

# Computer Networks & Data Communication (4361101) - Winter 2024

## Solution

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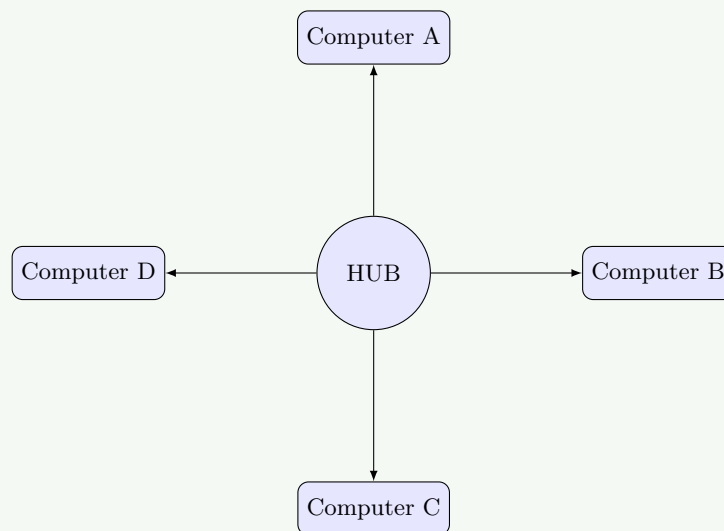
### Question 1(a) [3 marks]

Explain star topology in detail.

#### Solution

Star topology connects all devices to a central hub or switch. Each device has dedicated point-to-point connection with central device.

**Diagram:**



**Figure 1.** Star Topology

#### Key Features:

- **Central Hub:** All connections pass through central device
- **Dedicated Links:** Each node has separate connection
- **Easy Management:** Simple to add/remove devices

#### Mnemonic

“Star Shines Central - All devices connect to central point”

### Question 1(b) [4 marks]

Explain client-server network.

**Solution**

Client-server is network architecture where clients request services from centralized servers. Server provides resources and services to multiple clients.

**Table: Client vs Server**

Client	Server
Requests services	Provides services
Limited resources	Powerful hardware
Depends on server	Independent operation

**Table 1.** Client vs Server**Key Components:**

- **Client:** Requests data/services from server
- **Server:** Provides centralized resources and processing
- **Network:** Medium for communication between client-server

**Mnemonic**

“Client Calls, Server Serves”

**Question 1(c) [7 marks]**

Write a functional description of all layer of TCP/IP model.

**Solution**

TCP/IP model has four layers providing end-to-end communication over networks.

**Table: TCP/IP Model Layers**

Layer	Function	Protocols
Application	User interface, network services	HTTP, FTP, SMTP
Transport	End-to-end delivery, error control	TCP, UDP
Internet	Routing, logical addressing	IP, ICMP, ARP
Network Access	Physical transmission	Ethernet, WiFi

**Table 2.** TCP/IP Model Layers**Layer Functions:**

- **Application Layer:** Provides network services to user applications
- **Transport Layer:** Ensures reliable data delivery between processes
- **Internet Layer:** Routes packets across multiple networks using IP
- **Network Access Layer:** Handles physical transmission of data

**Mnemonic**

“All Transport Internet Networks (ATIN)”

**Question 1(c OR) [7 marks]**

Explain the functions of Data Link Layer & Network Layer of OSI reference model.

**Solution**

Data Link and Network layers provide reliable transmission and routing capabilities in OSI model.

**Table: Layer Comparison**

Feature	Data Link Layer	Network Layer
Main Function	Node-to-node delivery	End-to-end delivery
Addressing	MAC addresses	IP addresses
Error Control	Frame-level	Packet-level

**Table 3.** Layer Comparison**Data Link Layer Functions:**

- **Framing:** Organizes bits into frames
- **Error Control:** Detects and corrects transmission errors
- **Flow Control:** Manages data transmission rate

**Network Layer Functions:**

- **Routing:** Determines best path for packets
- **Logical Addressing:** Uses IP addresses for identification
- **Packet Forwarding:** Routes packets between networks

**Mnemonic**

“Data Links Locally, Network Routes Globally”

**Question 2(a) [3 marks]**

Compare repeater and hub.

