Computer Networks & Data Communication (4361101) - Summer 2025 Solution

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Question 1(a) [3 marks]

State different DSL technology and discuss ADSL

Solution

DSL Technology Types:

DSL Type	Full Name	Speed
ADSL	Asymmetric DSL	1-8 Mbps
SDSL	Symmetric DSL	768 Kbps
VDSL	Very high DSL	52 Mbps
HDSL	High bit-rate DSL	1.5 Mbps

Table 1. DSL Variants

ADSL Features:
- **Asymmetric**: Different upload/download speeds
- **Frequency Division**: Uses existing copper telephone lines
- **Download Speed**: Higher than upload speed

Mnemonic

"ADSL Downloads Faster"

Question 1(b) [4 marks]

Describe the network classification of based on Architecture.

Solution

Network Architecture Classification:

Architecture	Description	Features
Peer-to-Peer	All nodes equal	No central server
Client-Server	Centralized model	Dedicated server

Table 2. Network Architectures

Client-Server Advantages:
- **Centralized Control**: Easy management and security
- **Resource Sharing**: Efficient utilization of resources
- **Scalability**: Can handle more users effectively
- **Data Security**: Better backup and recovery

P2P Characteristics:
- **Decentralized**: No single point of failure
- **Cost Effective**: No need for dedicated server

Mnemonic

"Client Serves Better"

Question 1(c) [7 marks]

Draw the diagram of OSI Model and explain in detail with all layers.

Solution

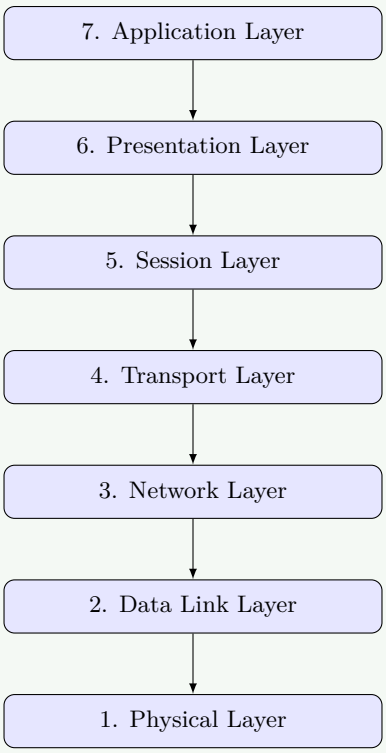

Figure 1. OSI Reference Model

OSI Layer Functions:

Layer	Function	Examples
Application	User interface	HTTP, FTP, SMTP
Presentation	Data formatting	Encryption, Compression
Session	Session management	NetBIOS, RPC
Transport	End-to-end delivery	TCP, UDP
Network	Routing	IP, ICMP
Data Link	Frame delivery	Ethernet, PPP
Physical	Bit transmission	Cables, Signals

Table 3. Layer Functions

Key Features:
- **Layered Approach**: Each layer serves specific function
- **Standardization**: Universal communication model
- **Troubleshooting**: Easy to identify network problems

Mnemonic

"All People Seem To Need Data Processing"

Question 1(c OR) [7 marks]

Draw the diagram of TCP/IP protocol suite and explain the functions of Application Layer, Transport Layer and Network Layer in detail.

Solution

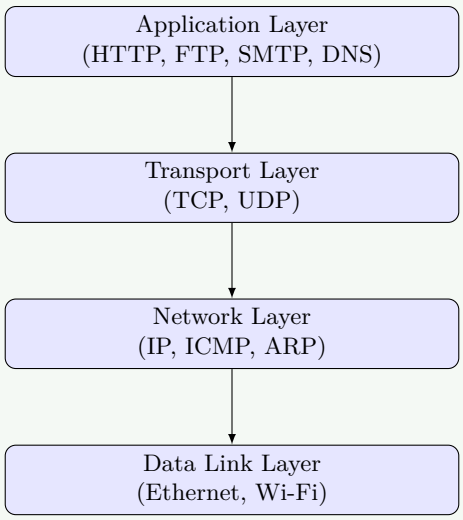

Figure 2. TCP/IP Protocol Suite

Layer Functions:

Layer	Primary Function	Protocols
Application	User services	HTTP, FTP, SMTP
Transport	End-to-end delivery	TCP, UDP
Network	Routing packets	IP, ICMP

