**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.

<table>
<thead>
<tr>
<th>Q. No</th>
<th>Sub Q.N.</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A)</td>
<td>Attempt any six of the following:</td>
</tr>
<tr>
<td></td>
<td>a) Ans.</td>
<td>What is data communication?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data communication is the exchange of data between two devices via some form of transmission medium such as a wire cable. For data communications to occur, the communicating devices must be part of a communication system made up of a combination of hardware (physical equipment) and software (programs).</td>
</tr>
<tr>
<td></td>
<td>b) Ans.</td>
<td>Define guided and unguided media.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guided media - The signal energy that propagates within the guided media i.e. through wires. It is mainly suited for point to point line configurations. The signal propagates in the form of voltage, current or photons. Examples of guided media are: - Twisted Pair Cable, Coaxial Cable, Optical Fiber Cable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unguided media - The signal energy that propagates through air. It is mainly used for broadcasting purpose. The signal propagates in the form of electromagnetic waves. Examples are:- Microwave or Radio Links Infrared</td>
</tr>
</tbody>
</table>
c) What is Error? Enlist types of errors.
Any distortion or noise occurred during the process of transmission or reception can be termed as error.

Types of errors:
1. Delay distortion
2. Attenuation
3. Noise

2M

Definition 1M

An 2 types ½ M each

d) What is SMDS?
1) Switched Multimegabit Data Services (SMDS) is a high speed MAN technology.
2) It is a packet switched datagram service for high speed MAN data transmission.

2M

SMDS 2M

e) What is Encapsulation?
(Note: Any relevant explanation or diagram shall be considered.)
The protocols operating at the various layers work together to supply a unified quality of service. Each protocol layer provides a service to the layers directly above and below it. The process of adding the headers and trailers to the data is called as data encapsulation.

OR
A packet (header and data) at level 7 is encapsulated in a packet at level 6. The whole packet at level 6 is encapsulated in a packet at level 5, and so on. In other words, the data portion of a packet at level N-1 carries the whole packet (data and header and maybe trailer) from level N. The concept is called encapsulation.

OR

2M

Definition 2M

A packet (header and data) at level 7 is encapsulated in a packet at level 6. The whole packet at level 6 is encapsulated in a packet at level 5, and so on. In other words, the data portion of a packet at level N-1 carries the whole packet (data and header and maybe trailer) from level N. The concept is called encapsulation.
### f) What are the problems in Internetworking?

*Note: Any relevant problem shall be considered*

The different problems that occur in Internetworking are:

1. **Addressing**: Each network might have its own addressing modes. For example, Ethernet uses 6 byte identifier while telephone uses 10 digits number.
2. **Bandwidth and Latency**: Heterogeneity in bandwidth ranges from small no of bits to many Gigabits, spanning many order of magnitudes. Similarly latency can range from microseconds to several seconds.
3. **Packet Size**: The maximum packet size will vary between different networks.
4. **Loss rates**: Networks differ widely in the loss rates and loss patterns of the links.
5. **Packet Routing**: Packet routing can be handled differently by each constituent network.

### g) What is router? List types of router.

A **router** is a network layer device that routes packets based on their logical address (host to host address). Routers normally connect LAN and WANS in the internet using route information stored in routing table. Routing table of router is a tabular database which stores information about destination and path (next Hop address through which to reach) information routing table is updated dynamically depending on changes in network.
### Two types of routers are:

1. **Static routers**: A router with *manually configured* routing tables is known as a static router.
2. **Dynamic routers**: A router with *dynamically configured* routing tables is known as a dynamic router. Dynamic routing consists of routing tables that are built and maintained automatically through an ongoing communication between routers.

### What is IP Address? Why it is required?

**IP address** is a logical address, 32 bit address having network_id & host_id that uniquely & universally identified over network or local network or to internet. Messages are routed in a network based on destination IP address. It has five classes: Class A, B,C,D,E.

**OR**

**IP Address**: IP Address is used in the source & destination address fields of the IP header it is 32 bit long. Each device has a unique IP Address.

**Need:**

1. In a internetwork each device/computer should have unique address for identification and communication. IP addressing provides that facility.
2. In order to communicate with other devices in the network, there needs a global addressing scheme. IP addresses are used for logically addressing the computers.
3. It provides a network address and host address so routing becomes easy task.
4. It gives facility of subnetting and supernetting.

### Attempt any two of the following:

**Explain virtual LAN with its two benefits.**

Virtual LANs (VLANs) are logical local area networks (LANs) based on physical LANs. A VLAN can be created by partitioning a physical LAN into multiple logical LANs using a VLAN ID. Alternatively, several physical LANs can function as a single logical LAN. The partitioned network can be on a single router, or multiple VLAN's can be on multiple routers just as multiple physical LAN's would be.
Model Answer

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Benefits of Virtual LAN are:
1) Ease of administration
2) Confinement of broadcast domains
3) Reduced broadcast traffic
4) Enforcement of security policies.

Any two benefits 1M each

b) Ans.

Describe any four advantages of fiber optic cable.