**Solution**

Both devices amplify signals but operate differently in network architecture.

**Table: Repeater vs Hub**

Feature	Repeater	Hub
Ports	2 ports	Multiple ports
Function	Signal amplification	Signal distribution
Collision Domain	Single	Single shared

**Table 4.** Repeater vs Hub**Key Differences:**

- **Port Count:** Repeater has 2 ports, hub has multiple
- **Usage:** Repeater extends distance, hub connects multiple devices

**Mnemonic**

“Repeater Extends, Hub Connects”

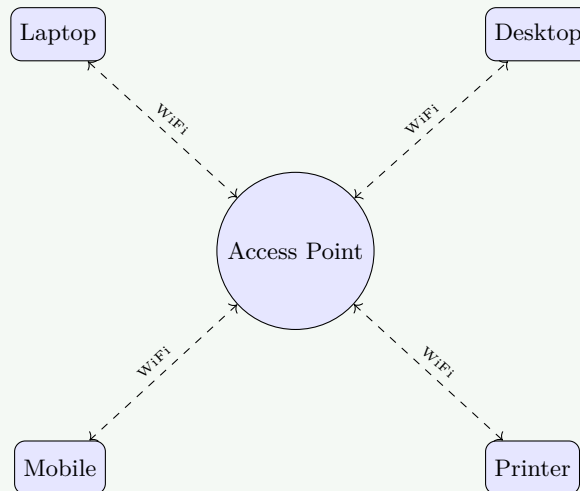
**Question 2(b) [4 marks]**

Explain wireless LAN.

**Solution**

Wireless LAN uses radio waves for network communication without physical cables.

**Diagram:**



**Figure 2.** Wireless LAN Architecture

**Key Components:**

- **Access Point:** Central wireless communication device
- **Wireless Clients:** Devices with WiFi capability
- **Radio Frequencies:** 2.4GHz and 5GHz bands commonly used

**Advantages:**

- **Mobility:** Users can move freely within coverage area
- **Easy Installation:** No physical cable installation required

**Mnemonic**

“Wireless Waves Connect”

**Question 2(c) [7 marks]**

Explain FDDI & CDDI.

**Solution**

FDDI and CDDI are ring-based network technologies providing high-speed data transmission.

**Table: FDDI vs CDDI Comparison**

Feature	FDDI	CDDI
Medium	Fiber optic	Copper (UTP)
Speed	100 Mbps	100 Mbps
Distance	200 km	100 meters
Cost	High	Lower

**Table 5.** FDDI vs CDDI

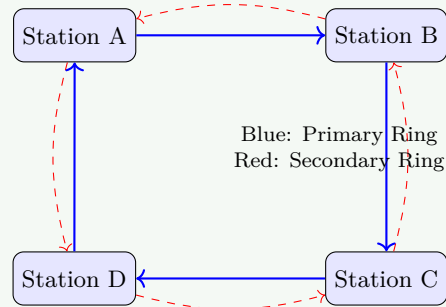
**FDDI Features:**

- **Dual Ring:** Primary and secondary rings for fault tolerance

- **Token Passing:** Deterministic access method
- **Self-Healing:** Automatic recovery from failures

**CDDI Features:**

- **Copper Medium:** Uses unshielded twisted pair cables
- **Same Protocol:** Identical to FDDI except transmission medium
- **Cost Effective:** Lower implementation cost than FDDI

**Ring Structure:****Figure 3.** FDDI Dual Ring Topology**Mnemonic**

“FDDI Fiber Fast, CDDI Copper Cheap”

**Question 2(a OR) [3 marks]**

How does a firewall protect data.

**Solution**

Firewall acts as security barrier between trusted internal network and untrusted external networks.

**Protection Methods:**

- **Packet Filtering:** Examines packet headers for security rules
- **Access Control:** Blocks unauthorized access attempts
- **Traffic Monitoring:** Monitors all incoming and outgoing traffic

**Mnemonic**

“Firewall Filters Foes”

**Question 2(b OR) [4 marks]**

Explain the structure of FDDI and give its advantages.