Table 4. TCP/IP Layers

Application Layer Functions:
- **Web Services**: HTTP for web browsing
- **File Transfer**: FTP for file sharing
- **Email**: SMTP for mail delivery

Transport Layer Functions:
- **Reliable Delivery**: TCP ensures data integrity
- **Unreliable Delivery**: UDP for fast transmission
- **Port Numbers**: Identify specific applications

Network Layer Functions:
- **Logical Addressing**: IP addresses for devices
- **Routing**: Best path selection for packets
- **Fragmentation**: Breaking large packets

Mnemonic

"Applications Transport Networks"

Question 2(a) [3 marks]

Explain WWW.

Solution

World Wide Web (WWW):

Component	Description
Web Browser	Client software (e.g., Chrome)
Web Server	Hosts websites (e.g., Apache)
HTTP	Communication protocol
URL	Web address

Table 5. WWW Components

WWW Features:
- **Hypertext**: Linked documents using HTML
- **Client-Server Model**: Browser requests, server responds
- **Universal Access**: Platform independent

Mnemonic

"Web Works Worldwide"

Question 2(b) [4 marks]

Explain FDDI and CDDI.

Solution

FDDI vs CDDI Comparison:

Feature	FDDI	CDDI
Medium	Fiber optic	Copper wire
Speed	100 Mbps	100 Mbps
Distance	200 km	100 meters
Cost	High	Low

Table 6. FDDI vs CDDI

FDDI Features:
- **Dual Ring Topology**: Primary and secondary rings
- **Token Passing**: Access control mechanism
- **Fault Tolerance**: Self-healing capability

CDDI Features:
- **Copper Based**: Uses twisted pair cables
- **Cost Effective**: Cheaper than fiber
- **Limited Distance**: Shorter transmission range

Mnemonic

"Fiber Fast, Copper Cheap"

Question 2(c) [7 marks]

Describe Network management system with functions of OS, CLI, Administrative functions, interfaces.

Solution

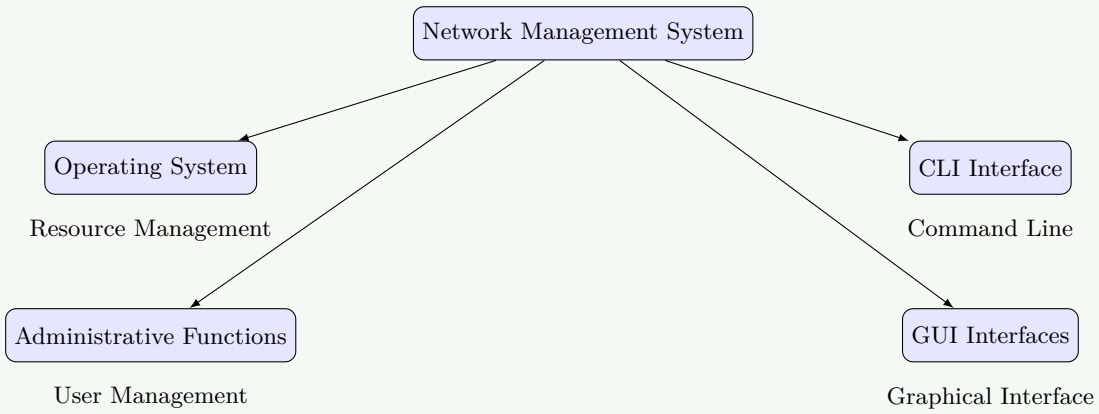

Figure 3. Network Management System

Network Management Components:

Component	Function	Examples
OS Functions	Resource management	Process, memory, file management
CLI	Command interface	Terminal, console commands
Admin Functions	System control	User accounts, security
Interfaces	User interaction	GUI, web interface

Table 7. System Functions

Operating System Functions:
- **Process Management**: Controlling running applications
- **Memory Management**: Allocating system resources
- **File System**: Organizing and storing data

CLI Functions:
- **Direct Commands**: Text-based control
- **Scripting**: Automation of tasks
- **Remote Access**: SSH, Telnet connections

Administrative Functions:
- **User Management**: Creating, modifying user accounts
- **Security Policies**: Access control, permissions
- **System Monitoring**: Tracking performance

Mnemonic

"OS CLI Admin Interfaces"

Question 2(a OR) [3 marks]

Compare connection-oriented protocol and connectionless protocol.