Advantages of fiber optic cable:
1. Less signal attenuation: Fiber-optic transmission distance is significantly greater.
2. No EMI (Electro Magnetic Interference): No effect of External environmental condition
3. High Band width up to 2 GBPS
5. Higher data transfer rate
6. Lesser repeater are required
7. Resistance to corrosive materials: Glass is more resistant to corrosive materials than other.
8. Light weight: Fiber-optic cables are much lighter than other cables.
9. Electrical isolation: Optical fibers (COF) are fabricated from glass or plastic polymers which are electrical insulators. Hence they do not exhibit earth loop.

Any 4 advantages 1M each

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10. **Signal security:** The light from OF does not radiate significantly and therefore they provide a high degree of signal security.

c) **List various standard organisations for data communication.**

Various Standard Organizations for data communications are the following:

d. Institute of Electrical and Electronics Engineers (IEEE).
e. Electronic Industries Association (EIA).

2. **Attempt any four of the following:**

   **Differentiate between serial and parallel transmission.**

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Serial Transmission</th>
<th>Parallel Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of bits transmitted at one clock pulse</td>
<td>1 bit</td>
<td>n bits</td>
</tr>
<tr>
<td>Number of lines required to transmit n bits</td>
<td>1 line</td>
<td>n lines</td>
</tr>
<tr>
<td>Speed of transfer</td>
<td>Slow</td>
<td>Fast</td>
</tr>
<tr>
<td>Cost of Transmission</td>
<td>Low, as one line is needed for transmission.</td>
<td>High, as n lines are needed for transmission.</td>
</tr>
<tr>
<td>Application</td>
<td>Used for long distance communication between the two computers.</td>
<td>Used for short distance communication. For example, between computer and printer.</td>
</tr>
</tbody>
</table>

b) **Explain Microwave communication.**

Microwave communication is the transmission of signals via microwave towers. The microwave band is well suited for wireless transmission of signals having large bandwidth. In case of
Microwave transmission, above 100 MHz, the waves travel in straight lines and can therefore be narrowly focused. Concentrating all the energy into a small beam using a parabolic antenna gives a much higher signal to noise ratio. Since the microwaves travel in a straight line, if the towers are too far apart, the earth will get in the way. Consequently, repeaters are needed periodically.

**Disadvantages:**
- Do not pass through buildings well
- multipath fading problem (the delayed waves cancel the signal)
- absorption by rain above 8 GHz
- severe shortage of spectrum

**Advantages:**
- no right way is needed (compared to wired media)
- relatively inexpensive
- simple to install

---

c) **Describe the characteristics of data communication system.**

The effectiveness of any data communications system depends upon the following four fundamental characteristics:

1. **Delivery:** The data should be delivered to the correct destination and correct user.
2. **Accuracy:** The communication system should deliver the data accurately, without introducing any errors. The data may get corrupted during transmission affecting the accuracy of the delivered data.
3. **Timeliness:** Audio and Video data has to be delivered in a timely manner without any delay; such a data delivery is called real time transmission of data.
4. **Jitter:** It is the variation in the packet arrival time. Uneven Jitter may affect the timeliness of data being transmitted.

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d) **Explain the functions of Network Layer in OSI model.**

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

**Functions of network layer:**
1) Logical addressing
2) Routing.
3) Congestion control
4) Accounting and billing
5) Address transformation
6) Source host to destination host error free delivery of packet.

e) Ans.

Describe the following: i) Wi-Fi    ii) Wi-MAX.

i. Wi-Fi
Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. Wi-Fi is simply a trademarked phrase that means IEEE 802.11. IEEE 802.11 wireless LAN: The 802.11 architecture defines two types of services and three different types of stations. 802.11 services: The two types of services are
1) Basic services set (BSS)
2) Extended services set (ESS)

Basic services set (BSS)
1) The basic services set contain stationary or mobile wireless station and central base station called access point (AP)
2) The use of access point is optimal
3) If the access point is not present, it is known as standalone network. Such a BSS cannot send data to other BSSs. These types of architecture are known as adhoc architecture.
4) The BSS in which an access point is present is known as infrastructure network.

Extended services set (ESS):
1) An extended service set is created by initializing two or more basic services set (BSS) having access points (APS)
2) These extended networks are created by joining the access points of basic station set through a wired LAN known as distribution system.
3) The distribution system can be any IEEE LAN.
4) There are two types of station in ESS.

Mobile Station: These are normal station inside a BSS
Stationary Station: these are AP station that are part of a wired LAN

Communication between two stations in two different BSS usually occurs via two APS. A mobile Station can belong to more than one BSS at the same time.

ii) Wi-Max:
Wi-Max is worldwide interoperability for Microwave Access. It is a wireless communication standard which can provide data rates up to 1 Gbps. It is refers to interoperable implementation of IEEE 802.16 family of standards.

Uses and Application:
1) To provides portable mobile broadband connectivity.
2) It can be used as an alternative to cable, digital subscriber line (DSL) for providing a broad band access.
3) To provide services such as voice on VIP(VOIP)
4) For providing a source of internet connectivity.
### Internet Access

1) Wi-Max is capable of providing at home or mobile internet access across the whole city or country.

