SECTION A — (10 × 2 = 20 marks)

Answer any TEN questions.

1. **Mention the characteristics of data communication.**
   - Delivery: Ensures data reaches the correct destination.
   - Accuracy: Data must be delivered accurately without alteration.
   - Timeliness: Data should be delivered within a specified time frame.
   - Jitter: Variation in packet arrival time should be minimized.
2. **What is Full duplex?**
   - Full duplex allows communication in both directions simultaneously.
   - It is used in telephones, allowing talking and listening at the same time.
   - Increases efficiency compared to half-duplex communication.
   - Requires separate transmission channels for sending and receiving.
3. **What is unguided media?**
   - Unguided media refers to wireless transmission methods.
   - Includes radio waves, microwaves, and infrared signals.
   - No physical medium is required for data transmission.
   - Used in satellite communication and Wi-Fi networks.
4. **Define error detection.**
   - Error detection is a method to identify errors in transmitted data.
   - Techniques include parity checks, checksums, and CRC (Cyclic Redundancy Check).
   - Helps maintain data integrity in communication systems.
   - Used in data transmission protocols to ensure accuracy.
5. **What is Multiplexing?**
   - Multiplexing allows multiple signals to share the same communication medium.
   - Techniques include Time Division Multiplexing (TDM) and Frequency Division Multiplexing (FDM).
   - Increases the efficiency of data transmission.
   - Reduces the cost of infrastructure by sharing resources.
6. **What is switching?**
   - Switching is the process of directing data from one network device to another.
   - Types include circuit switching, packet switching, and message switching.
   - Helps route data in telecommunications networks.
   - Improves the efficiency of data communication in large networks.
7. **Define Ethernet.**
   - Ethernet is a widely used LAN technology.
   - It defines wiring and signaling standards for the physical layer.

- Ethernet frames carry data between devices on the same network.
- Standardized as IEEE 802.3.

8. **What is a Digital Network?**
   - A digital network transmits data in the form of binary signals.
   - Includes technologies like ISDN and DSL.
   - More efficient than analog networks in terms of speed and reliability.
   - Provides high-speed data transfer and better signal quality.
9. **What is a Broadband connection?**
   - Broadband refers to high-speed internet connections.
   - It uses a wide range of frequencies for data transmission.
   - Examples include DSL, fiber optics, and cable internet.
   - Allows simultaneous transmission of multiple signals and services.
10. **What is packet switching?**
    - Packet switching breaks data into small packets for transmission.
    - Each packet is sent independently through the network.
    - More efficient than circuit switching for data communication.
    - Used in the Internet and other digital communication networks.
11. **What is a Router?**
    - A router directs data between different networks.
    - Determines the optimal path for data packets based on the network topology.
    - Operates at the network layer of the OSI model.
    - Commonly used to connect local networks to the internet.
12. **What is WWW?**
    - The World Wide Web (WWW) is a system of interlinked hypertext documents.
    - It uses the HTTP protocol to access web pages.
    - Invented by Tim Berners-Lee in 1989.
    - Accessible via web browsers like Chrome and Firefox.

SECTION B — (5 × 5 = 25 marks)

Answer any FIVE questions.

13. **Write short notes on transmission modes.**

- **Simplex**: Data flows in one direction only (e.g., keyboard to computer).
- **Half-duplex**: Data flows in both directions, but not simultaneously (e.g., walkie-talkies).

- **Full-duplex**: Data flows in both directions simultaneously (e.g., telephones).
- **Parallel transmission**: Multiple bits are transmitted simultaneously on different channels.
- **Serial transmission**: Bits are transmitted one after another on a single channel.
- Transmission mode affects the efficiency of data communication.

14. **Explain analog signals and analog transmission.**

- Analog signals are continuous and vary over time.
- Examples include sound waves and television signals.
- Analog transmission sends data as continuous signals.
- Requires modulation techniques like AM (Amplitude Modulation) and FM (Frequency Modulation).
- Susceptible to noise and signal degradation over distance.
- Used in older communication systems like radio and telephones.

15. **Discuss circuit switching.**

- Circuit switching establishes a dedicated path between the sender and receiver.
- Commonly used in telephone networks.
- The entire bandwidth is reserved for the connection, providing consistent communication.
- Efficient for voice calls but inefficient for data transmission.
- Requires setup and teardown phases for each connection.
- Circuit switching is not ideal for bursty data transmission like the internet.

