1. Fundamentals & Basics

- What is a Computer Network

- Network goals (resource sharing, reliability, scalability)

- Types of networks

    - PAN, LAN, MAN, WAN

    - Internet, Intranet, Extranet

- Network topologies

    - Bus, Star, Ring, Mesh, Tree, Hybrid

- Network architecture

    - Client–Server

    - Peer-to-Peer

- Network components

    - NIC, Hub, Switch, Router, Bridge, Repeater, Gateway, Modem

- Bandwidth, throughput, latency, jitter

- Bit rate vs baud rate

- Propagation delay, transmission delay, queuing delay, processing delay

- Packet switching vs circuit switching vs message switching

- Connection-oriented vs connectionless communication

2. OSI Model (Very Important)

- Purpose of layered architecture

- OSI 7 layers

1. Physical

2. Data Link

3. Network

4. Transport

5. Session

6. Presentation

7. Application

- Functions of each layer

- Protocols at each OSI layer

- Encapsulation and decapsulation

- Advantages & disadvantages of OSI model

3. **TCP/IP Model**

- TCP/IP vs OSI comparison

- TCP/IP layers

  - Network Access

  - Internet

  - Transport

  - Application

- Protocol mapping between OSI & TCP/IP

4. **Physical Layer**

- Transmission media

- Guided: Twisted Pair, Coaxial, Fiber Optic

- Unguided: Radio, Microwave, Infrared, Satellite

- Encoding & modulation

  - NRZ, RZ, Manchester, Differential Manchester

  - ASK, FSK, PSK, QAM

- Multiplexing

  - FDM, TDM, WDM, CDM

- Switching techniques

- Line configuration (point-to-point, multipoint)

- Physical devices

5. Data Link Layer

- Framing methods

  - Character count

  - Byte stuffing

  - Bit stuffing

- Error detection & correction

  - Parity

  - Checksum

  - CRC

  - Hamming code

- Flow control

  - Stop-and-Wait

- - Sliding Window

- ARQ protocols

  - Stop-and-Wait ARQ

  - Go-Back-N

  - Selective Repeat

- MAC sublayer

- MAC addressing

- Ethernet (IEEE 802.3)

- Switching concepts

  - Store-and-Forward

  - Cut-through

- VLAN

- Spanning Tree Protocol (STP)

6. <u>Network Layer</u>

- Logical addressing

- IPv4 and IPv6

- IP packet format

- Fragmentation & reassembly

- Routing vs forwarding

- Routing algorithms

  - Distance Vector

  - Link State

- Routing protocols

    - RIP

    - OSPF

    - BGP

- ICMP

- ARP & RARP

- NAT

- Subnetting & supernetting

- CIDR

- Default gateway

7. <u>**Transport Layer**</u>

- Transport services

- TCP vs UDP (very important)

- TCP features

    - Reliability

    - Flow control

    - Congestion control

    - Error control

- TCP segment format

- TCP 3-way handshake

- TCP connection termination

- TCP congestion control

- ○ Slow Start

- ○ Congestion Avoidance

- ○ Fast Retransmit

- ○ Fast Recovery

- UDP features & use cases

- Port numbers

- Multiplexing & demultiplexing

8. <u>Application Layer Protocols</u>

- HTTP / HTTPS

- FTP / SFTP

- SMTP

- POP3

- IMAP

- DNS

- DHCP

- Telnet

- SSH

- SNMP

- NTP

- SIP

- RTP / RTCP

- WebSockets

9. **Socket Programming & APIs**

- Client-server model

- Sockets

- TCP sockets

- UDP sockets

- Blocking vs non-blocking I/O

- Ports & services

- Inetd / xinetd

10. **Network Security**

- Network security basics

- CIA triad (Confidentiality, Integrity, Availability)

- Encryption

  - Symmetric

  - Asymmetric

- SSL / TLS

- HTTPS working

- Firewalls

  - Packet filtering

  - Stateful firewall

  - Application firewall

- IDS / IPS

- VPN

- IPsec

- Authentication vs authorization

- Common network attacks

    - DoS / DDoS

    - MITM

    - Spoofing

    - Phishing

    - Packet sniffing

11. <u>**Wireless & Mobile Networks**</u>

- Wireless LAN (Wi-Fi)

- IEEE 802.11 standards

- Bluetooth

- Cellular networks

    - 2G, 3G, 4G, 5G

- Handoff

- Mobile IP

- Ad-hoc networks

- IoT networking basics

12. <u>**Performance & QoS**</u>

- Network performance metrics

- Throughput analysis

- Delay analysis

- Congestion

- Congestion control techniques

- Traffic shaping

- Quality of Service (QoS)

- Load balancing

13. **Network Management**

- Network monitoring

- SNMP

- MIB

- Fault management

- Configuration management

- Performance management

- Accounting management

14. **Advanced & Real-World Concepts**

- CDN (Content Delivery Network)

- Proxy servers

- Reverse proxy

- HTTP caching

- Load balancers (L4 vs L7)

- DNS resolution process

- NAT traversal

- Multicast & broadcast

- Peer-to-peer networks

- SDN (Software Defined Networking)

- NFV (Network Function Virtualization)

- Cloud networking basics

- Microservices networking

15. <u>Common Interview Scenarios</u>

- How the internet works end-to-end

- What happens when you type a URL in a browser

- How DNS works internally

- TCP vs UDP use cases

- Difference between hub, switch, router

- How HTTPS is secure

- How packet loss is handled

- Network troubleshooting basics

Final Advice (Important)

If you can confidently explain:

- **OSI vs TCP/IP**

- **TCP internals**

- **IP + DNS + HTTP flow**

- **Subnetting**

- **Basic security**