2) It is cheap to use Wi-Max to provide Internet Access to the remote locator.

### f) What is FDDI? Explain its working in details.

The Fiber Distributed Data Interface (FDDI) network architecture is a LAN protocol standardized by ANSI and other organizations. It supports data transmission rates of up to 100 Mbps, and is an alternative to Ethernet and Ring architectures. Originally, FDDI was developed using optical fiber as the transmission medium because only optical fibre could support data rates of 100 Mbps. FDDI uses glass fibers for data transmission. And therefore, encodes data bits in the form of pulses of light.

The working of FDDI can be summarized as follows:

**Token passing for Media Access Control** - Like the Token Ring Protocol, FDDI also uses the concept of a token frame to regulate medium access. The same principles of token frame apply here. FDDI is also a ring-like structure where the network medium starts from a computer, passes through all the hosts in the network, and ends back at the original host.

**Self mechanism** - the hardware in FDDI provides mechanism for detecting and correcting problems on its own. When a network error occurs, or a host is down, the NIC uses the second ring which is used as a backup for such failures for data transmission. This is called loop back. Whenever the first ring fails or a host on a ring fails, the second ring is used to create another closed loop.

### 3.

**a) Attempt any four of the following:**

**Describe the various IP Address classes.**

**IP address:** It is a unique address specified in the TCP/IP used to identify the host in a computer network. It can be a 32 bit address (IPv4) or a 128 bit address (IPv6).

There are five different classes or formats of IP address are as given below:

**Class A:** Class A type of IP addresses have First byte 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.

**Class B**: This type has first two bytes specifying network ID with starting two bits as 10 and last two bytes referring to host ID.

**Class C**: This class has first three bytes referring to network with starting bits as 110 and last byte signifies Host ID. Here, number of networks are more when compared to number of hosts in each network.

**Class D**: Class D is used for multicasting and its starting bits are 1110

**Class E**: Class E is reserved for future use and its starting bits are 1111

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**b)** Compare TCP and UDP (4 points only).

<table>
<thead>
<tr>
<th>TCP</th>
<th>UDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working</td>
<td>Full-Featured Protocol that allows applications to send data reliably without worrying about N/w layer issues.</td>
</tr>
<tr>
<td>Protocol</td>
<td>Connection-oriented;</td>
</tr>
</tbody>
</table>
### Model Answer

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**Subject: Data Communication & Networking**  
**Subject Code:** 17430

<table>
<thead>
<tr>
<th>Connection</th>
<th>Data Interface to Application</th>
<th>Reliability and Ack</th>
<th>Retransmission</th>
<th>Features</th>
<th>Transmission Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection must be established prior to transmission</td>
<td>Stream-based; Data is sent by appln with no particular structure</td>
<td>Reliable With acknowledgement</td>
<td>Lost data is retransmitted automatically</td>
<td>Flow control using sliding window protocol, Congestion avoidance algorithm</td>
<td>High, but not as UDP</td>
</tr>
<tr>
<td>Data is sent without setup</td>
<td>Message-Based; Data is sent in discrete packet (Datagram)</td>
<td>Unreliable Without acknowledgement</td>
<td>Not Performed</td>
<td>No Flow control</td>
<td>Very High</td>
</tr>
</tbody>
</table>

**c) Ans.**

**With the help of diagram describe Internet Topology.**  
**Internet topology:** Internet topology is the structure by which hosts, routers or autonomous systems (ASes) are connected to each other. It is representation of interconnection of between directly connected peers or nodes in network. It describes how host routers connects to each other It is organized in hierarchical manner as shown in figure.

**Diagram**

![Internet Topology Diagram](image-url)

**Description**

- **Very High Speed Backbone (MCI-operated)**
- **Washington (MFS)**
- **California (PacBell)**
- **New York (Sprint)**
- **MCI**
- **Sprint**
- **AT&T**
- **AOL**
- **UUNet**
- **Network Access Provider s (NAP)**
- **Internet Service Providers (ISP)**
- **Backbone**
- **Home Users**
- **Small Businesses**
- **Large Businesses**
- **Government**
- **End Users**
**d) Explain Leased Line with its benefits.**

Many medium and large organizations generally need a high bandwidth for connecting to the Internet, because the number of users is very high. For this, an ISP provides an option of leasing lines to these kinds of organizations. A leased line can be thought of as a very thick pipe connecting the office of an organization with the internet via the ISP. A medium-to-big organization obtains a digital line from an ISP for a fixed charge per month, regardless of its actual use. That is, the organization may or may not use the complete bandwidth of the leased line, but it would still pay a fixed charge. In return, the organization gets larger bandwidth from the ISP, shared by multiple users mostly through a LAN.

**Benefits of leased line (Any TWO points):**
1. It provides high speed/ bandwidth dedicated internet line.
2. It provides bandwidth on demand for a specified duration of time.
3. More nodes can be added to the network without much modification.