Solution

Protocol Comparison:

Feature	Connection-Oriented	Connectionless
Setup	Required	Not required
Reliability	High	Low
Speed	Slower	Faster
Example	TCP	UDP

Table 8. Connection vs Connectionless

Connection-Oriented Features:
- **Three-way Handshake**: Establishes connection before transfer
- **Reliable Delivery**: Guarantees packet delivery and order

Connectionless Features:
- **No Setup**: Sends data immediately
- **Best Effort**: No guarantee of delivery

Mnemonic

"TCP Connects, UDP Delivers"

Question 2(b OR) [4 marks]

Explain Network device Repeater.

Solution

Repeater Functions:

Function	Description
Signal Amplification	Boosts weak signals
Range Extension	Increases network distance
Noise Reduction	Cleans signal quality

Table 9. Repeater Functions

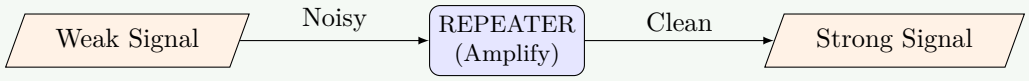

Figure 4. Repeater Operation

Repeater Characteristics:
- **Physical Layer Device**: Operates at Layer 1
- **Bit-by-Bit**: Regenerates digital signals
- **No Intelligence**: Cannot filter or route data

Mnemonic

"Repeater Regenerates Signals"

Question 2(c OR) [7 marks]

Differentiate between Router, Hub and Switch.

Solution

Network Device Comparison:

Feature	Hub	Switch	Router
OSI Layer	Physical (1)	Data Link (2)	Network (3)
Collision Domain	Single	Multiple	Multiple
Broadcast Domain	Single	Single	Multiple
Intelligence	None	Learn MAC	IP Routing
Full Duplex	No	Yes	Yes

Table 10. Hub vs Switch vs Router

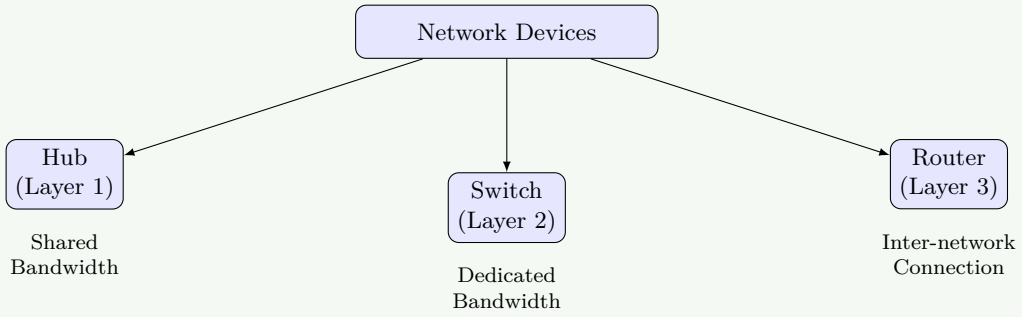

Figure 5. Network Devices Classification

Hub Characteristics:
- **Shared Medium**: All ports share bandwidth
- **Half Duplex**: Cannot send and receive simultaneously
- **Collision Prone**: Single collision domain

Switch Characteristics:
- **MAC Address Table**: Learns device locations
- **Full Duplex**: Simultaneous send/receive
- **VLAN Support**: Virtual network segmentation

Router Characteristics:
- **IP Routing**: Forwards packets between networks
- **Routing Table**: Maintains network topology
- **NAT Support**: Network Address Translation

Mnemonic

"Hub Shares, Switch Switches, Router Routes"

Question 3(a) [3 marks]