**Solution**

FDDI uses dual counter-rotating rings for high-speed, fault-tolerant networking.

**Structure Components:**

- **Primary Ring:** Main data transmission path
- **Secondary Ring:** Backup path for fault recovery
- **Dual Attachment Stations:** Connect to both rings
- **Single Attachment Stations:** Connect to one ring only

**Advantages:**

- **High Speed:** 100 Mbps transmission rate
- **Fault Tolerance:** Automatic recovery using secondary ring
- **Long Distance:** Supports up to 200 km networks

**Mnemonic**

“FDDI Dual Rings Deliver Reliability”

**Question 2(c OR) [7 marks]**

**Explain and distinguish Ethernet, Fast Ethernet, Gigabit Ethernet.**

**Solution**

Evolution of Ethernet standards providing increasing bandwidth and improved performance.

**Table: Ethernet Comparison**

Feature	Ethernet	Fast Ethernet	Gigabit Ethernet
Speed	10 Mbps	100 Mbps	1000 Mbps
Standard	802.3	802.3u	802.3z/ab
Cable	Coax/UTP	UTP/Fiber	UTP/Fiber
Distance	500m (coax)	100m (UTP)	100m (UTP)

**Table 6.** Ethernet Comparison

**Key Differences:**

- **Bandwidth:** Each generation increases speed by factor of 10
- **Media Support:** Newer standards support more cable types
- **Backward Compatibility:** Higher standards support lower speeds

**Applications:**

- **Ethernet:** Legacy systems, basic connectivity
- **Fast Ethernet:** Desktop connections, small networks
- **Gigabit Ethernet:** Server connections, backbone networks

**Mnemonic**

“Ethernet Evolves: 10-100-1000”

**Question 3(a) [3 marks]**

**Explain types of DSL.**

**Solution**

DSL provides high-speed internet over existing telephone lines using different frequency bands.

**Table: DSL Types**

Type	Full Form	Speed
ADSL	Asymmetric DSL	Up to 8 Mbps down
SDSL	Symmetric DSL	Equal up/down
VDSL	Very-high-bit-rate DSL	Up to 52 Mbps

**Table 7.** DSL Types**Characteristics:**

- **ADSL:** Different upload/download speeds for home users
- **SDSL:** Same speed both directions for business use

**Mnemonic**

“DSL: Asymmetric, Symmetric, Very-fast”

**Question 3(b) [4 marks]**

Explain ARP & RARP.

**Solution**

ARP and RARP provide address resolution between IP and MAC addresses.

**Table: ARP vs RARP**

Feature	ARP	RARP
Purpose	IP to MAC	MAC to IP
Used by	All devices	Diskless workstations
Direction	Logical to Physical	Physical to Logical

**Table 8.** ARP vs RARP**ARP Process:**

- **Request:** Broadcast “Who has IP address X?”
- **Reply:** Target responds with MAC address
- **Caching:** Stores mapping in ARP table

**RARP Process:**

- **Request:** “What is my IP address?”
- **Server Response:** RARP server provides IP address

**Mnemonic**

“ARP: Address Resolution Protocol, RARP: Reverse ARP”

**Question 3(c) [7 marks]**

Describe circuit switching and packet switching.

**Solution**

Two fundamental approaches for establishing communication paths in networks.

**Table: Circuit vs Packet Switching**

Feature	Circuit Switching	Packet Switching
Path Setup	Dedicated path	No dedicated path
Resource Usage	Reserved throughout	Shared dynamically
Delay	Constant	Variable
Examples	Telephone	Internet

