1. Define application layer. Write the services of application layer.

The application layer is the topmost layer of the OSI (Open Systems Interconnection) model and the TCP/IP protocol suite. It serves as the interface between the network and the user, providing a platform for users or application processes to communicate and interact with the network. The application layer encompasses a variety of protocols and services that enable communication between different applications running on devices across a network.

Services of the Application Layer:

- **File Transfer**: Application layer protocols such as FTP (File Transfer Protocol), SFTP (SSH File Transfer Protocol), and TFTP (Trivial File Transfer Protocol) facilitate the transfer of files between devices on a network.
- **Email Services**: Protocols like SMTP (Simple Mail Transfer Protocol), POP3 (Post Office Protocol version 3), and IMAP (Internet Message Access Protocol) provide email services, including sending, receiving, and accessing email messages over the internet.
- **Web Services:** HTTP (Hypertext Transfer Protocol) and HTTPS (HTTP Secure) are application layer protocols used for accessing and transferring hypertext documents, web pages, and other resources on the World Wide Web.
- **Domain Name System (DNS):** DNS is a hierarchical naming system that translates human-readable domain names into numerical IP addresses, enabling devices to locate resources on the internet based on domain names.
- **Remote Access and Management**: Protocols like Telnet and SSH (Secure Shell) allow users to remotely access and manage devices, servers, and network equipment over a network connection.
- **Remote Desktop Services**: Protocols such as RDP (Remote Desktop Protocol) and VNC (Virtual Network Computing) enable users to remotely access and control desktop environments or graphical user interfaces (GUIs) of remote computers or servers.
- **Voice and Video Conferencing**: Protocols like SIP (Session Initiation Protocol), RTP (Real-Time Transport Protocol), and RTSP (Real-Time Streaming Protocol) facilitate real-time communication for voice and video conferencing applications over IP networks.

2. **Explain major protocols used in application layer.**
   The application layer of the OSI (Open Systems Interconnection) model and the TCP/IP protocol suite encompasses a variety of protocols that enable communication between different applications running on devices across a network. Some of the major protocols used in the application layer include:

   1. Hypertext Transfer Protocol (HTTP):
      HTTP is the foundation of data communication on the World Wide Web, enabling the transfer of hypertext documents, web pages, and other resources between web servers and clients (web browsers). It follows a client-server model, where a client sends requests for resources (e.g., web pages) to a web server, and the server responds with the requested content. HTTP operates over TCP/IP and uses a stateless request-response protocol, where each request from the client is independent of previous requests.

   2. File Transfer Protocol (FTP):
      FTP is a standard protocol used for transferring files between devices on a network. It supports both interactive (user-initiated) and batch (automated) file transfers, allowing users to upload, download, rename, delete, and manage files on remote servers. FTP operates over TCP/IP and provides authentication mechanisms for secure access to files and directories.

   3. Simple Mail Transfer Protocol (SMTP):
      SMTP is an application layer protocol used for sending email messages between email servers. It defines the format and rules for email transmission, including the addressing scheme, message format, and message transfer procedures. SMTP operates over TCP/IP and uses a store-and-forward mechanism to route email messages between mail servers until they reach their destination.

   4. Post Office Protocol version 3 (POP3):
      POP3 is an application layer protocol used for retrieving email messages from a mail server to a client device. It allows users to download email messages from their mailbox to a local device for offline access. POP3 operates over TCP/IP and typically uses port 110 for communication.

   5. Internet Message Access Protocol (IMAP):
      IMAP is an application layer protocol used for accessing and managing email messages stored on a remote mail server. Unlike POP3, which

downloads email messages to a local device, IMAP allows users to view, organize, and manage email messages directly on the server. IMAP operates over TCP/IP and typically uses port 143 for communication.

6. Domain Name System (DNS):
DNS is a hierarchical naming system used for translating human-readable domain names (e.g., www.example.com) into numerical IP addresses (e.g., 192.0.2.1) used by network devices to locate resources on the internet. It provides domain name resolution services, allowing users to access websites, send emails, and access other internet resources using easy-to-remember domain names. DNS operates over TCP/IP and uses both UDP (User Datagram Protocol) and TCP (Transmission Control Protocol) for communication.

3. **Define DNS. Explain the working procedure of DNS server.**

DNS is a hierarchical naming system used for translating human-readable domain names (e.g., www.example.com) into numerical IP addresses (e.g., 192.0.2.1) used by network devices to locate resources on the internet. It provides domain name resolution services, allowing users to access websites, send emails, and access other internet resources using easy-to-remember domain names. DNS operates over TCP/IP and uses both UDP (User Datagram Protocol) and TCP (Transmission Control Protocol) for communication.

The working procedure of a DNS server involves several steps:

DNS Resolution Request: When a user enters a domain name (e.g., www.example.com) into a web browser or attempts to access a network resource, their device sends a DNS resolution request to a DNS resolver (usually a DNS server provided by their internet service provider or configured by the network administrator).

Local DNS Cache Check: The DNS resolver first checks its local cache to see if it already has the IP address corresponding to the requested domain name. If the IP address is found in the cache and is still valid (not expired), the resolver can immediately return the IP address to the requesting device, bypassing the need for further resolution.

Recursive DNS Query: If the requested domain name is not found in the local cache or if the cached entry has expired, the DNS resolver initiates a recursive DNS query. It sends a request to one of the root DNS servers, asking for the IP

address of the top-level domain (TLD) server responsible for the domain name's extension (e.g., ".com", ".org", ".net").

Top-Level Domain (TLD) Resolution: The root DNS server responds to the resolver with the IP address of the appropriate TLD server based on the domain name's extension. For example, if the domain name is "www.example.com," the root server directs the resolver to the ".com" TLD server.

Authoritative Name Server Query: The resolver then sends another DNS query to the TLD server, asking for the IP address of the authoritative name server responsible for the specific domain name (e.g., "example.com").

Domain Name Resolution: The TLD server responds to the resolver with the IP address of the authoritative name server for the requested domain name.

IP Address Retrieval: Finally, the resolver sends a DNS query directly to the authoritative name server for the domain name, requesting the IP address associated with the domain name.

Response to Client: The authoritative name server responds to the resolver with the IP address corresponding to the requested domain name.

Caching: The resolver caches the IP address locally for future use, reducing the need for repeated DNS resolutions for frequently accessed domain names.

Client Access: The resolver returns the IP address to the requesting client device, allowing it to establish a connection and access the desired network resource (e.g., website, email server).