Draw neat diagram of UTP, Coaxial and Fiber optic cable

Solution

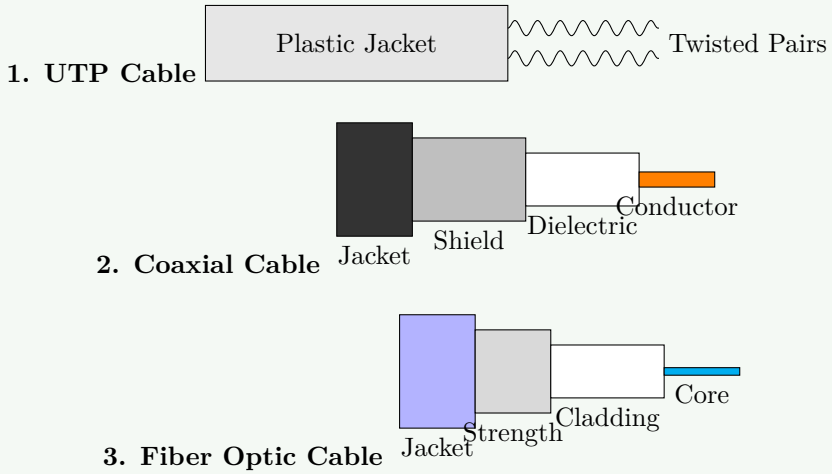

Figure 6. Transmission Media Cables

Cable Characteristics:

Cable Type	Core Material	Bandwidth
UTP	Copper wire	100 MHz
Coaxial	Copper conductor	1 GHz
Fiber Optic	Glass/Plastic	Very high

Table 11. Cable Comparison

Mnemonic

"Twisted Copper Glass"

Question 3(b) [4 marks]

Differentiate switching circuit and packet switching circuit.

Solution

Switching Methods Comparison:

Feature	Circuit Switching	Packet Switching
Path	Dedicated	Shared
Setup Time	Required	Not required
Bandwidth	Fixed	Variable
Example	Telephone	Internet

Table 12. Circuit vs Packet Switching

Circuit Switching Features:
- **Dedicated Path**: Exclusive connection between communicating parties
- **Constant Bandwidth**: Fixed data rate throughout communication
- **Setup Phase**: Connection established before data transfer

Packet Switching Features:
- **Store and Forward**: Packets stored at intermediate nodes
- **Dynamic Routing**: Different paths for different packets
- **Resource Sharing**: Multiple users share network resources

Mnemonic

"Circuit Connects, Packet Shares"

Question 3(c) [7 marks]

Describe unguided media and guided media.

Solution

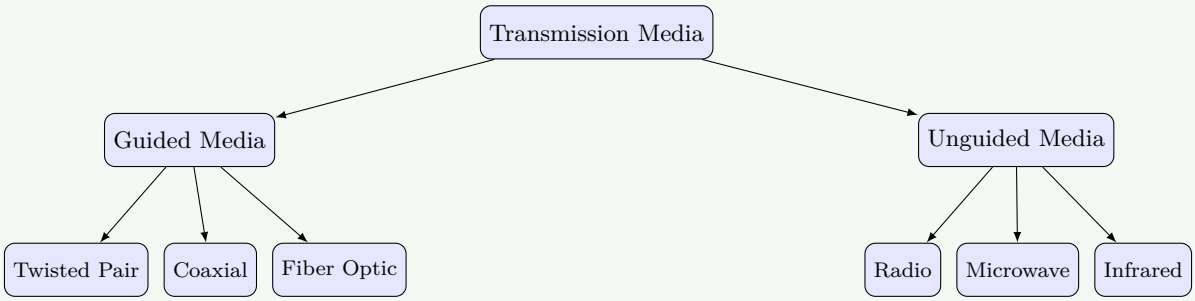

Figure 7. Transmission Media Classification

Guided Media Characteristics:

Type	Material	Distance	Cost
Twisted Pair	Copper	100m	Low
Coaxial	Copper + Shield	500m	Medium
Fiber Optic	Glass	2km+	High

Table 13. Guided Media

Unguided Media Characteristics:

Type	Frequency	Range	Application
Radio Waves	3KHz-1GHz	Long	AM/FM Radio
Microwaves	1GHz-300GHz	Line of sight	Satellite
Infrared	300GHz-400THz	Short	Remote control

Table 14. Unguided Media

Mnemonic

"Guided Wires, Unguided Airs"

Question 3(a OR) [3 marks]

Discuss various connectors used in Computer Networks.

Solution

Network Connectors:

Connector	Cable Type	Application
RJ-45	UTP/STP	Ethernet
BNC	Coaxial	Legacy networks
SC/ST	Fiber optic	High-speed networks

Table 15. Connectors

Connector Features:
- **RJ-45**: 8-pin modular connector for twisted pair
- **BNC**: Bayonet connector for coaxial cables
- **SC/ST**: Push-pull and twist-lock fiber connectors

Mnemonic

"RJ BNC Fiber Connect"

Question 3(b OR) [4 marks]

Explain IP addressing scheme with examples.