16. **Discuss ATM protocol.**

- Asynchronous Transfer Mode (ATM) is a network protocol for high-speed data transfer.
- It uses fixed-sized cells (53 bytes) for transmission.
- Designed for both real-time and non-real-time traffic, such as voice and video.
- Operates at the data link layer of the OSI model.
- Provides reliable, low-latency communication.
- Commonly used in WANs and ISDN networks.

17. **Discuss error control.**

- Error control ensures accurate data transmission.
- Techniques include error detection and error correction.
- **Error detection** methods: Parity bits, checksums, CRC.
- **Error correction** methods: Automatic Repeat Request (ARQ), Forward Error Correction (FEC).
- Ensures data integrity, especially in noisy communication channels.
- Used in TCP, Ethernet, and other communication protocols.

18. **Explain the concept of FDDI in detail.**

- FDDI (Fiber Distributed Data Interface) is a high-speed networking standard.
- Uses optical fiber for transmission, providing up to 100 Mbps speeds.
- Based on a dual-ring topology for fault tolerance.
- Primarily used in large LANs and MANs.
- Supports a maximum distance of 200 kilometers.
- Ideal for backbone networks and interconnecting geographically distant locations.

19. **Explain the following: (a) TCP/IP Network**:

- TCP/IP is the fundamental protocol suite for the internet.
- **TCP (Transmission Control Protocol)** ensures reliable data transmission.
- **IP (Internet Protocol)** handles addressing and routing of data packets.
- Enables communication across interconnected networks globally.
  (b) Repeaters:
- Devices that regenerate signals in a communication channel.
- Used to extend the range of data transmission over long distances.
- Commonly used in Ethernet and wireless networks to strengthen weak signals.

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

20. **Explain the data communication process.**

- **Sender**: Originates the message to be sent (e.g., computer, phone).
- **Encoder**: Converts the message into signals for transmission (e.g., modem).
- **Transmission medium**: Carries the signal to the destination (e.g., copper wire, fiber optic).
- **Decoder**: Converts the received signals back into the original message (e.g., modem).
- **Receiver**: The final destination for the message (e.g., computer, phone).
- **Feedback**: Acknowledgement sent by the receiver back to the sender.
- Ensures data integrity, timeliness, and security during communication.
- Involves error detection, correction, and encryption for secure data transmission.

21. **Explain briefly the OSI model with a neat diagram.**

- OSI (Open Systems Interconnection) model standardizes communication functions.
- **Layer 1**: **Physical layer** (transmits raw bit streams over the physical medium).
- **Layer 2**: **Data Link layer** (ensures reliable transmission through error correction).

- **Layer 3**: **Network layer** (handles routing and addressing of data).
- **Layer 4**: **Transport layer** (provides reliable data transfer and flow control).
- **Layer 5**: **Session layer** (manages sessions between applications).
- **Layer 6**: **Presentation layer** (translates data formats for application layer).
- **Layer 7**: **Application layer** (provides services like email, file transfer).
- Each layer has specific responsibilities and interacts with the layer above and below it.
- **Diagram**:

```mathematica
Application

Presentation
Session
Transport
Network
Data Link
Physical
```

22. **Elucidate frequency division multiplexing (FDM).**

- FDM is a multiplexing technique that divides the available bandwidth into multiple frequency bands.
- Each frequency band carries a separate signal simultaneously over the same medium.
- Commonly used in radio and television broadcasting.
- Reduces interference between signals by assigning them different frequency ranges.
- Example: Radio stations broadcast on different frequency bands to avoid overlap.
- Efficient for transmitting multiple data streams over long distances.
- Requires modulation techniques like AM and FM for signal separation.

23. **Briefly explain connection-oriented and connectionless services.**
Connection-oriented services:

- A dedicated communication path is established between sender and receiver.
- Example: Telephone networks, TCP protocol.
- Ensures reliable and sequenced data delivery.
- Requires connection setup and termination phases.
Connectionless services:
- No dedicated path; each packet is sent independently.
- Example: Internet using UDP (User Datagram Protocol).
- Faster and more efficient for certain applications.
- Suitable for broadcasting and real-time applications.

24. **Briefly explain the routing algorithm with examples.**

- A routing algorithm determines the best path for data transmission in a network.
- **Shortest Path Algorithm**: Chooses the path with the least number of hops (e.g., Dijkstra's Algorithm).
- **Distance Vector Routing**: Each router shares its routing table with neighbors (e.g., RIP protocol).
- **Link State Routing**: Routers build a complete map of the network and calculate shortest paths (e.g., OSPF protocol).
- **Dynamic Routing**: Adapts to changes in network topology (e.g., BGP protocol).
- Ensures optimal network performance and efficient data delivery.
- Routing algorithms help avoid congestion and manage traffic flow.