**Table 9.** Circuit vs Packet Switching

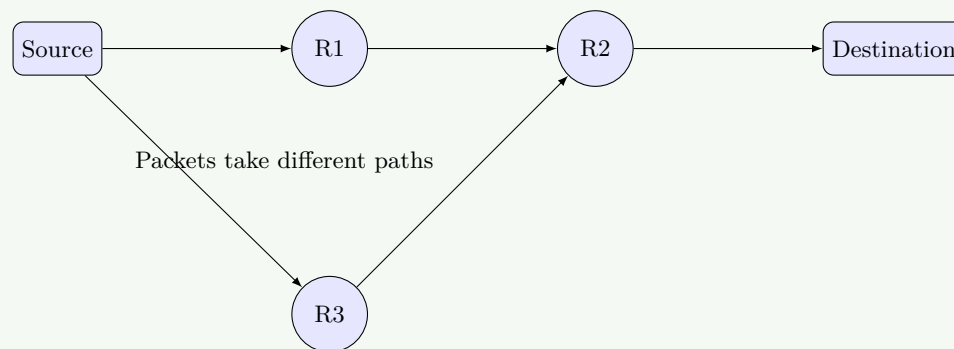
**Circuit Switching:**

- **Path Establishment:** Dedicated circuit created before communication
- **Resource Reservation:** Bandwidth reserved for entire session
- **Guaranteed Service:** Consistent performance throughout connection

**Packet Switching:**

- **Store and Forward:** Packets stored temporarily at intermediate nodes
- **Dynamic Routing:** Each packet can take different path
- **Resource Sharing:** Network resources shared among multiple connections

**Diagram: Packet Switching**



**Figure 4.** Packet Switching

**Mnemonic**

“Circuit Commits, Packet Partitions”

## Question 3(a OR) [3 marks]

Describe DHCP & BOOTP protocol.

**Solution**

Both protocols automatically assign IP addresses to network devices.

**Table: DHCP vs BOOTP**



Feature	DHCP	BOOTP
Address Type	Dynamic/Static	Static only
Lease Time	Temporary	Permanent
Configuration	Automatic	Manual setup

Table 10. DHCP vs BOOTP

**Functions:**

- **DHCP:** Dynamic address assignment with lease management
- **BOOTP:** Bootstrap protocol for diskless workstations

**Mnemonic**

“DHCP Dynamic, BOOTP Bootstrap”

**Question 3(b OR) [4 marks]**

Explain IPv4 & IPv6 in detail.

**Solution**

Internet Protocol versions providing addressing and routing capabilities.

**Table: IPv4 vs IPv6**

Feature	IPv4	IPv6
Address Size	32 bits	128 bits
Address Format	Dotted decimal	Hexadecimal
Address Space	4.3 billion	340 undecillion
Header Size	20-60 bytes	40 bytes

Table 11. IPv4 vs IPv6

**IPv4 Features:**

- **Address Format:** 192.168.1.1 (4 octets)
- **Classes:** A, B, C, D, E address classes
- **NAT Required:** Address shortage requires NAT

**IPv6 Features:**

- **Address Format:** 2001:db8::1 (8 groups of 4 hex digits)
- **No NAT Needed:** Abundant address space
- **Built-in Security:** IPSec support mandatory

**Mnemonic**

“IPv4 Four Octets, IPv6 Six-teen Bytes”

**Question 3(c OR) [7 marks]**

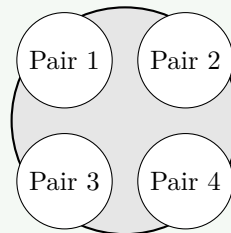
Draw and explain constructional details of twisted pair cable, coaxial cable, and fiber optic cable with label.

## Solution

Three main types of guided transmission media with different construction and characteristics.

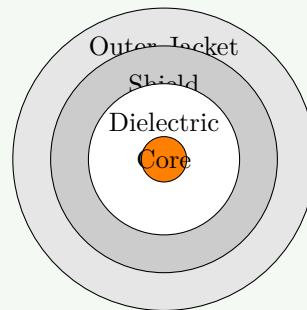
### Twisted Pair Cable:

Outer Jacket



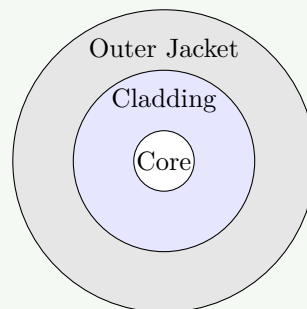
**Figure 5.** Twisted Pair Cable Cross-section

