Solutions to Data Communication and Networking (DSC-14)

Section A: Short Answer Questions (2 Marks each)

1. Define data communication and list the four fundamental components involved in the process.

Data communication refers to the exchange of data between two devices via some form of transmission medium.

Four fundamental components:

- Sender: The device that sends the data (e.g., a computer).
- Receiver: The device that receives the data (e.g., a server).
- Transmission Medium: The physical path through which the data is transmitted (e.g., cables, air).
- Protocol: A set of rules that governs the data communication (e.g., TCP/IP).

2. What are the primary differences between circuit-switched and packet-switched networks?

- Circuit-Switched: A dedicated communication path is established before data transmission (e.g., telephone networks).
- Packet-Switched: Data is divided into packets and transmitted over shared networks (e.g., the internet).

3. Explain the term modulation in data communication and name two types of modulation techniques.

Modulation is the process of varying a carrier signal to transmit data.

Types:

- Amplitude Modulation (AM)
- Frequency Modulation (FM)

4. What is meant by bandwidth in networking?

Bandwidth is the maximum data transfer rate of a network or internet connection, measured in bits per second (bps).

5. List and briefly explain the three types of errors that can occur during data transmission.

- Single-bit Error: Only one bit in the data unit changes.
- Burst Error: Two or more bits in the data unit change.
- Packet Loss: Entire data packets fail to arrive at their destination.

6. Define the term multiplexing. Mention two types of multiplexing techniques used in communication systems.

Multiplexing is the process of combining multiple signals into one signal over a shared medium.

Types:

- Frequency Division Multiplexing (FDM)
- Time Division Multiplexing (TDM)

7. Describe the function of the Network Interface Card (NIC) in a computer network.

NIC is a hardware component that connects a computer to a network, enabling communication over a LAN or the internet.

8. Explain the concept of DNS (Domain Name System) on the Internet.

DNS translates human-readable domain names (e.g., www.google.com) into IP addresses (e.g., 8.8.8.8) that computers can understand.

9. What is the role of IP addresses in networking? Differentiate between IPv4 and IPv6.

IP addresses uniquely identify devices on a network.

- IPv4: 32-bit address, e.g., 192.168.1.1.
- IPv6: 128-bit address, e.g., 2001:0db8:85a3:0000:0000:8a2e:0370:7334.

10. What is error detection? Mention any two techniques used for error detection in data communication.

Error detection ensures data integrity during transmission.

Techniques:

- Parity Check

- Cyclic Redundancy Check (CRC)

Section B: Long Answer Questions (5 Marks each)

1. Discuss the OSI model and describe the function of each layer in detail.

The OSI model is a conceptual framework used to understand network communication. It consists of 7 layers:

- Physical Layer: Transmits raw bits over a medium.
- Data Link Layer: Ensures error-free data transfer between adjacent nodes.
- Network Layer: Manages data routing and addressing (e.g., IP).
- Transport Layer: Ensures reliable data transfer (e.g., TCP).
- Session Layer: Establishes, maintains, and terminates sessions.
- Presentation Layer: Translates data formats (e.g., encryption).
- Application Layer: Interfaces with the user (e.g., HTTP).

2. Explain the types of transmission media used in data communication, with examples and their advantages/disadvantages.

Transmission media:

- Wired: Includes twisted-pair cables, coaxial cables, and fiber optics.
  - Advantages: Reliable, high speed.
  - Disadvantages: Limited mobility, expensive for large distances.
- Wireless: Includes radio waves, microwaves, and infrared.
  - Advantages: Mobility, easy installation.
  - Disadvantages: Interference, lower speeds compared to wired.

3. What is flow control in data communication? Explain the different methods used for flow control.

Flow control manages data flow between sender and receiver to prevent buffer overflow.

Methods:

- Stop-and-Wait: Sender waits for acknowledgment before sending the next packet.
- Sliding Window: Allows multiple packets to be sent before acknowledgment.

4. Explain the TCP/IP model. How does it differ from the OSI model? Discuss the functionality of each layer in the TCP/IP model.

TCP/IP has 4 layers:

- Network Interface: Handles hardware addressing and physical data transfer.
- Internet: Routes data packets (e.g., IP).
- Transport: Ensures reliable data transfer (e.g., TCP, UDP).
- Application: Interfaces with user applications (e.g., HTTP, SMTP).

Differences:

- TCP/IP is a practical implementation, while OSI is theoretical.
- OSI has 7 layers; TCP/IP has 4 layers.

Section C: Case Study (10 Marks each)

Case Study 1: Setting up a LAN

Solution:

- Topology: Use a star topology for reliability and ease of troubleshooting.
- Cables and Connectors: Use Cat6 cables and RJ45 connectors for high-speed transmission.
- Security Measures:
  - Implement a firewall and antivirus.
  - Use strong passwords and enable encryption (e.g., WPA3 for wireless).
  - Set up a secure VLAN for sensitive data.

Case Study 2: Designing a WAN

Solution:

- WAN Technologies: MPLS for reliability, SD-WAN for flexibility.
- Routing Protocols: Use OSPF for intra-office routing and BGP for inter-office routing.
- QoS:
  - Prioritize video conferencing traffic.
  - Use traffic shaping and bandwidth reservation techniques.

Case Study 3: E-commerce Network Performance

Solution:

- Potential Issues:
  - Network congestion.
  - Faulty hardware or outdated firmware.
  - Poorly configured routers/switches.
- Troubleshooting:
  - Analyze traffic using network monitoring tools.
  - Check for hardware/software issues.

  - Verify DNS and server response times.

- Optimization Steps:

  - Use a Content Delivery Network (CDN).

  - Upgrade bandwidth.

  - Implement load balancing.