---

**e) Describe DQDB.**

The Distributed Queue Dual Bus (DQDB) protocol is a dual bus configuration. This means that each host in the network connects to two backbone network lines. The hosts get an access to the transmission medium with an approach that is different from LANs. Distributed Queue Dual Bus (DQDB) is a Data-link layer communication protocol for Metropolitan Area Networks (MANs), specified in the IEEE 802.6 standard and designed for use in MANs.
In case of DQDB, a mechanism called distributed queue is used and hence the name Distributed queue Dual Bus (DQDB). Figure shows sample DQDB architecture with two unidirectional buses, called bus A and B. In the fig, hosts numbered 1 to N connect to these buses. Each bus connects to the hosts on their input and output ports. Distributed Queue Dual Bus (DQDB) is an example of MAN. It uses the mechanism of a dual queue. There are two buses connecting all the computers on a DQDB network. Each bus allows traffic in a single direction only. To transmit data, the sending host must select one of the two buses. A host reserves the slot before transmitting its data. At any point of time, every host knows how many reservations are pending to be served.

f) Explain VRC method of error detection with suitable example.

VRC:
- Vertical redundancy check (VRC), a parity bit is added to every data unit so that the total number of 1’s become even.
- A redundant bit is called as parity bit.
- After appending redundant bit to data unit if total number of 1’s in the packet (including parity bit) becomes even then it is called even parity checking & if total number of 1’s in the packet (including parity bit) becomes odd then it is called odd parity checking.

1. A parity bit is added to data packet for purpose of error detection.
2. Upon receipt of the packet, parity needed for data is recomputed & compared to parity received with the data. If any bit has changed state, parity will not match & error can be detected.
3. In fact, if an odd number of bits (not just one) have been altered, parity will not match. If even numbers of bits have been reversed, the parity will match even though error has occurred.

**Example:** Suppose sender wants to send 1110111 data unit to receiver & both uses even parity checking.

**Solution:**
Original Data to send:

```
1 1 1 0 1 1 1
```

Both sender & receiver use Even parity checking. As total number of
1’s in data unit are even i.e. six the parity bit added to end of data unit will be 0, so it maintains even parity of data unit. Actual data send by sender:

```
1 1 1 1 0 1 1 1 0
```

### 4.

**a)**

**Ans.**

Attempt any four of the following:

**Explain Packet Switching for datagram approach.**

**Datagram Packet Switching:**

Datagram packet-switching is a packet switching technology by which each packet, now called a datagram, is treated as a separate entity. Each packet is routed independently through the network. Therefore packets contain a header with the full information about the destination. The intermediate nodes examine the header of a packet and select an appropriate link to another node which is nearer to the destination. In this system, the packets do not follow a pre-established route, and the intermediate nodes do not require prior knowledge of the routes that will be used.

In datagram packet switching each packet is transmitted without any regard to other packets. Every packet is treated as individual, independent transmission.

Even if a packet is a part of multi-packet transmission the network treats it as though it existed alone. Packets in this approach are called datagrams. Datagram switching is done at the network layer. Figure show how a datagram approach is used to deliver four packets from station A to station D. All the four packets belong to same message but they may travel via different paths to reach the destination i.e. station D.
Datagram approach can cause the datagrams to arrive at their destination out of order with different delays between the packets. Packets may also be lost or dropped because of lack of resources. The datagram networks are also referred as connectionless networks. Here connectionless means that the switch does not keep information about connection state. There are no connection establishment or tear down phases.

The datagram can arrive at the destination with a different order from the order in which they were sent. The source and destination address are used by the routers to decide the route for packets. Internet use datagram approach at the network layer.

b) Draw the components of data communication system and state the function of each component.

Ans.
Components of data communication:

A data communications system has five components:

1. **Message:** The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.

2. **Sender:** The sender is the device that sends the data message. It can be a computer, Workstation, telephone handset, video camera, and so on.

3. **Receiver:** The receiver is the device that receives the message. It can be a computer, Workstation, telephone handset, television, and so on.

4. **Transmission medium:** The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves.

5. **Protocol:** A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating.
c) Ans. Compare WAN and MAN (any 4 points).

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Parameter</th>
<th>WAN</th>
<th>MAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ownership of Network</td>
<td>Private or Public</td>
<td>Private or Public</td>
</tr>
<tr>
<td>2</td>
<td>Area covered</td>
<td>Very large (states or countries)</td>
<td>Moderate (City)</td>
</tr>
<tr>
<td>3</td>
<td>Design and Maintenance</td>
<td>Not Easy</td>
<td>Not Easy</td>
</tr>
<tr>
<td>4</td>
<td>Communication medium</td>
<td>PSTN or Satellite links</td>
<td>Coaxial cables, PSTN, Optical Fiber Cables, Wireless</td>
</tr>
<tr>
<td>5</td>
<td>Data rates</td>
<td>Low</td>
<td>Moderate</td>
</tr>
<tr>
<td>6</td>
<td>Mode of communication</td>
<td>Each station cannot transmit</td>
<td>Each station can transmit or receive</td>
</tr>
<tr>
<td>7</td>
<td>Principle</td>
<td>Switching</td>
<td>Both</td>
</tr>
<tr>
<td>8</td>
<td>Propagation Delay</td>
<td>Long</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

d) Ans. Explain FTP with its working.