### Coaxial Cable:



**Figure 6.** Coaxial Cable Cross-section

### Fiber Optic Cable:



**Figure 7.** Fiber Optic Cable Cross-section

### Construction Details:

- **Twisted Pair:** Copper wires twisted to reduce interference
- **Coaxial:** Central conductor surrounded by dielectric and shield
- **Fiber Optic:** Glass core with cladding for total internal reflection

### Characteristics:

- **Twisted Pair:** Low cost, easy installation, limited bandwidth
- **Coaxial:** Better shielding, higher bandwidth than twisted pair
- **Fiber Optic:** Highest bandwidth, immune to electromagnetic interference

**Mnemonic**

“Twisted Copper, Coax Shielded, Fiber Light”

**Question 4(a) [3 marks]**

Name any three data link layer protocol and explain any one in detail.

**Solution**

Common data link layer protocols: HDLC, PPP, Ethernet.

**HDLC (High-Level Data Link Control):**

- **Frame Structure:** Flag, Address, Control, Data, FCS, Flag
- **Error Control:** Uses sequence numbers and acknowledgments
- **Flow Control:** Sliding window protocol for efficient transmission

**Key Features:**

- **Bit-oriented:** Works with bit streams rather than characters
- **Full-duplex:** Simultaneous bidirectional communication

**Mnemonic**

“HDLC Handles Data Link Control”

**Question 4(b) [4 marks]**

Explain TCP and UDP protocol.

**Solution**

Transport layer protocols providing different levels of service reliability.

**Table: TCP vs UDP**

Feature	TCP	UDP
Connection	Connection-oriented	Connectionless
Reliability	Reliable	Unreliable
Speed	Slower	Faster
Header Size	20+ bytes	8 bytes

**Table 12.** TCP vs UDP

**TCP Features:**

- **Connection Setup:** Three-way handshake establishes connection
- **Error Recovery:** Retransmits lost packets automatically
- **Flow Control:** Prevents sender from overwhelming receiver

**UDP Features:**

- **No Connection:** Sends data without establishing connection
- **Best Effort:** No guarantee of delivery or order
- **Low Overhead:** Minimal header for fast transmission

**Mnemonic**

“TCP Trustworthy, UDP Unreliable but Quick”

## Question 4(c) [7 marks]

Describe VoIP with example.

### Solution

Voice over Internet Protocol transmits voice communications over IP networks instead of traditional telephone systems.

#### VoIP Components:

- **IP Phone:** Hardware device for VoIP calls
- **Softphone:** Software application for computer-based calls
- **Gateway:** Connects VoIP to traditional phone networks
- **PBX:** Private branch exchange for business phone systems

#### VoIP Process:

1. **Voice Capture:** Microphone converts voice to analog signal
2. **Digitization:** ADC converts analog to digital samples
3. **Compression:** Codec compresses audio data
4. **Packetization:** Voice data divided into IP packets
5. **Transmission:** Packets sent over IP network
6. **Reconstruction:** Receiving end reassembles and plays audio

#### Example Applications:

- **Skype:** Consumer VoIP service for personal calls
- **WhatsApp Calling:** Mobile VoIP application
- **Business PBX:** Corporate phone systems using VoIP

#### Advantages:

- **Cost Effective:** Lower long-distance call costs
- **Feature Rich:** Video calling, conferencing, call forwarding
- **Scalability:** Easy to add new users

#### Disadvantages:

- **Internet Dependency:** Requires stable internet connection
- **Quality Issues:** May suffer from network congestion
- **Power Dependency:** Requires electricity unlike traditional phones

### Mnemonic

“VoIP: Voice over Internet Protocol”

## Question 4(a OR) [3 marks]

Explain DNS (Domain Name System).

### Solution

DNS translates human-readable domain names into IP addresses for network communication.

#### DNS Components:

- **Domain Names:** Hierarchical naming system (www.example.com)
- **Name Servers:** Computers that store DNS records
- **Resolvers:** Client software that queries DNS servers

#### DNS Process:

1. User enters domain name in browser
2. Local resolver queries DNS server
3. DNS server returns corresponding IP address

### Mnemonic

“DNS: Domain Name to IP Address”

## Question 4(b OR) [4 marks]

Write a short note on DSL.