Solution

IP Address Classes:

Class	Range	Default Mask	Example
A	1-126	/8	10.0.0.1
B	128-191	/16	172.16.0.1
C	192-223	/24	192.168.1.1

Table 16. IP Classes

IP Address Structure:
- **Network Part**: Identifies the network
- **Host Part**: Identifies the device
- **Subnet Mask**: Separates network and host portions

Special Addresses:
- **Loopback**: 127.0.0.1 (localhost)
- **Private**: 10.x.x.x, 172.16.x.x, 192.168.x.x
- **Broadcast**: All host bits set to 1

Example Calculation: `IP: 192.168.1.100/24`
- Network: 192.168.1.0
- Broadcast: 192.168.1.255

Mnemonic

"A Big Class Networks"

Question 3(c OR) [7 marks]

Differentiate between IPv4 and IPv6.

Solution

IPv4 vs IPv6 Comparison:

Feature	IPv4	IPv6
Address Length	32 bits	128 bits
Address Format	Decimal	Hexadecimal
Address Space	4.3 billion	340 undecillion
Header Size	20-60 bytes	40 bytes
Fragmentation	Router/Host	Host only
Security	Optional	Built-in

Table 17. IPv4 vs IPv6

IPv4 Characteristics:
- **Address Example**: 192.168.1.1
- **Dotted Decimal**: Four octets separated by dots
- **Classes**: A, B, C, D, E addressing scheme
- **NAT Required**: Due to address exhaustion

IPv6 Characteristics:
- **Address Example**: 2001:0db8:85a3::8a2e:0370:7334
- **Colon Notation**: Eight groups of hexadecimal digits
- **No Classes**: Hierarchical addressing
- **Auto-configuration**: Stateless address configuration

IPv6 Advantages:
- **Larger Address Space**: Eliminates address exhaustion
- **Simplified Header**: Improved processing efficiency
- **Built-in Security**: IPSec mandatory
- **Better QoS**: Flow labeling for traffic prioritization

Migration Strategies:
- **Dual Stack**: Run both IPv4 and IPv6
- **Tunneling**: Encapsulate IPv6 in IPv4
- **Translation**: Convert between protocols

Mnemonic

"IPv6 Has More Addresses"

Question 4(a) [3 marks]

Explain File Transfer Protocol.

Solution

FTP Characteristics:

Feature	Description
Port Numbers	20 (data), 21 (control)
Protocol	TCP-based
Authentication	Username/password

Table 18. FTP Basics

FTP Operations:
- **Upload**: PUT command to transfer files to server
- **Download**: GET command to retrieve files from server

- **Directory**: LIST command to show file listings

Mnemonic

"FTP Files Transfer Put Get"

Question 4(b) [4 marks]

Write short note on DNS.

Solution

Domain Name System (DNS):

Component	Function
DNS Server	Resolves domain names
DNS Cache	Stores recent lookups
DNS Records	Maps names to addresses

Table 19. DNS Components

DNS Hierarchy:
- **Root Domain**: Top-level (.)
- **Top-Level Domain**: .com, .org, .net
- **Second-Level Domain**: google.com

Mnemonic

"DNS Domain Names Servers"

Question 4(c) [7 marks]

Explain Electronic Mail.

Solution

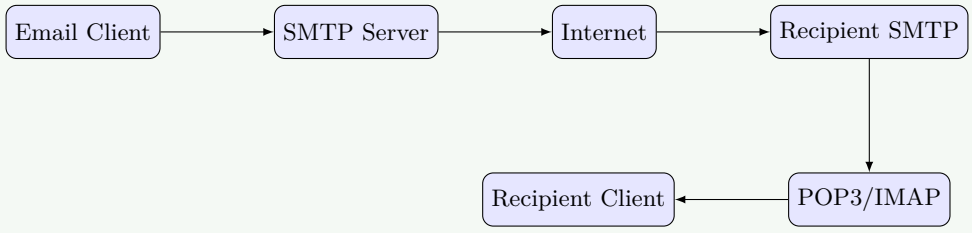

Figure 8. Email Delivery System

Email System Components:

Component	Function	Protocol
User Agent	Email client	Outlook, Gmail
Mail Server	Store/forward	SMTP, POP3, IMAP
Message Transfer	Delivery	SMTP

Table 20. Email Components

Mnemonic

"SMTP Sends, POP3 Pulls, IMAP Integrates"

Question 4(a OR) [3 marks]

Explain Web browser.

