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1.
  - a) Define computer network and its types.
  - b) Write down the classifications of Computer Network?
  - c) What are the applications of Computer Network?
  - d) Describe about different types of computer network.
  
2.
  - a) What is hub?
  - b) What types of devices are used in an ethernet network?
  - c) What are the categories of computer network security threads?
  - d) What is Encryption? Write down the types of encryption / decryption / cryptographic algorithm?
  
3.
  - a) Write down the effectiveness in data communication Write down network criteria?
  - b) Identify the components of data communication systems.
  - c) What is distributed processing? Why we use it?
  - d) What are the advantages and disadvantages of distributed processing?

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4. a) Define Permutation.  
b) What is a Digital Signature?  
c) Describe about communication services of computer network . with examples  
d) Write down about application services of computer network .

5. a) Define client - server model .  
b) Draw the client - server model for two processes to interact .  
c) what are application layer protocols ?

- Explain them .  
6. a) what is the function of SMTP ?  
b) Why is an application such as pop needed for electronic messaging ?  
c) Write down about directory services .  
d) Describe about file sharing and transferring over the network .

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7. a) What is ethernet ?  
b) Write down about LAN Technologies.  
c) What is the difference between a switch and a hub ?  
d) Write the names of different types of topologies.
8. a) Define CGI. ~~What is CGI~~ What does it do?  
b) How many processes are there to communicate with two people ?  
c) How client server model works ?  
d) How the browser interacts with the servers ?

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1. (a) Define computer network.

Answer: A system of interconnected computers and computerized peripherals such as printers is called computer network. This interconnection among computers facilitates information sharing among them. Computers may connect to each other wired or wireless media.

(b) Write down the classifications of computer network?

Answer: Computer networks are classified based on various factors. They includes—

- (i) Geographical span
- (ii) Inter-connectivity
- (iii) Administration
- (iv) Architecture

Geographical span: Geographically a network can be seen in one of the following categories:

1. It may be spanned across our table,

among Bluetooth enabled devices, with Ranging not more than few meters.

2. It may be spanned across a whole city.

3. It may be spanned across multiple cities or provinces.

4. It may be one network covering whole world.

5. It may be spanned across a whole building, including intermediate devices to connect all floors.

Inter-connectivity: Components of a network

can be connected to each other differently in some fashion. By connectedness we mean either logically, physically or both ways.

1. Every single device can be connected to every other device on network, making the network mesh.

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2. All devices can be connected to a single medium but geographically disconnected, creating bus like structure.
3. Each device is connected to its left and right peers only creating linear structure.
4. All devices connected arbitrarily using all previous ways to connect each other, resulting in a hybrid structure.

Administration: From an administrator's point of view, a network can be private network which belongs to a single autonomous system and cannot be accessed outside its physical or logical domain. A network can be public which is accessed by all.

Network Architecture: Computer networks can be discriminated into various types such as client - server, peer-to-peer, or hybrid, depending upon its architecture.

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1. There can be one or more systems acting as server. Others being client, requesting the servers to serve requests.
2. Two systems can be connected point-to-point, or in back-to-back function. They both reside at the same level and called peers.
3. There can be hybrid network which involves network architecture of both the above types.

(c) What are the applications of computer network?

Answer: Computer systems and peripherals are

connected to form a network. The applications of computer network are given

below:

1. Resource sharing such as printers and storage devices.

2. Exchange of information by means of E-Mails and FTP.

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3. Information sharing by using Web or Internet.
4. Interaction with other users using dynamic web pages.
5. IP phones
6. video conferences
7. Parallel computing
8. Instant messaging

(d) Describe about different types of Computer Network.

Answer: Generally, networks are distinguished based on their geographical span. A network can be as small as distance between our mobile phone and its bluetooth headphone and as large as the internet itself, covering the whole geographical world.

