Question 1(a) [3 marks]

Differentiate between Information and Knowledge.

Answer:

Aspect	Information	Knowledge
Definition	Raw facts and figures	Processed information with understanding
Processing	Data that is organized	Information combined with experience
Application	Can be shared easily	Requires interpretation and context

- **Information**: Raw facts, data, and figures that can be processed
- **Knowledge**: Understanding gained through experience and learning

Mnemonic: "Information Informs, Knowledge Knows"

Question 1(b) [4 marks]

Explain Functions of OS.

Answer:

Primary Functions of Operating System:

Function	Description
Process Management	Controls execution of programs
Memory Management	Allocates and deallocates memory
File Management	Organizes and manages files
Device Management	Controls input/output devices

- **Process Control**: Scheduling and managing running programs
- **Resource Allocation**: Distributing system resources efficiently
- **User Interface**: Providing interaction between user and computer

Mnemonic: "PMFD - Process, Memory, File, Device"

Question 1(c) [7 marks]

Define Universal gate and Build Basic gate using NAND Universal gate.

Answer:

Universal Gate Definition:
A logic gate that can implement any Boolean function without using any other type of gate.

NAND Gate Truth Table:

A	B	NAND Output
0	0	1
0	1	1
1	0	1
1	1	0

Basic Gates using NAND:

```
NOT Gate using NAND:
A ----+
      |
      NAND ---- Output (NOT A)
      |
A ----+


AND Gate using NAND:
A ----+
      |
      NAND ---- NAND ---- Output (A AND B)
      |
B ----+


OR Gate using NAND:
A ---- NAND ----+
                |
                NAND ---- Output (A OR B)
                |
B ---- NAND ----+
```

- **NOT**: Single input to both NAND inputs
- **AND**: NAND followed by NOT (another NAND)
- **OR**: NOT both inputs, then NAND result

Mnemonic: "NAND Needs Another NAND Definitely"

Question 1(c OR) [7 marks]

Perform Following Conversion:

Answer:

Conversion Solutions:

From	To	Process	Result
$(1456)_8$	Base 16	8→10→16	$(32E)_{16}$
$(1011)_2$	Base 10	Binary to Decimal	$(11)_{10}$
$(247.38)_{10}$	Base 8	Integer and Fraction separately	$(367.3)_8$

Detailed Solutions:

1. **$(1456)_8 = (32E)_{16}$**

   - $1×8^3 + 4×8^2 + 5×8^1 + 6×8^0 = 512 + 256 + 40 + 6 = (814)_{10}$

   - $814 ÷ 16 = 50$ remainder 14(E), $50 ÷ 16 = 3$ remainder 2

   - Result: $(32E)_{16}$

2. **$(1011)_2 = (11)_{10}$**

   - $1×2^3 + 0×2^2 + 1×2^1 + 1×2^0 = 8 + 0 + 2 + 1 = (11)_{10}$

3. **$(247.38)_{10} = (367.3)_8$**

   - Integer: $247 ÷ 8 = 30$ remainder 7, $30 ÷ 8 = 3$ remainder 6, $3 ÷ 8 = 0$ remainder 3

   - Fraction: $0.38 × 8 = 3.04$ (take 3)

   - Result: $(367.3)_8$

Mnemonic: "Convert Carefully, Check Calculations"

Question 2(a) [3 marks]

List out types of Memory.

Answer:

Memory Classification:

Type	Examples	Characteristics
Primary Memory	RAM, ROM, Cache	Directly accessible by CPU
Secondary Memory	HDD, SSD, CD/DVD	Non-volatile storage
Cache Memory	L1, L2, L3	High-speed buffer memory

- **Volatile**: Loses data when power off (RAM)

- **Non-volatile**: Retains data without power (ROM, HDD)

- **Access Speed**: Cache > RAM > Secondary Storage

Mnemonic: "Primary Processes, Secondary Stores"

Question 2(b) [4 marks]

Differentiate Kernel Mode Vs User Mode.

