Q 1. OSI & TCP/IP Models

OSI Reference Model (7 Layers)

1. **Physical:** Transmits raw bit streams (electrical/light signals) over hardware. Devices: Hubs, cables.
2. **Data Link:** Frames data, handles physical addressing (MAC), and error detection. Devices: Switches.
3. **Network:** Handles logical addressing (IP) and routing packets between networks. Devices: Routers.
4. **Transport:** Ensures reliable, end-to-end data delivery and flow control (TCP/UDP).
5. **Session:** Establishes, manages, and terminates connections between applications.
6. **Presentation:** Translates data formats, encrypts, and compresses data.
7. **Application:** Provides network services directly to user apps (Browsers, Email).

TCP/IP Model (4 Layers)

- **Network Access:** Combines OSI Physical and Data Link layers; handles hardware and MAC addressing.
- **Internet:** Corresponds to OSI Network layer; handles IP addressing and routing.
- **Transport:** Matches OSI Transport layer; provides TCP (reliable) or UDP (fast) delivery.
- **Application:** Combines OSI Session, Presentation, and Application layers; handles user protocols (HTTP, FTP).

Q 2. Types of Computer Networks

- **PAN (Personal Area Network):** Short-range (meters) for individual use (e.g., Bluetooth).
- **LAN (Local Area Network):** Connects devices in a limited area like a home or office (e.g., Wi-Fi, Ethernet).
- **MAN (Metropolitan Area Network):** Covers a city or campus; connects multiple LANs.
- **WAN (Wide Area Network):** Spans countries or continents; connects MANs/LANs (e.g., The Internet).

Q 3. Internet, Intranet, and Extranet

- **Internet:** Public, global network of interconnected networks using TCP/IP.
- **Intranet:** Private, internal network for a single organization, protected by firewalls.
- **Extranet:** A private network extended to authorized external users (partners/vendors) for secure collaboration.

Q 4, 6. Transmission Media

Guided (Wired) Media

- **Twisted-Pair:** Pairs of copper wires twisted to reduce interference. Common in Ethernet (UTP/STP).
- **Coaxial:** Copper core with a metal shield. Higher bandwidth; used for Cable TV.
- **Fiber-Optic:** Transmits light pulses through glass. Highest speed and security; immune to interference.

Wireless (Unguided) Media

- **Ground Propagation:** Low-frequency waves travel along Earth's curvature (AM Radio).
- **Sky Propagation:** Waves bounce off the ionosphere for long distances (Shortwave/Ham Radio).
- **Line-of-Sight:** Direct path required between antennas (FM, Microwave, Satellite).

Q 5. Modulation and Multiplexing

Modulation (Digital to Analog)

- **ASK (Amplitude Shift Keying):** Varies signal amplitude. Simple but noisy.
- **FSK (Frequency Shift Keying):** Varies signal frequency.
- **PSK (Phase Shift Keying):** Varies signal phase. Efficient and robust.

Multiplexing (Combining Signals)

- **FDM (Frequency Division):** Splits channel by frequency bands (Analog/Radio).
- **TDM (Time Division):** Splits channel by time slots (Digital/Cellular).

Q 7, 8, 9, 10, 11, 12, 13. Network Protocols and Concepts

Switching Techniques

- **Circuit Switching:** Dedicated path established before transmission (Telephone network).
- **Packet Switching:** Data split into packets and routed independently (Internet).

Protocols & Methods

- **Stop-and-Wait:** Sender waits for an acknowledgement (ACK) after every frame. Simple but inefficient.
- **ARP (Address Resolution Protocol):** Maps an IP address to a physical MAC address on a local network.
- **Subnetting:** dividing a large network into smaller logical subnets to improve performance and security.
- **Distance Vector Routing:** Routers share distance tables with neighbors to find the best path (e.g., RIP).

Error Detection

- **Parity Check:** Adds a bit to make the count even/odd; detects single-bit errors.
- **Checksum:** Sums data segments; receiver compares total to detect errors.
- **CRC (Cyclic Redundancy Check):** Uses binary division; highly reliable detection.

Transport & Link Protocols

- **TCP:** Connection-oriented, reliable, ordered delivery (Web, Email).
- **UDP:** Connectionless, fast, best-effort delivery (Streaming, Gaming).
- **PPP:** Point-to-Point Protocol for direct connections (VPN, Dial-up).

Q 14. Application Layer Protocols

- **WWW (World Wide Web):** System of interlinked documents accessed via the Internet using URLs.
- **Telnet:** Command-line remote login protocol. Insecure (sends data in plain text).
- **URL (Uniform Resource Locator):** Standard address used to locate resources on the web.

- **HTTP (Hypertext Transfer Protocol):** Stateless protocol for transferring web pages between servers and browsers.
- **FTP (File Transfer Protocol):** Standard protocol for transferring files between a client and server.