There are different types of computer network. They are -

1. Personal Area Network
2. Local Area Network
3. Metropolitan Area Network
4. Wide Area Network
5. Internetwork

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1. Personal Area Network: A personal area network (PAN) is the smallest network which is very personal to any user. This may include Bluetooth enabled devices or infrared enabled devices. PAN has connectivity range up to 10 meters. PAN may include wireless computer keyboard and mouse. Bluetooth enabled headphones, wireless printers and TV remotes.

For example, Piconet is a Bluetooth enabled Personal Area Network which may contain up to 8 devices connected together in a master-slave fashion.

2. Local Area Network: A computer network spanned inside a building and operated under single administrative system is generally termed as Local Area Network (LAN). Usually, LAN covers an organization's offices, schools, colleges or universities.

Number of systems connected in LAN may vary from as least as two to as much as 16 million.

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LAN provides a useful way of sharing the resources between local users. The resources such as printers, file servers, scanners, and internet can be easily sharable among computers.

In LAN, users either ethernet or token-ring technology. Ethernet is most widely employed LAN technology and uses star topology, while token-ring is rarely seen.

LAN can be wired, wireless or both forms at once.

3. Metropolitan Area Network: The Metropolitan Area Network (MAN) generally expands throughout a city such as cable TV network. It can be in the form of ethernet, token-ring, ATM or Fiber Distributed Data Interface (FDDI).

Metro ethernet is also service which is provided by ISPs. This service enables its users to expand their local Area Networks.

For example, MAN can help an organization to connect all of its offices in a city.

Backbone of MAN is high capacity and high-speed fibre optics. MAN works in between Local Area Network and Wide Area Network.

MAN provides uplink for LANs to WANs or internet.

MAN has main backbone and local connectivity.

4. Wide Area Network: As the name suggests, the wide Area Network (WAN) covers a wide area may span across provinces and even a whole country. Generally, telecommunication networks are Wide Area Networks. These networks provides connectivity between MANs and other LANs. Since they are equipped with every high speed backbone, WANs use very expensive network equipment.

WAN may use advanced technologies such as Asynchronous Transfer Mode (ATM), Frame Relay and Synchronous Optical Network (SONET). WAN may be managed by multiple administration.

5. **Internetwork:** A network of networks is called an internetwork, or simply the internet. It is the largest network in existence on this planet. The internet hugely connects all WANs and it can have connection to LANs and home networks. Internet uses TCP/IP protocol suite and uses IP as its addressing protocol. Present day, Internet is widely implemented using IPv4. Because of storage of address spaces, it is gradually migrating from IPv4 to IPv6.

Internet, enables its users to share and access enormous amount of information worldwide. It uses WWW, FTP, email services, audio and video streaming etc. At huge level, internet works on client server model.

Internet uses very high-speed backbone of fiber optics. To inter-connect various continents, fibers are laid under sea known to us as submarine communication cable.

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Internet is serving many purposes and is involved in many aspects of life. Some of them are -

- (i) Web sites
- (ii) E-mail
- (iii) Instant messaging
- (iv) Blogging
- (v) Social Media
- (vi) Marketing
- (vii) Networking
- (viii) Resource sharing
- (ix) Audio and video streaming

2. (a) What is hub? Explain its working.

Answer:

Hub: A hub is a network hub used for connection of devices in a network. It connects several devices in a LAN. All the devices in the network connection is connected through hub that acts as a central connection for all the devices.

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(b) What types of devices are used in an ethernet network?

Answer: Hubs, switches, routers, media converters and the various user devices that can connect to them. Switches are used to manage traffic in an efficient manner and are available in managed and unmanaged versions.

Hubs are older technology devices that repeat the transmission that is received on one port to all ports - a very inefficient operation. Media converters allow two different forms of media - copper and fibre - to 'connect'.

A router is a device that manages traffic between network segments. It connects networks at Layer 3 of the OSI model.

(c) What are the categories of computer network security threats?