Answer:

Aspect	Kernel Mode	User Mode
Privilege Level	Full system access	Restricted access
Instructions	All instructions allowed	Limited instruction set
Memory Access	Complete memory access	Limited memory regions
System Calls	Direct hardware access	Through system calls only

- **Kernel Mode**: Operating system runs with full privileges
- **User Mode**: Applications run with limited privileges
- **Security**: Mode switching prevents unauthorized access

Mnemonic: "Kernel Controls, User Consumes"

Question 2(c) [7 marks]

List out types of OS and Explain any two OS

Answer:

Types of Operating Systems:

Type	Examples	Characteristics
Batch OS	Early mainframes	No user interaction
Time-sharing OS	UNIX, Linux	Multiple users simultaneously
Real-time OS	Embedded systems	Guaranteed response time
Distributed OS	Cloud systems	Multiple connected computers
Network OS	Windows Server	Network resource management
Mobile OS	Android, iOS	Smartphone/tablet systems

Detailed Explanation:

1. Time-sharing OS (Linux):

- **Multi-user**: Multiple users can access simultaneously
- **Multi-tasking**: Runs multiple processes concurrently
- **Resource Sharing**: CPU time divided among processes
- **Examples**: UNIX, Linux, Windows

2. Real-time OS:

- **Deterministic**: Guaranteed response within time limits

- **Priority-based**: Critical tasks get higher priority

- **Applications**: Medical devices, industrial control

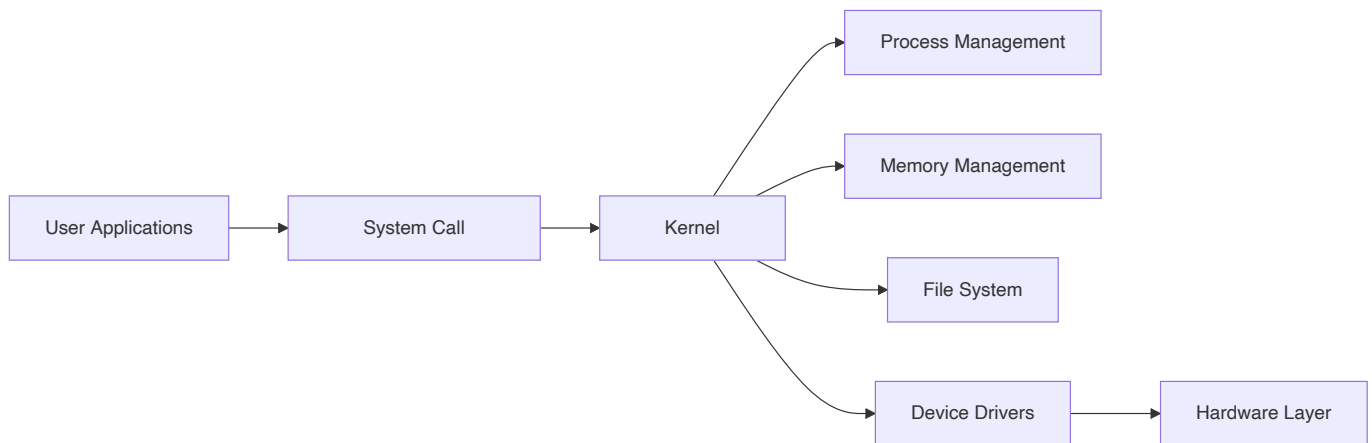- **Types**: Hard real-time and Soft real-time

Mnemonic: "Time Ticks, Real-time Reacts"

Question 2(a OR) [3 marks]

Explain Architecture of Linux Operating System.

Answer:

Linux Architecture Layers:

- **User Space**: Applications and user programs

- **System Calls**: Interface between user and kernel

- **Kernel**: Core operating system functions

Mnemonic: "Users Use, Kernel Controls"

Question 2(b OR) [4 marks]

Explain Working of Search Engine.