**Definition:** FTP (File Transfer Protocol) is a high-level (application layer) protocol is an interface for any user of the internet to transfer files. The user requests the FTP to either retrieve from or upload a file to a remote server.

**Working:** FTP presents the user with a prompt and allows entering of various commands for accessing and downloading files that are physically exist on a remote computer. After invoking an FTP application, the user identifies a remote computer and instructs FTP to establish a connection with it. FTP contacts the remote computer using TCP/IP software. Once the connection is established, the user can choose to download a file from the remote computer, or can send file to be stored on the remote computer. FTP uses two connections between a client and a server. One connection is used for the actual file’s data transfer and the other is used for control information (commands and responses). These two connections and components
of FTP are as shown in the diagram.

The client has three components namely, User interface, Client control process and client data transfer process. The server has two components namely, the server control process and server data transfer process.

The TCP control connection is made between the control processes of the client and the server. While the data is sent (IP packets) from the server to the client, the server keeps track of the progress of the file: how much data has been sent, the number of bytes sent, the percentage of total file size in bytes and how much remains to be sent. It sends this information simultaneously on the second connection, i.e., control connection. This is used for the successful upload and download of the files. If multiple files are to be transferred, control connection will remain active throughout the entire FTP session, whereas data transfer connection is opened and closed for each file that is to be transferred. FTP uses two well-known TCP ports: port 21 is used for the control connection and port 20 is used for the data connection.

e) Ans. Explain with diagram of ARP message format. 4M
Following are the fields in the Address Resolution Protocol (ARP) Message Format.

**Hardware Type:** Hardware Type field in the Address Resolution Protocol (ARP) Message specifies the type of hardware used for the local network transmitting the Address Resolution Protocol (ARP) message. Ethernet is the common Hardware Type and he value for Ethernet is 1. The size of this field is 2 bytes.

**Protocol Type:** Each protocol is assigned a number used in this field. IPv4 is 2048 (0x0800 in Hexa).

**Hardware Address Length:** Hardware Address Length in the Address Resolution Protocol (ARP) Message is length in bytes of a hardware (MAC) address. Ethernet MAC addresses are 6 bytes long.

**Protocol Address Length:** Length in bytes of a logical address (IPv4 Address). IPv4 addresses are 4 bytes long.
**Operation/Opcode:** Operation/Opcode field in the Address Resolution Protocol (ARP) Message specifies the nature of the ARP message. 1 for ARP request and 2 for ARP reply.

**Sender Hardware Address:** Layer 2 (MAC Address) address of the device sending the message.

**Sender Protocol Address:** The protocol address (IPv4 address) of the device sending the message

**Target Hardware Address:** Layer 2 (MAC Address) of the intended receiver. This field is ignored in requests.

**Target Protocol Address:** The protocol address (IPv4 Address) of the intended receiver.

### f) Ans.

Describe SLIP and PPP.

**SLIP:** SLIP (Serial Line Internet Protocol)

The Serial Line Internet Protocol (also SLIP) is an encapsulation of the Internet Protocol designed to work over serial ports and modem connections.

- SLIP is a connection less protocol.
- SLIP does not perform error detection & correction.
- SLIP supports only IP.
- IP address is assigned statically.
- SLIP does not provide any authentication.
- SLIP is not approved Internet standard. SLIP is not a group of protocols.

**PPP:** PPP (Point-to-Point Protocol)

PPP is a connection-oriented protocol

- PPP performs error detection & correction.
- PPP supports multiple protocols.
- IP address is assigned dynamically.
- PPP provides authentication.
- PPP is approved Internet standard.
- PPP is a collection of three protocols:
  1. A datagram encapsulation protocol
  2. LCP (Link control Protocol), enabling testing and communication configuration.
5. Attempt any four of the following:

   a) Describe Gateways with its two advantages and two disadvantages.

   Ans.
   Gateway is device which operates on all layers of OSI model & TCP/IP Gateway is protocol converter. Gateway enables communication between different network architecture and environments. Gateway connects two systems that do not use the same protocol, data format, language and architecture. Convert commonly used protocols (e.g. TCP/IP) to a specialized protocol (for example, an SNA: System Network Architecture). Convert message formats from one format to another. Translate different addressing schemes.

   **Advantages of Gateways:**
   1. Used to expand the network.
   2. Gateway is a server so it provides some security.
   3. We can connect two different types of networks.
   4. Protocol conversion is done.
   5. Effectively handles the traffic problems.

   **Disadvantages of Gateway:**
   1. Not an intelligent device. So noise prevention is not done.
   2. Never filter out the data.
   3. Somewhat costly
   4. Protocol conversion is done so transmission rate is slower.
   5. Somewhat hard to handle.

   b) Explain Data Fragmentation and Reassembly.

   **Data Fragmentation:** For transferring data over network each transfer protocol applies upper limit to size of data in PDU (packet). If size of datagram is larger than MTU then it is divided into small units of size supported called fragment & this activity of dividing datagram into small unit is called as fragmentation.