Answer: During initial days of Internet, its use was limited to military and universities for research and development purpose. Later when all networks merged together and formed Internet, the data used to travel through public transit network. Common people may send the data that can be highly sensitive such as their bank credentials, username and passwords, personal documents, online shopping details or confidential documents.

All security threats are intentional i.e. they occur only if intentionally triggered. Security threats can be divided into the following categories —

- ① Interception: Interception is a security threat in which availability of resources is attacked. For example, a user is unable to access its web-server or the web-server is hijacked.

(ii) Privacy - Breach: In this moment threat, the privacy of a user is compromised. Someone, who is not the authorized person is accessing or intercepting data sent or received by the original authenticated user.

(iii) Integrity: This type of threat includes any alteration or modification in the original context of communication. The attacker intercepts and receives the data sent by the sender, and the attacker then either modifies or generates false data and sends to the receiver. The receiver receives the data assuming that it is being sent by the original sender.

(iv) Authenticity: This threat occurs when an attacker, or security violator, poses as a genuine person and accesses the resources or communicates with other genuine users.

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(d) What is encryption? Write down the types of encryption / decryption / cryptographic algorithm?

Answer:

Encryption: Encryption is a way of scrambling data so that only authorized parties can understand the information. In technical terms, it is the process of converting plaintext to ciphertext.

Cryptography is a technique to encrypt the plain-text data which makes it difficult to understand and interpret. There are several cryptographic algorithms available present day as described below.

- i Secret key Encryption.
- ii Private key Encryption
- iii Message Digest.

i) Secret key Encryption: Both sender and receiver have one secret key. This secret key is used to encrypt the data at sender's end.

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After the data is encrypted, it is sent on the public domain to the receiver. Because the receiver knows and has the secret key, the encrypted data packets can easily be decrypted.

Example of secret key encryption is Data Encryption Standard (DES). In secret key encryption, it is required to have a separate key for each host on the network making it difficult to manage.

## (ii) Public key Encryption :

In this encryption system, every user has its own secret key and it is not the shared domain. The secret key is never revealed on public domain. Along with secret key, every user has its own but public key. Public key is always made public and is used by senders to encrypt the data. When the user receives the encrypted data, he can easily decrypt it by using its own secret key.

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Example of public key encryption is (Rivest - Shamir - Adleman) (RSA).

(iii) Message Digest: In this method, actual data is not sent, instead a hash value is calculated and sent. The other end user, computes its own hash value and compares it with the one just received. If both hash values are matched, then it is accepted, otherwise rejected.

Example of Message Digest is MD5 hashing, it is mostly used in authentication where user's password is checked with the one saved on the server.

Message digest matching happens when two different messages are hashed into the same block. Authorization happens after the user's message is hashed with the password and the result is compared with the saved hash.

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3. (a) Write down the effectiveness in data communication ? Write down network criteria?

Answer: Data communications are 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 communication system made up to of a combination of hardware (physical equipment) and software (programs). The effectiveness of a data communications system depends on four fundamental characteristics: delivery, accuracy, timeliness and jitter.

1. Delivery : The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.

2. Accuracy : The system must deliver the data accurately. Data that have been

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altered in transmission and left uncorrected are unusable.

3. Timeliness: The system must deliver data in a timely manner. Data delivered late are useless. In the case of video and audio, timely delivery means delivering data as they are produced, in the same order that they are produced and without significant delay. This kind of delivery is called real-time transmission.

4. Jitter: Jitter refers to the variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets. For example, let us assume that video-packets are sent every 30 ms. If some of the packets arrive with 30-ms delay and others with 40-ms delay, an uneven quality in the video is the result. A network must be able to meet a certain number of criteria. The most important of these are performance, reliability and security.