Answer:

Search Engine Working Process:

Step	Process	Function
Crawling	Web spiders scan websites	Discovers web pages
Indexing	Analyzes and stores content	Creates searchable database
Ranking	Applies algorithms	Determines relevance order
Retrieval	Returns results	Displays ranked results

Working Steps:

- **Web Crawlers**: Automated bots scan internet content

- **Index Database**: Stores and organizes webpage information

- **Query Processing**: Analyzes user search terms

- **Result Ranking**: Uses algorithms to order results by relevance

Mnemonic: "Crawl, Index, Rank, Retrieve"

Question 2(c OR) [7 marks]

Difference between Open Source Software and Proprietary Software.

Answer:

Aspect	Open Source Software	Proprietary Software
Source Code	Freely available and modifiable	Closed and protected
Cost	Usually free	Requires license purchase
Support	Community-based	Vendor-provided
Customization	Fully customizable	Limited customization
Examples	Linux, Firefox, LibreOffice	Windows, MS Office, Photoshop
Security	Transparent, community-audited	Security through obscurity
Updates	Community-driven	Vendor-controlled

Key Differences:

- **Licensing**: Open source allows redistribution and modification

- **Cost Model**: Open source typically free vs. proprietary paid

- **Development**: Community collaboration vs. company-controlled

- **Transparency**: Open source code visible vs. proprietary hidden

Advantages:

- **Open Source**: Cost-effective, customizable, secure

- **Proprietary**: Professional support, integrated features, user-friendly

Mnemonic: "Open Opens, Proprietary Protects"

Question 3(a) [3 marks]

Give full form of the following: OSI, LLC, FTP

Answer:

Full Forms:

Abbreviation	Full Form
OSI	Open Systems Interconnection
LLC	Logical Link Control
FTP	File Transfer Protocol

- **OSI**: Networking reference model with 7 layers
- **LLC**: Sublayer of Data Link Layer in OSI model
- **FTP**: Protocol for transferring files over network

Mnemonic: "Open Logic Files"

Question 3(b) [4 marks]

Give advantages and disadvantages of Twisted Pair Cable.

Answer:

Twisted Pair Cable Analysis:

Advantages	Disadvantages
Low Cost	**Limited Distance**
Easy Installation	**Electromagnetic Interference**
Flexible	**Lower Bandwidth**
Widely Available	**Security Issues**

Advantages:

- **Cost-effective**: Cheapest networking cable option
- **Easy Installation**: Simple to install and maintain
- **Flexibility**: Can be bent and routed easily

Disadvantages:

- **Distance Limitation**: Maximum 100 meters without repeater

- **Interference**: Susceptible to electromagnetic interference

- **Bandwidth**: Lower data transmission rates compared to fiber

Mnemonic: "Twisted is Cheap but Limited"

Question 3(c) [7 marks]

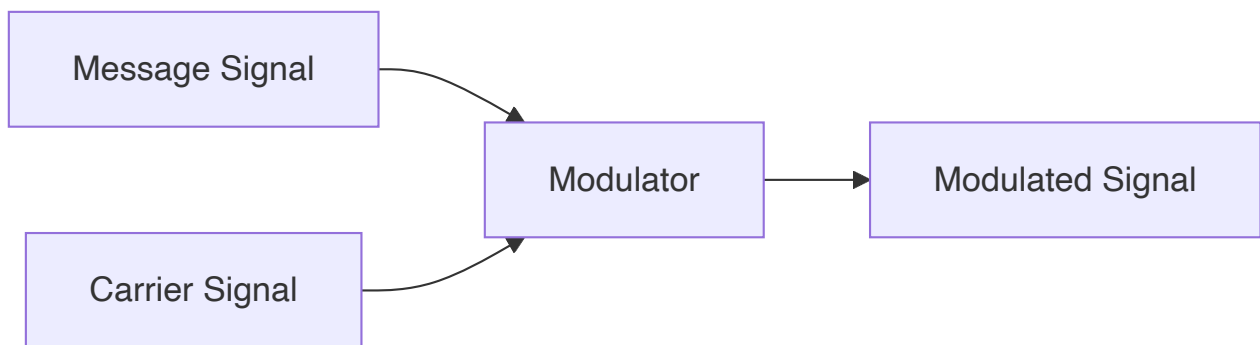**What is Modulation? Explain Analog Modulation.**

Answer:

Modulation Definition:
Process of varying carrier signal characteristics to transmit information over long distances.