### Solution

Digital Subscriber Line provides high-speed internet access over existing telephone infrastructure.

#### DSL Technology:

- **Frequency Division:** Uses higher frequencies than voice calls
- **Simultaneous Use:** Internet and phone can work together
- **Distance Limitation:** Performance decreases with distance from exchange

#### DSL Types:

- **ADSL:** Asymmetric speeds for residential users
- **SDSL:** Symmetric speeds for business applications
- **VDSL:** Very high speeds over short distances

#### Advantages:

- **Existing Infrastructure:** Uses existing telephone lines
- **Always On:** Continuous internet connection
- **Cost Effective:** Lower cost than dedicated lines

### Mnemonic

“DSL: Digital Subscriber Line over Phone Lines”

## Question 4(c OR) [7 marks]

Explain forum and blogs with example.

### Solution

Online platforms for information sharing and community interaction.

#### Table: Forum vs Blog

Feature	Forum	Blog
Structure	Discussion threads	Chronological posts
Interaction	Multi-user discussions	Comments on posts
Moderation	Community moderated	Author controlled
Purpose	Community support	Information sharing

**Table 13.** Forum vs Blog

#### Forum Characteristics:

- **Discussion Threads:** Topics organized by subject
- **User Participation:** Multiple users contribute to discussions
- **Categories:** Topics organized into different sections
- **Moderation:** Community rules and moderators maintain order

#### Blog Characteristics:

- **Personal Publishing:** Individual or organization publishes content
- **Chronological Order:** Posts displayed by date
- **Comments:** Readers can respond to blog posts
- **RSS Feeds:** Readers can subscribe to updates

#### Examples:

- **Technical Forums:** Stack Overflow for programming questions
- **Community Forums:** Reddit for diverse topics

- **Personal Blogs:** Individual websites sharing experiences
- **Corporate Blogs:** Company blogs for marketing and updates

**Benefits:**

- **Knowledge Sharing:** Users share expertise and experiences
- **Community Building:** Brings together people with common interests
- **Problem Solving:** Forums help users find solutions
- **Content Creation:** Blogs provide platform for publishing

**Mnemonic**

“Forums Foster Discussion, Blogs Broadcast Information”

**Question 5(a) [3 marks]**

Define the terms "encryption".

**Solution**

Encryption converts plaintext data into ciphertext to protect information from unauthorized access.

**Encryption Process:**

- **Plaintext:** Original readable data
- **Algorithm:** Mathematical process for transformation
- **Key:** Secret parameter used in encryption algorithm
- **Ciphertext:** Encrypted unreadable data

**Purpose:**

- **Confidentiality:** Prevents unauthorized data access
- **Data Protection:** Secures sensitive information during transmission

**Mnemonic**

“Encryption: Plain to Cipher with Key”

**Question 5(b) [4 marks]**

Explain any two of following: (1) WWW (2) FTP (3) SMTP

**Solution****WWW (World Wide Web):**

- **Hypertext System:** Documents linked through hyperlinks
- **HTTP Protocol:** HyperText Transfer Protocol for web communication
- **Web Browser:** Client software for accessing web pages
- **Web Server:** Hosts websites and serves web pages

**FTP (File Transfer Protocol):**

- **File Transfer:** Protocol for transferring files between computers
- **Client-Server:** FTP client connects to FTP server
- **Two Modes:** Active and passive modes for data transfer
- **Authentication:** Username and password for access control

**Features:**

- **WWW:** Graphical interface, multimedia support, hyperlinks
- **FTP:** Large file transfer, directory navigation, resume capability

**Mnemonic**

“WWW: Web World Wide, FTP: File Transfer Protocol”

**Question 5(c) [7 marks]**

**Difference between symmetric and asymmetric encryption algorithms**

**Solution**

Two fundamental approaches to cryptographic key management with different characteristics.