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1. Performance: Performance can be measured in many ways, including transit time and response time. Transit time is the amount of time required for a message to travel from one device to another. Response time is the elapsed time between an inquiry and a response. The performance of a network depends on a number of factors, including the number of users, the type of transmission medium, the capabilities of connecting hardware, and the efficiency of the software. Performance is often evaluated by two networking metrics: throughput and delay. We often need more throughput and less delay. However, these two criteria are often contradictory. If we try to send more data to the network, we may increase throughput but we increase the delay because of traffic congestion in the network.

2. Reliability : In addition to accuracy of delivery, network reliability is measured by the frequency of failure, the time it takes a link to recover from a failure, and the network's robustness in a catastrophe.

3. Security : Network security issues include data from unauthorized access, protecting data from damage and development, and implementing policies and procedures for recovery from breaches and data losses.

(b) Identify the components of data communication systems.

Answer: The components of data communication systems is given below:

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

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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, just as a person speaking French can not be understood by a person who speaks only Japanese.

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(Q) What is distributed processing? Why we use it?

Answer: Distributed computing in simple words can be defined as a group of computers that are working together at the backend while appearing as one to the end user. The individual computers working together in such groups operate concurrently and allow the whole system to keep working if one or some of them fail.

In a distributed system multiple computers can host different software components, but all the computers work to accomplish a common goal. The computers in a distributed system or group can be physically located at the same place or close together, connected via a local network or connected by a Wide Area Network.

Deploying, maintaining, troubleshooting distributing systems can be a complex and challenging task. The main reason behind their increasing acceptance is perhaps necessity as they allow scaling horizontally. For example, traditional databases that run on a single machine requires users to upgrade the hardware to handle increasing traffic.

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(d) What are the advantages and disadvantages of distributed processing?

Answer:

• The advantages of Distributed Processing :

1. Scalability and Modular Growth
2. Fault Tolerance and Redundancy
3. Low latency
4. Cost Effectiveness
5. Efficiency

• Disadvantages of Distributed Processing :

1. Complexity
2. Higher Initial Cost
3. Security Concerns

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Ques. 1. (a) Define Permutation.

Answer: Permutation is transposition at bit level.

(b) What is a Digital Signature?

Answer: Digital signature is an electronic signature that can be used to authenticate the identity of the sender of a message or document and possibly to ensure that the original content of the message or document has been present unchanged.

Digital signature is easily transportable, cannot be imitated by someone else, and can be automatically time stamped. The ability to ensure that the original signed message arrived means that the sender cannot easily repudiate it later.

(c) Describe about communication services of Computer network?

Answer: Few of Communication services are here —

- (i) Email
- (ii) Social Networking

- (iii) Internet Chat
- (iv) Discussion Boards
- (v) Remote access

- (i) Email: Electronic mail is a communication method and something a computer user cannot work without. This is the basis of today's internet features. Email system has one or more email servers. All its users are provided with unique IDs. When a user sends an email to other user, it is actually transferred between users with help of email servers.
- (ii) Social Networking: Recent technologies have made technical life social. The computer savvy peoples, can find other known peoples or friends, can connect with them, can share thoughts, pictures and videos.
- (iii) Internet Chat: Internet chat provides instant text transfer services between two hosts. Two or more people can communicate

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with each other using text based Internet Relay Chat services. These days, voice chat and video chat are very common.

(iv) Discussion Boards: Discussion boards provide a mechanism to connect multiple people with same interests. It enables the users to put queries, questions, suggestions etc. which can be seen by all other users. Others may respond as well.

(v) Remote access: This service enables user to access the data residing on the remote computer. This feature is known as Remote Desktop. This can be done via some remote device, e.g. mobile phone or home computer.

(d) Write down about application services of Computer Network.

Answer: Application services are nothing but network based services to the users such as web services, database managing and resource sharing.

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Resource sharing: To use resources efficiently and economically, network provides a mean to share them. This may include servers, printers and storage media etc.

Databases: This application service is one of the most important services. It stores data and information, processes it and enables the users to retrieve it efficiently by using queries. Databases help organizations to make decisions based in statistics.

