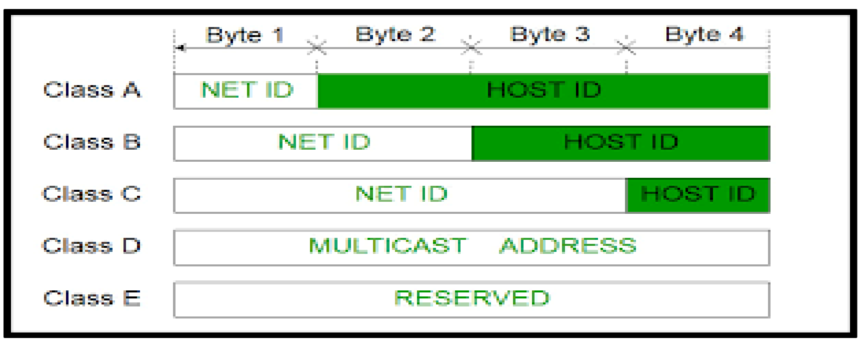
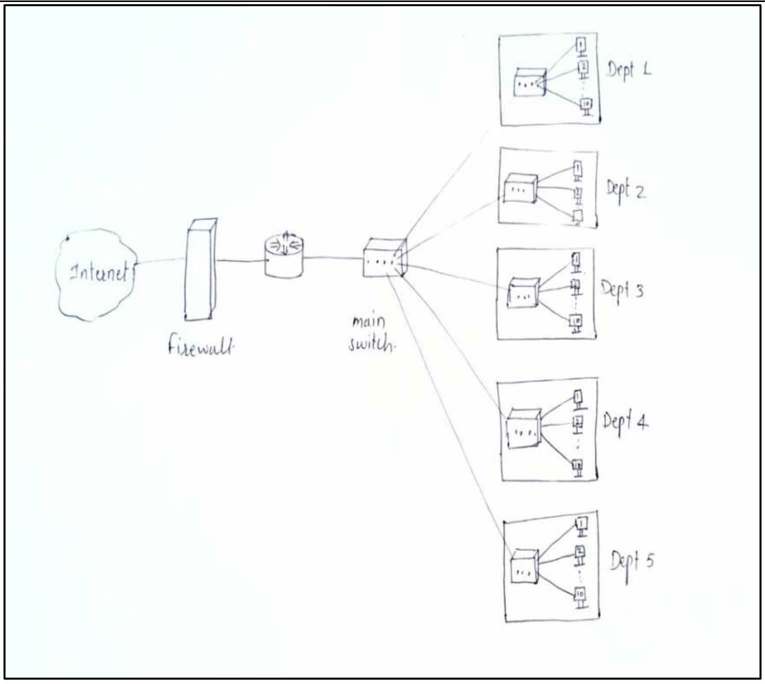
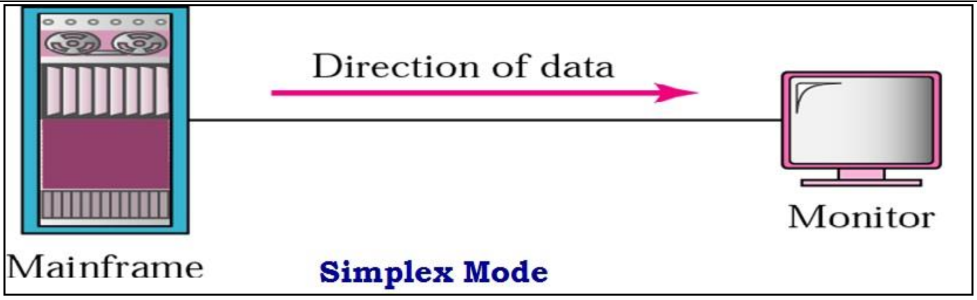


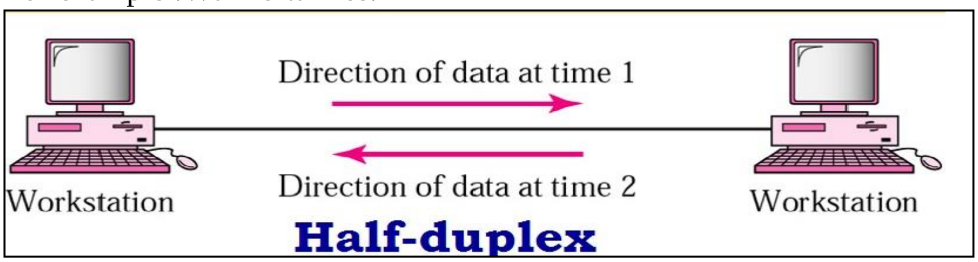
Fig : IP address classes

	e	Design suitable network layout for an organization with five department	4 M

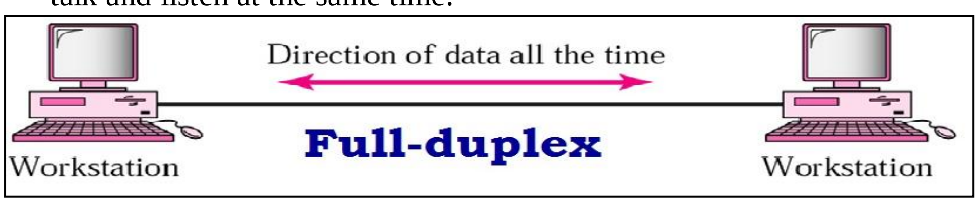
	ans		ten users each) (Correct dia 4M) Consider any suitable diagram
Q5		**Attempt any TWO of the following:**	**12 M**
	a	**Describe the process of data communication in various modes**	**6 M**
	ans	Transmission mode refers to the mechanism of transferring of data between two devices connected over a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

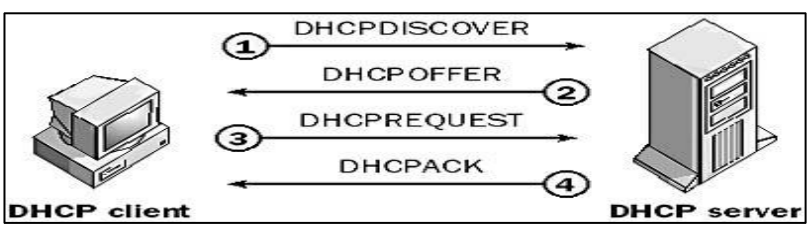


b. In full-duplex mode both stations can transmit and receive data simultaneously. The transmission medium sharing can occur in two ways, namely, either the link must contain two physically separate transmission paths or the capacity of the channel is divided between signals traveling in both directions.
-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	