Analog Modulation Types:

Type	Parameter Varied	Application
AM	Amplitude	Radio broadcasting
FM	Frequency	FM radio, TV sound
PM	Phase	Digital communications

Amplitude Modulation (AM):

Key Concepts:

- **Carrier Wave**: High-frequency signal for transmission

- **Message Signal**: Information to be transmitted

- **Modulation Index**: Degree of modulation applied

Applications:

- **AM Radio**: 530-1710 kHz frequency band

- **FM Radio**: 88-108 MHz frequency band

- **Television**: Various modulation techniques

Advantages:

- **Long Distance**: Enables long-range communication
- **Noise Immunity**: FM provides better noise resistance

Mnemonic: "Amplitude Alters, Frequency Fluctuates"

Question 3(a OR) [3 marks]

List out Network Topologies. Write Advantages and Disadvantages of Bus Topology.

Answer:

Network Topologies:

- **Bus Topology**
- **Star Topology**
- **Ring Topology**
- **Mesh Topology**
- **Hybrid Topology**

Bus Topology Analysis:

Advantages	Disadvantages
Simple Design	**Single Point of Failure**
Cost-effective	**Limited Cable Length**
Easy to Expand	**Performance Degradation**

Mnemonic: "Bus is Simple but Single-failure-prone"

Question 3(b OR) [4 marks]

Differentiate Serial and Parallel Transmission.

Answer:

Aspect	Serial Transmission	Parallel Transmission
Data Path	Single communication line	Multiple lines simultaneously
Speed	Slower for short distances	Faster for short distances
Cost	Lower cost	Higher cost
Distance	Suitable for long distances	Limited to short distances

Characteristics:

- **Serial**: Bits transmitted one after another
- **Parallel**: Multiple bits transmitted simultaneously
- **Applications**: Serial for networks, Parallel for internal buses

Mnemonic: "Serial Single-file, Parallel Processes"

Question 3(c OR) [7 marks]

Explain Transmission Modes.

Answer:

Transmission Modes Classification:

Mode	Direction	Examples	Applications
Simplex	One-way only	Radio, TV broadcast	Broadcasting
Half-duplex	Two-way, not simultaneous	Walkie-talkie	Turn-based communication
Full-duplex	Two-way simultaneous	Telephone	Real-time communication

Detailed Explanation:

1. Simplex Mode:

- **Unidirectional**: Data flows in one direction only
- **Examples**: Television broadcasting, radio transmission
- **Advantage**: Simple implementation
- **Disadvantage**: No feedback possible

2. Half-duplex Mode:

- **Bidirectional**: Data can flow both ways, but not simultaneously
- **Examples**: Walkie-talkies, CB radio
- **Advantage**: Two-way communication with single channel
- **Disadvantage**: Cannot send and receive simultaneously

3. Full-duplex Mode:

- **Simultaneous Bidirectional**: Data flows both ways at same time
- **Examples**: Telephone conversations, modern networks
- **Advantage**: Efficient real-time communication
- **Disadvantage**: Requires more complex implementation

Mnemonic: "Simplex Single, Half-duplex Halts, Full-duplex Flows"

Question 4(a) [3 marks]

Draw Crossover Ethernet Cable.

Answer:

Crossover Cable Wiring Diagram:

```
RJ-45 Connector A              RJ-45 Connector B
Pin 1: White-Orange  <--->  Pin 3: White-Green
Pin 2: Orange        <--->  Pin 6: Green
Pin 3: White-Green   <--->  Pin 1: White-Orange
Pin 4: Blue          <--->  Pin 4: Blue
Pin 5: White-Blue    <--->  Pin 5: White-Blue
Pin 6: Green         <--->  Pin 2: Orange
Pin 7: White-Brown   <--->  Pin 7: White-Brown
Pin 8: Brown         <--->  Pin 8: Brown
```

Key Points:

- **Purpose**: Direct connection between similar devices
- **Crossed Pairs**: Transmit and receive pairs are swapped
- **Usage**: PC to PC, Switch to Switch connections

Mnemonic: "Cross Connects Computers"

Question 4(b) [4 marks]

Difference between IPv4 and IPv6.