Solution

Web Browser Functions:

Function	Description
HTTP Client	Requests web pages
HTML Renderer	Displays web content
JavaScript Engine	Executes scripts

Table 21. Browser Functions

Mnemonic

"Browser Render Web Pages"

Question 4(b OR) [4 marks]

Explain Mail Protocols.

Solution

Email Protocol Comparison:

Protocol	Type	Function	Port
SMTP	Outgoing	Send mail	25
POP3	Incoming	Download mail	110
IMAP	Incoming	Sync mail	143

Table 22. Mail Protocols

SMTP Features:
- **Push Protocol**: Sender initiates transfer
- **Store and Forward**: Intermediate mail servers
- **Text-based**: ASCII command protocol

POP3 Features:
- **Download and Delete**: Mail removed from server
- **Offline Access**: Local mail storage

IMAP Features:
- **Server Storage**: Mail remains on server
- **Multi-device**: Access from multiple clients

Mnemonic

"SMTP Sends, POP3 Pulls, IMAP Integrates"

Question 4(c OR) [7 marks]

Describe TCP and UDP protocols.

Solution

TCP vs UDP Comparison:

Feature	TCP	UDP
Connection	Connection-oriented	Connectionless
Reliability	Reliable	Unreliable
Speed	Slower	Faster
Header Size	20 bytes	8 bytes
Flow Control	Yes	No
Error Control	Yes	No

Table 23. TCP vs UDP

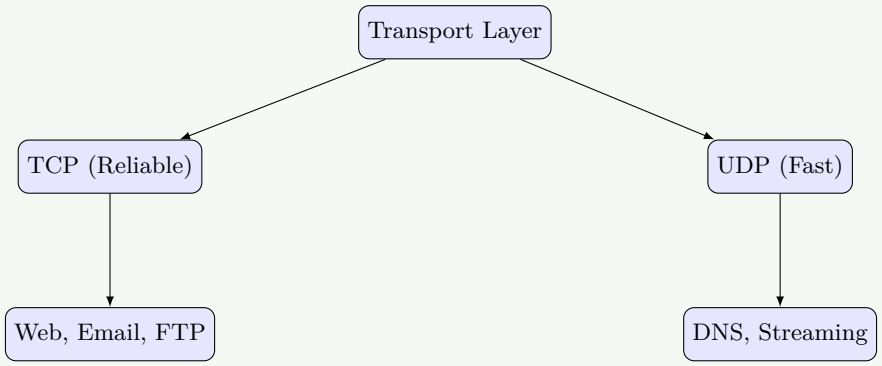

Figure 9. Transport Protocols

TCP Features:
- **Three-way Handshake**: SYN, SYN-ACK, ACK
- **Sequence Numbers**: Ordered packet delivery
- **Acknowledgments**: Confirms packet receipt

UDP Features:
- **Stateless**: No connection state maintained
- **Best Effort**: No delivery guarantee
- **Low Overhead**: Minimal header information

Mnemonic

"TCP Tries Carefully, UDP Unleashes Data"

Question 5(a) [3 marks]

Describe Network device Bridge.

Solution

Bridge Characteristics:

Feature	Description
OSI Layer	Data Link (Layer 2)
Function	Segment collision domains
Learning	MAC address table

Table 24. Bridge Functions

Bridge Operations:
- **Learning**: Records MAC addresses from frames
- **Filtering**: Forwards frames only when necessary
- **Forwarding**: Sends frames to appropriate segment

Mnemonic

"Bridge Breaks Collisions"

Question 5(b) [4 marks]

Explain Social issues and Hacking also discuss its precautions.

Solution

Social Issues in Networks:

Issue	Impact
Digital Divide	Unequal access to technology
Privacy Concerns	Personal data misuse
Cyberbullying	Online harassment

Table 25. Social Issues

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

Precautions and Measures:
- **Strong Passwords**: Use complex, unique passwords
- **Software Updates**: Keep systems patched
- **Firewall**: Block unauthorized access
- **Education**: User awareness training

Mnemonic

"Secure Systems Save Societies"

Question 5(c) [7 marks]

Explain IP Security in detail.