Web services: Worldwide web has become the synonym for internet. It is used to connect to the internet and access files and information services provided by the internet servers.

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Q. 5. (a) Define client - server model.

Answer: A client server network is a specific type of online network comprised of a single central computer acting as a server that directs multiple other computers, which are referred to as the clients. In a client-server model, whether a computer is a client, server or both, is determined by the nature of the application that requires the service functions.

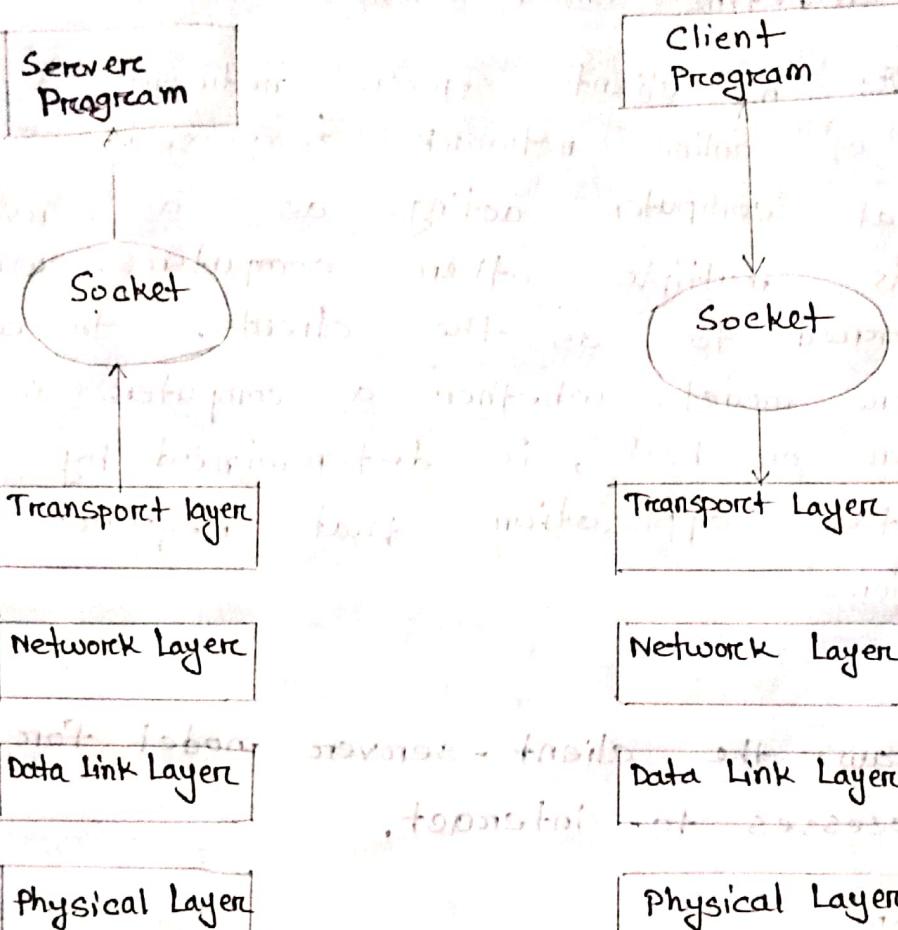
(b) Draw the client - server model for two processes to interact.

Answer:

The structure is given below:

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(c) What are application layer protocols? Explain them.

Answer: There are several protocols which work for users in Application Layer. Application layer protocols can be broadly divided into two categories:

- Protocols which are used by users. For example, email.
- Protocols which help and support protocols used by users. For example, DNS.

Few of Application layer protocols are described below:

Domain Name System: The Domain Name System (DNS) works on client server model. It uses UDP for transport layer communication. DNS uses hierarchical domain based naming scheme. The DNS server is configured with Fully Qualified Domain Names (FQDN) and email addresses mapped with their respective Internet protocol addresses.