   **Reassembly:** When a datagram is fragmented, either by the originating device or by one or more routers transmitting the datagram, it becomes multiple fragment datagrams. The destination of the overall message must collect these fragments and then reassemble them into the original message. Reassembly is

<table>
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<tr>
<th>5. a) Describe Gateways with its two advantages and two disadvantages.</th>
<th>16 (\text{Description} 2M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ans. Gateway is device which operates on all layers of OSI model &amp; TCP/IP Gateway is protocol converter. Gateway enables communication between different network architecture and environments. Gateway connects two systems that do not use the same protocol, data format, language and architecture. Convert commonly used protocols (e.g. TCP/IP) to a specialized protocol (for example, an SNA: System Network Architecture). Convert message formats from one format to another. Translate different addressing schemes.</td>
<td>4M Any two advantages 1M each</td>
</tr>
<tr>
<td>Advantages of Gateways:</td>
<td>Any two disadvantages 1M each</td>
</tr>
<tr>
<td>1. Used to expand the network.</td>
<td></td>
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<tr>
<td>2. Gateway is a server so it provides some security.</td>
<td></td>
</tr>
<tr>
<td>3. We can connect two different types of networks.</td>
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</tr>
<tr>
<td>4. Protocol conversion is done.</td>
<td></td>
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<tr>
<td>5. Effectively handles the traffic problems.</td>
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<tr>
<td>Disadvantages of Gateway:</td>
<td></td>
</tr>
<tr>
<td>1. Not an intelligent device. So noise prevention is not done.</td>
<td></td>
</tr>
<tr>
<td>2. Never filter out the data.</td>
<td></td>
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<tr>
<td>3. Somewhat costly</td>
<td></td>
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<tr>
<td>4. Protocol conversion is done so transmission rate is slower.</td>
<td></td>
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<tr>
<td>5. Somewhat hard to handle.</td>
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accomplished by using the special information in the fields we saw in
the preceding topic to help us “put the jigsaw puzzle back together
again”.

c) Ans. Explain layers of OSI model (any 2 layers).

OSI model has following 7 layers as Physical layer, data link layer,
Network layer, Transport layer, Session layer, Presentation layer,
Application layer. Following are the functions performed by the
above layer.

1. **Physical layer**: it deals with the mechanical and electrical
   specification of the interface and transmission medium.
   a. Physical characteristics of interfaces and medium.
   b. Representation of bits or signals.
   c. Data rate
   d. Synchronization of bit
   e. Line configuration or connection type.
   f. Physical topology
   g. Transmission mode.

2. **Data link layer**: It performs node to node delivery of the data It
   is responsible for transmitting group of bits between the adjacent
   nodes. The group of bits is called as frame.
   a. Framing
   b. Physical addressing
   c. Flow control
   d. Error control
   e. Media access control
   f. Node to node delivery

3. **Network layer**: It is responsible for routing the packets within
   the subnet i.e. from source to destination. It is responsible for
   source to destination delivery of individual packets across
   multiple networks. It ensures that packet is delivered from point
   of origin to destination.
   a. Logical addressing
   b. Routing
   c. Congestion control
   d. Accounting and billing
   e. Fragmentation
   f. Source host to destination host error free delivery of
packet.

4. **Transport layer**: Responsibility of process to process delivery of message. Ensure that whole message arrives in order.
   a. Service point addressing
   b. Segmentation and reassembly
   c. Connection control
   d. Flow control: Flow control is performed end to end
   e. Error control

5. **Session layer**: Establishes, maintains, and synchronizes the interaction among communication systems. It is responsible for dialog control and synchronization.
   a. Dialog control
   b. Synchronization
   c. Token Management
   d. Activity Management
   e. Data Exchange

6. **Presentation layer**: It is concerned with syntax, semantics of information exchanged between the two systems.
   a. Translation: presentation layer is responsible for converting various formats into required format of the recipient
   b. Encryption: Data encryption and decryption is done by presentation layer for security.
   c. Compression and Decompression: data to be transform compressed while sending and decompress while receiving for reducing time of transmission.

7. **Application layer**: It enables user to access the network. It provides user interfaces and support for services like email, remote file access.
   a. Network virtual terminal.
   b. File transfer access and management.
   c. Mail services
   d. Directory services

<table>
<thead>
<tr>
<th>d) Ans.</th>
<th>Describe CRC with example.</th>
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<td></td>
<td><strong>Cyclic Redundancy Check</strong> (CRC): An error detection mechanism in which a special number is appended to a block of data in order to</td>
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detect any changes introduced during storage (or transmission). The CRC is recalculated on retrieval (or reception) and compared to the value originally transmitted, which can reveal certain types of error.

**CRC is more powerful than VRC and LRC in detecting errors.**
1. It is based on binary division.
2. At the sender side, the data unit to be transmitted is divided by a predetermined divisor (binary number) in order to obtain the remainder. This remainder is called CRC.
3. The CRC has one bit less than the divisor. It means that if CRC is of n bits, divisor is of n+1 bit.
4. The sender appends this CRC to the end of data unit such that the resulting data unit becomes exactly divisible by predetermined divisor i.e. remainder becomes zero.
5. At the destination, the incoming data unit i.e. data + CRC is divided by the same number (predetermined binary divisor).
6. If the remainder after division is zero then there is no error in the data unit & receiver accepts it.
7. If remainder after division is not zero, it indicates that the data unit has been damaged in transit and therefore it is rejected.
8. This technique is more powerful than the parity check and checksum error detection.
9. CRC is based on binary division. A sequence of redundant bits called CRC or CRC remainder is appended at the end of a data unit such as byte.