**Table: Symmetric vs Asymmetric Encryption**

Feature	Symmetric	Asymmetric
Keys	Single shared key	Key pair (public/private)
Speed	Fast	Slower
Key Distribution	Difficult	Easier
Key Management	Complex for large groups	Simpler
Examples	AES, DES	RSA, ECC

**Table 14.** Symmetric vs Asymmetric Encryption

**Symmetric Encryption:**

- **Single Key:** Same key used for encryption and decryption
- **Speed:** Fast processing due to simple algorithms
- **Key Sharing Problem:** Secure key distribution challenge
- **Session Keys:** Often used for bulk data encryption

**Asymmetric Encryption:**

- **Key Pair:** Public key for encryption, private key for decryption
- **Digital Signatures:** Private key signs, public key verifies
- **Key Exchange:** Solves key distribution problem
- **Computationally Intensive:** Slower than symmetric encryption

**Usage Scenarios:**

- **Symmetric:** Bulk data encryption, secure communications
- **Asymmetric:** Key exchange, digital signatures, authentication

**Hybrid Approach:**

- **Best of Both:** Asymmetric for key exchange, symmetric for data
- **SSL/TLS:** Uses both types for secure web communications

**Mnemonic**

“Symmetric Single Key, Asymmetric Key Pair”

**Question 5(a OR) [3 marks]**

**Write brief note on Cyber Security.**

**Solution**

Cyber security protects digital systems, networks, and data from digital attacks and unauthorized access.

**Key Components:**

- **Network Security:** Protects network infrastructure from intrusions

- **Data Protection:** Safeguards sensitive information from theft
- **Application Security:** Secures software applications from vulnerabilities

**Common Threats:**

- **Malware:** Viruses, worms, trojans that damage systems
- **Phishing:** Fraudulent attempts to steal credentials

**Mnemonic**

“Cyber Security: Protect Digital Assets”

**Question 5(b OR) [4 marks]**

**Explain hacking and its precautions.**

**Solution**

Hacking involves unauthorized access to computer systems, often with malicious intent.

**Types of Hacking:**

- **White Hat:** Ethical hacking for security testing
- **Black Hat:** Malicious hacking for illegal purposes
- **Gray Hat:** Between ethical and malicious hacking

**Common Hacking Methods:**

- **Password Attacks:** Brute force, dictionary attacks
- **Social Engineering:** Manipulating people to reveal information
- **Malware:** Viruses, trojans, ransomware
- **Network Attacks:** Man-in-the-middle, packet sniffing

**Precautions:**

- **Strong Passwords:** Complex, unique passwords for all accounts
- **Regular Updates:** Keep software and systems updated
- **Firewall:** Use firewall to block unauthorized access
- **Antivirus:** Install and update antivirus software regularly

**Mnemonic**

“Hacking Hurts, Precautions Protect”

**Question 5(c OR) [7 marks]**

**Briefly describe the Information Technology (Amendment) Act, 2008, and its impact on cyber laws in India.**

**Solution**

The IT Amendment Act 2008 significantly strengthened India's cyber law framework and expanded the scope of cybercrime legislation.

**Key Amendments:**

- **Data Protection:** Enhanced provisions for protecting sensitive personal data
- **Cybercrime Definitions:** Expanded definitions of cybercrime including identity theft
- **Penalties:** Increased penalties for various cyber offenses
- **Cyber Terrorism:** Introduced provisions to deal with cyber terrorism

**Major Provisions:**

- **Section 43A:** Data protection and compensation for negligence
- **Section 66A:** Punishment for offensive messages (later struck down)
- **Section 66C:** Identity theft punishment



- **Section 66D:** Cheating by personation using computer resource

**Impact on Cyber Laws:**

- **Legal Framework:** Provided comprehensive legal framework for cybercrime
- **Business Compliance:** Mandated data protection measures for businesses
- **Law Enforcement:** Empowered authorities with investigation tools
- **International Cooperation:** Facilitated cooperation in cybercrime investigation

**Regulatory Bodies:**

- **CERT-In:** Computer Emergency Response Team for incident response
- **Cyber Cells:** Specialized police units for cybercrime investigation
- **Adjudicating Officers:** For compensation and penalty determination

**Mnemonic**

“IT Act 2008: India’s Cyber Law Foundation”