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Simple Mail Transfer Protocol: The Simple Mail Transfer Protocol (SMTP) is used to transfer electronic mail ~~for~~ from one user to another. This task is done by means of email client software (User Agents) where user is using User Agents help the user to type and format the email and store it until internet is available.

File Transfer Protocol: The file Transfer Protocol (FTP) is the most widely used protocol for file transfer over the network. FTP uses TCP / IP for communication and it works on TCP port 21.

FTP works on Client / Server Model where a client requests file from Server and server sends requested resource back to the client.

Post Office Protocol (POP): The Post Office Protocol version 3 (POP3) is a simple mail retrieval protocol used by

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User Agents (client email software) to retrieve mails from mail servers.

Hyper Text Transfer Protocol : The Hyper text

Transfer Protocol (HTTP) is the foundation of World Wide Web. Hyper text is well organized documentation system which uses hyperlinks to link the pages in the text documents. HTTP works on client server model. HTTP is a stateless protocol, which means the server maintains no information about earlier requests by clients.

HTTP versions :

- HTTP 1.0 uses non persistent HTTP. At most one subject can be sent over a single TCP connection.
- HTTP 1.1 uses persistent HTTP. In this version, multiple objects can be sent over a single TCP connection.

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Q. (a) What is the function of SMTP?

Answer:

Function of SMTP: The TCP / IP protocol supports electronic mail on the Internet is called Simple Mail Transfer Protocol (SMTP). It is a system for sending messages to other computers users based on e-mail addresses. SMTP provides mail exchange between users on the same or different computers.

(b) Why is an application such as POP needed for electronic messaging?

Answer:

Workstations interact with the SMTP host which receives the mail on behalf of every host in the organization, to retrieve messages by using a client server protocol such as Post Office Protocol, version 3 (POP3). Although POP3 is used to download messages from the server, the SMTP client still

needed on the desktop to forward messages from the workstation user to its SMTP mail server.

(c) Write down about directory services.

Answer: Network services are mapping between name and its value, which can be variable value or fixed. This software system helps to store the information, organize it and provides various means of accessing it.

① Accounting: In an organization, a number of users have their user names and passwords mapped to them. Directory services provide means of storing this information in encrypted form and make available when requested.

② Authentication and Authorization: User credentials are checked to authenticate a user at the time of login and / or periodically. User accounts can be set into hierarchical structure and their access to resources can be controlled using authorization schemes.

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(c) Domain Name Services: DNS is widely used and one of the essential services on which internet works. This system maps IP addresses to domain names, which are easier to remember and recall than IP addresses. Because network operates with the help of IP addresses and humans tends to remember website names, the DNS provides website's IP address which is mapped to its name from the back-end on the request of a website name from the user.

(d) Description about file sharing and transferring over the network.

Answer: File services include sharing and transferring files over the network.

i) File sharing

ii) File transferring

i) File sharing: One of the reasons which gave birth to networking was file sharing. File sharing enables its users to share their data with other users. Users can upload the file to a specific server, which is accessible by all intended users. As an alternative, user can make its file shared on its own computer and provides access to intended users.

ii) File Transfer: This is an activity to copy or move files from one computer to another computer or to multiple computers, with help of underlying network. Network enables its users to locate other users in the network and transfers files.

7. (a) What is Ethernet?

Answer:

Ethernet: Ethernet is a local area network (LAN) protocol that was originally developed to link computers.

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(b) Write down about LAN technologies.

Answer:

There are various LAN technologies —

- (i) Ethernet
- (ii) Fast-Ethernet
- (iii) Gigabit Ethernet
- (iv) Virtual LAN

(i) Ethernet: Ethernet is a widely deployed LAN technology. This technology was invented by Bob Metcalfe and D.R. Boggs in the year 1970. It was standardized in IEEE 802.3 in 1980.

Ethernet shares media. Network which uses shared media has high probability of data collision. Ethernet uses carrier sense multi access / collision detection (CSMA/CD) technology to detect collisions. Ethernet follows star topology with segment length up to 100 meters.