**Example:**

<table>
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</table>
e) Explain different types of transmission errors.

There are two types of transmission errors:
1. Single bit errors
2. Burst errors

**Single bit errors:** If the signal is carrying binary data, and if a value of 0 to changes to 1 or vice versa then it is known as single bit error. Single bit errors are more likely in the case of parallel transmission because it is likely that one of the eight wires carrying the bits has become noisy, resulting in corruption of a single bit of each byte. This can be a case of parallel transmission between the CPU and the memory inside a computer.

**Burst errors:** In burst error multiple bits of binary value are changed. In contrast, a burst changes at least two bits during data transmission because of errors. Note that burst errors can change any two or more bits in a transmission. These bits need not necessarily be adjacent bits. Burst errors are more likely in serial transmission, because the duration of noise is longer, which causes multiple bits to be corrupted.

f) State the meanings of:

i) **Phase**
   - It describes position of waveform with respect time \((t=0)\).
   - In electronic signaling, phase is a definition of the position of a point in time (instant) on a waveform cycle.

ii) **Frequency**
    - Frequency is the rate of change with respect to time.
    - OR
    - Frequency is also defined as the number of cycles per second, which is the inverse of Period.

iii) **Bandwidth**
    - The information carrying capacity of a signal or a medium, calculated using the difference between the highest and the lowest frequency. A range of frequencies within a given band, in particular that used for transmitting a signal. Bandwidth (signal processing) or analog bandwidth, frequency bandwidth or radio bandwidth: a measure of the width of a range of frequencies, measured in hertz.
iv) Time Period: A Time period (T) is the time needed for one complete cycle of vibration to pass a given point. As the frequency of a wave increases, the time period of the wave decreases. Frequency and time Period are in a reciprocal relationship that can be expressed mathematically as: \( T = \frac{1}{f} \) or as: \( f = \frac{1}{T} \).

6. a) Ans.

Attempt any four of the following:

**Compare between OSI and TCP/IP model (any 4 points).**

<table>
<thead>
<tr>
<th>OSI (Open System Interconnection)</th>
<th>TCP/IP (Transmission Control Protocol / Internet Protocol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. OSI is a generic, protocol independent standard, acting as a communication gateway between the network and end user.</td>
<td>1. TCP/IP model is based on standard protocols around which the Internet has developed. It is a communication protocol, which allows connection of hosts over a network.</td>
</tr>
<tr>
<td>2. In OSI model the transport layer guarantees the delivery of packets</td>
<td>2. In TCP/IP model the transport layer does not guarantees delivery of packets.</td>
</tr>
<tr>
<td>3. OSI model has a separate Presentation layer and Session layer.</td>
<td>3. TCP/IP does not have a separate Presentation layer or Session layer.</td>
</tr>
<tr>
<td>5. OSI is a reference model around which the networks are built. Generally it is used as a guidance tool.</td>
<td>5. TCP/IP model is, in an actual implementation of protocols which we use on day to day basis.</td>
</tr>
<tr>
<td>6. Network layer of OSI model provides both connection oriented and connectionless service.</td>
<td>6. The Network layer in TCP/IP model provides connectionless service.</td>
</tr>
<tr>
<td>7. OSI model has a problem of fitting the protocols into the model.</td>
<td>7. TCP/IP model has its own set of protocols for each layer.</td>
</tr>
<tr>
<td>8. Protocols are hidden in OSI model and are easily replaced as the technology changes.</td>
<td>8. In TCP/IP protocols are well known and not easy to replace.</td>
</tr>
<tr>
<td>9. OSI model defines services, interfaces and protocols very</td>
<td>9. In TCP/IP, services, interfaces and protocols are not</td>
</tr>
</tbody>
</table>
clearly and makes clear distinction between them. It is protocol independent.

| 10. It has 7 layers | 10. It has 4 layers |

b) **Describe the following:**

1) **Bridges and 2) Repeaters.**

1) **Bridge:** Bridge is a device used to connect two or more LAN segments together. Bridge operates at the data link layer of OSI model. A Bridge provides packet filtering at data link layer, meaning that it only passes the packets that are destined for the other side of the network.

   **Types of Bridges:**
   Following types of Bridges are used in network:
   1) Transparent Bridge.
   2) Translational Bridge.
   3) Source route Bridge.

2) **Repeater:** Repeater operates at the physical layer. Its job is to regenerate 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. An important point to be noted about repeaters is that they do no amplify the signal. When the signal becomes weak, they copy the signal bit by bit and regenerate it at the original strength. It is a 2 port device.