Solution

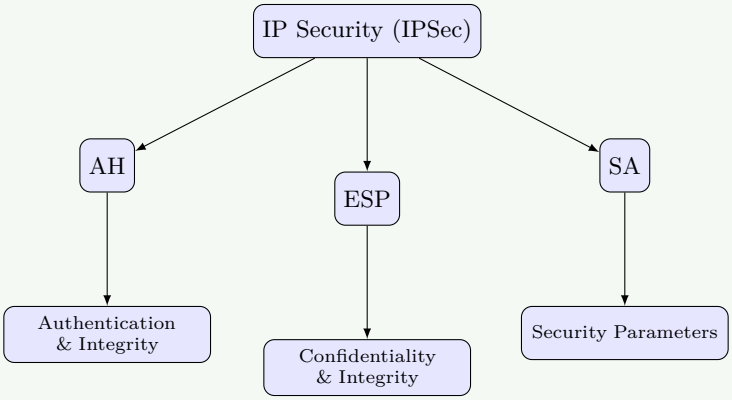

Figure 10. IPSec Architecture

IPSec Components:

Component	Full Name	Service
AH	Authentication Header	Integrity, Auth
ESP	Encapsulating Security Payload	Confidentiality, Integrity
SA	Security Association	Parameters

Table 26. IPSec Components

IPSec Modes:
- **Transport**: Protects payload only (Host-to-Host)
- **Tunnel**: Protects entire packet (Network-to-Network)

Safety Services: Authentication, Integrity, Confidentiality, Non-repudiation.

Mnemonic

"IPSec Authenticates, Encrypts, Secures"

Question 5(a OR) [3 marks]

Explain wireless LAN.

Solution

Wireless LAN (WLAN):

Feature	Description
Standard	IEEE 802.11
Frequency	2.4 GHz, 5 GHz
Access Method	CSMA/CA

Table 27. WLAN Features

Standards:
- **802.11a/g**: 54 Mbps
- **802.11n**: 600 Mbps (MIMO)
- **Components**: Access Points, Clients, SSID

Mnemonic

"Wireless Waves Work"

Question 5(b OR) [4 marks]

Differentiate between symmetric and asymmetric encryption algorithms

Solution

Encryption Comparison:

Feature	Symmetric	Asymmetric
Keys	Single shared key	Public/Private pair
Speed	Fast	Slow
Key Dist.	Difficult	Easy
Example	AES, DES	RSA, ECC

Table 28. Symmetric vs Asymmetric

Symmetric Encryption:
- Uses same key for encryption/decryption
- Efficient for large data

Asymmetric Encryption:
- Public key encrypts, Private key decrypts
- Supports digital signatures

Mnemonic

"Symmetric Same, Asymmetric Pair"

Question 5(c OR) [7 marks]

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

Solution

IT Act 2008 Overview:

Section	Offense	Penalty
66	Hacking	3 years
66A	Offensive messages	3 years + fine
66C	Identity theft	3 years + fine

Table 29. IT Act Penalties

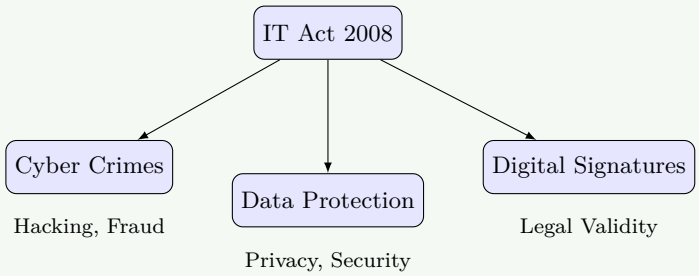

Figure 11. IT Act Framework

Key Amendments & Impact:

- **Cyber Terrorism**: Introducted under Section 66F
- **Data Protection**: Mandatory security practices for corporates
- **Digital Signatures**: Legal recognition extended
- **Certifying Authorities**: Controllers appointed

Industry Impact:

- Compliance requirements for companies
- Legal framework for e-commerce
- Liability for intermediaries (Section 79)

Mnemonic

"IT Act Protects Digital India"