(ii) Fast-Ethernet: To encompass need of fast emerging software and hardware technologies, Ethernet extends itself as Fast-Ethernet.

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It can run on UTP, Optical Fibers and wirelessly too. It can provide speed up to 100 mbps. This standard is named as 100 BASE-T in IEEE 802.3 using Cat-5 twisted pair cable. It uses CSMA/CD technique for wired media sharing among the ethernet hosts and CSMA/CA (CA stands for collision avoidance) technique for wireless ethernet LAN.

- iii) Giga Ethernet: After being introduced in 1995, Fast-Ethernet could enjoy its high-speed status only for 3 years till Giga-Ethernet introduced. Giga-Ethernet provides speed up to 1000 mbps.
- iv) Virtual LAN: LAN uses Ethernet which inherently works on shared media. Shared media in ethernet create one single broadcast domain and one single collision domain. Introduction of switches to ethernet has removed single collision domain issue and each device connected to switch works in its separate collision domain.

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(c) What is the difference between a switch and a hub?

Answer:

Difference between a switch and a hub:

Switch	Hub
1. Switch works in full duplex mode.	1. Hub works in half duplex mode.
2. Sends data in form of frames.	2. Sends data in form of bits.
3. Multicast device.	3. Broadcast device.
4. Switch works in Data link/ Network layers of OSI model.	4. Hub works in physical layer of OSI model.
5. It is used to connect devices to the network.	5. It is used to connect devices to the same network.
6. It stores MAC address and IP address of nodes in the network.	6. It does not store any MAC address of a node in the network.
7. Types are Layer 2 and Layer 3 switch.	7. Types are: Active hub, passive hub, intelligent hub.

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(d) Write the names of different types of topologies.

Answer:

A network topology is the arrangement with which computer systems or network devices are connected to each other. Topologies may define both physical and logical aspect of the network. Both logical and physical topologies could be same or different in a same network.

There are different types of topologies:

- i Point-to-Point topology
- ii Bus topology
- iii Star topology
- iv Ring topology
- v Mesh topology
- vi Tree topology
- vii Daisy chain
- viii Hybrid topology

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### 8. (a) Define CGI for web application.

Answer:

CGI : CGI is a standard for communication between HTTP servers and executable programs. It is used in creating dynamic documents.

- (b) How many processes are there to communicate with two people?

Answer: Two remote application processes can communicate mainly in two different fashions—

i) Peer-to-peer : Both remote processes are executing at same level and they exchange data using some shared resource.

ii) Client-Server : One remote process acts as a client and requests some resource from another application process acting as server.

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### (C) How client server model works ?

Answer: The client - server model is a distributed application structure that partitions task or workload between the providers of a resource or service, called servers and service requesters called clients.

Client: When we talk the word client, it mean to talk of a person or an organization using a particular service. Similarly in the digital world a client is a computer (Host) i.e. capable of receiving information or using a particular service from the service providers (servers).

Servers: Similarly, when we talk the word servers, it mean a person or medium that serves something. Similarly, in this digital world a server is a remote computer which provides information (data) or access to particular services.

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So, it's basically the client requesting something and the server serving it as long as it's present in the database.

(d) How does the browser interacts with the servers?

Answer: There are few steps to follow to interact with the servers and a client —

- ① User enters the URL (Uniform resource Locator) of the website on its file. The browser then requests the DNS (Domain Name System) server.
- ② DNS server looks up for the address of the web server.
- ③ DNS server responds with the IP address of the web server.

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- ④ Browser sends over an HTTP/ HTTPS request to web server's IP (provided by DNS server)
- ⑤ Server sends over the necessary files of the website.
- ⑥ Browser then renders the files and the website it displayed. This rendering is done with the help of DOM (Document Object Model) interpreter, CSS interpreter and JS Engine collectively known as the JIT or (Just in time) compilers.