 Ans.

| 4M | Bridge 2M |

| 2M | Repeater 2M |

c) **Describe internal architecture of ISP.**

[Diagram of ISP]

**Figure:** ISP

4M

2M
A subscriber of an ISP connects to one of the telephone lines of the ISP via modem. ISP is equipment. The ISP’s modem routes the subscriber to the remote access server (RAS) to authenticate the subscriber. Once the user is authenticated, the subscriber is as good as connected to the internet. Once the user is connected to the internet, the user can requests web pages send/receive emails or files, so on. The user interaction with the internet is coordinated by the RAS (remote Access Server), the ISP allows the user to create an email ID and use it for sending/receiving emails. The main point is that since the internet users are not always connected to the internet, an ISP stores emails on their behalf on the SMTP server temporarily. Web server performs two operations.

i. It can be used by the ISP to setup a portal

ii. This web can be used to store the web pages created by the subscribers. These web pages belongs to the ISP’s portal, can be hosted by different web servers for security and maintenance.

### Compare Analog signal and Digital signal. (4 points).

<table>
<thead>
<tr>
<th>Analog Signal</th>
<th>Digital Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>An analog signal has infinitely many levels of intensity over a period of time</td>
<td>A digital signal has only a limited number of values along its value</td>
</tr>
<tr>
<td>As the wave moves from value A to value B. it passes through and includes an infinite number of values along its path</td>
<td>Although each value can be any number, it is often as simple as 1 and 0</td>
</tr>
<tr>
<td>Analog signals are continuous in nature</td>
<td>Digital signals are discrete in nature</td>
</tr>
<tr>
<td>Analog signals are higher density</td>
<td>Digital signals are lower density</td>
</tr>
<tr>
<td>Loss and Distortion is high</td>
<td>Loss and Distortion is low</td>
</tr>
<tr>
<td>Analog signals are less secure</td>
<td>Digital signals are more secure</td>
</tr>
<tr>
<td>Less bandwidth is require for transmission</td>
<td>High bandwidth is requiring for transmission</td>
</tr>
<tr>
<td>Synchronization not present</td>
<td>Synchronization present</td>
</tr>
<tr>
<td>Examples: Human voice in air, signals in analog electronic devices</td>
<td>Examples: Computers and digital electronic devices</td>
</tr>
<tr>
<td>Analog signal is best suited for</td>
<td>Digital signal is best suited for</td>
</tr>
</tbody>
</table>
### e) What is WAN Addressing? Give its use.

**WAN Addressing:** WAN addressing is hierarchical addressing system. The address of a host on WAN is composed of two parts as follows:
1. Switch no.: It identifies switch to which host is connected.
2. Host no.: It identifies Host which is attached to that switch.

Overall address is made up of combination of switch no. & host no. as shown in following figure:

![WAN Addressing Diagram](image)

In the given example, hosts are connected to WAN switches 1,2. The host in this example will be identified by switch ID & its own ID relevant to that switch that means different host on different switch can have same Host ID like host(2,1) & host (3,1) having same host ID.

**Use of WAN Addressing:** A WAN address is the IP address that router uses to connect to the Internet. It is different from IP addresses of computers and devices on a local network, because the WAN IP is essentially shared by all the devices. WAN IPs is commonly used for server connections, because the address can be used to connect to servers over the Internet.

### f) What is Multiplexing? List types of multiplexing and explain any one.

**Multiplexing:** Multiplexing divides the physical line or a medium into logical segments called channels. In multiplexing, different channels carry data simultaneously over the same physical medium.

**Types of Multiplexing:**
- **Time Division Multiplexing (TDM):**
- **Frequency Division Multiplexing (FDM):**
- **Wavelength Division Multiplexing (WDM):**

**Example:**

A good example of multiplexing is when a telephone company assigns a specific frequency for a particular channel. This allows multiple conversations to occur simultaneously over the same physical medium.
Hardware equipment called multiplexer (or mux in short) combines (or multiplexes) the inputs from different sources, and loads them on different channels of a medium. The combined data traverses over the medium simultaneously. At the destination, a demultiplexer (also called demux) separates (or demultiplexes) the signals meant for different destinations. The demultiplexer sends these separated signals appropriately to the different destinations. This is depicted in fig. This is cheaper than having three separate lines.

**Types of Multiplexing:** There are basically two ways in which multiplexing and demultiplexing can be achieved. They are Frequency Division Multiplexing (FDM), Wave Division Multiplexing (WDM) and Time Division Multiplexing (TDM).

1. **Frequency Division Multiplexing (FDM):** FDM divides the channel into multiple, but smaller frequency ranges to accommodate more users. FDM is an analog technology. FDM divides the spectrum or carrier bandwidth in logical channels and allocates one user to each channel. Each user can use the channel frequency independently and has exclusive access of it. All channels are divided in such a way that they do not overlap with each other.

2. **Wave Division Multiplexing:** It is a technology which multiplexes a number of optical carrier signals onto a single optical fiber by using different wavelengths (i.e., colors) of laser light. This technique enables bidirectional communications over one strand of fiber, as well as multiplication of capacity.

2. **Time Division Multiplexing (TDM):** TDM divides a channel by allocating a time period for each channel. 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.