Answer:

Feature	IPv4	IPv6
Address Size	32 bits	128 bits
Address Format	Dotted decimal	Hexadecimal colon
Address Space	4.3 billion addresses	340 undecillion addresses
Header Size	Variable (20-60 bytes)	Fixed (40 bytes)

Key Differences:

- **IPv4 Example**: 192.168.1.1
- **IPv6 Example**: 2001:0db8:85a3:0000:0000:8a2e:0370:7334
- **Security**: IPv6 has built-in IPSec support
- **NAT**: IPv4 requires NAT, IPv6 eliminates need

Mnemonic: "IPv4 Four-billion, IPv6 Six-teen-times-more"

Question 4(c) [7 marks]

Draw neat and clean figure of OSI Model and write down the functionality of Physical Layer and Data Link Layer.

Answer:

OSI Model Diagram:

Layer Functions:

Layer	Function	Examples
Physical (Layer 1)	Bit transmission over medium	Cables, hubs, repeaters
Data Link (Layer 2)	Frame delivery between adjacent nodes	Switches, MAC addresses

Physical Layer Functions:

- **Bit Transmission**: Converts data into electrical/optical signals
- **Medium Specification**: Defines cable types and connectors
- **Signal Encoding**: Determines how bits are represented
- **Transmission Rate**: Controls data speed

Data Link Layer Functions:

- **Frame Formation**: Organizes bits into frames
- **Error Detection**: Identifies transmission errors
- **Flow Control**: Manages data transmission rate
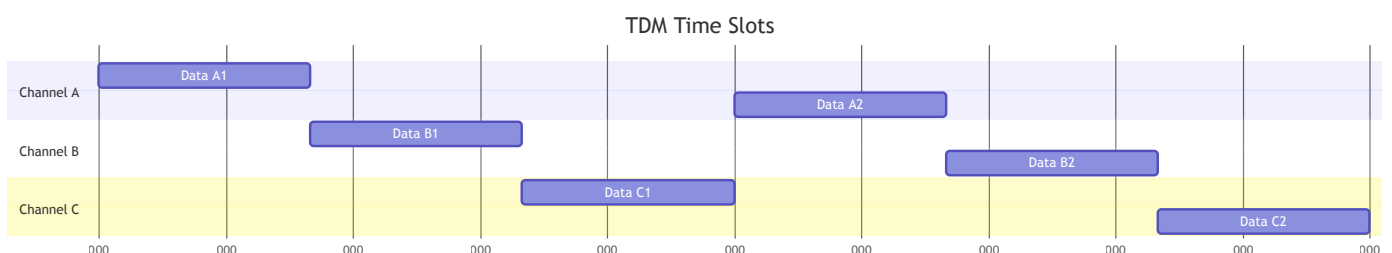- **MAC Addressing**: Uses hardware addresses for local delivery

Mnemonic: "Physical Pushes, Data-Link Delivers"

Question 4(a OR) [3 marks]

Explain Time Division Multiplexing.

Answer:

Time Division Multiplexing (TDM):

TDM Characteristics:

- **Time Slots**: Each channel gets dedicated time period
- **Synchronization**: All channels must be synchronized
- **Bandwidth Sharing**: Single high-speed link shared among multiple channels

Mnemonic: "Time Takes Turns"

Question 4(b OR) [4 marks]

List out types of Networking Device and Explain any one.

Answer:

Networking Devices:

Device	Layer	Function
Hub	Physical	Signal repeater
Switch	Data Link	Frame switching
Router	Network	Packet routing
Bridge	Data Link	Network segmentation

Switch Explanation:

- **Function**: Forwards frames based on MAC addresses
- **Learning**: Builds MAC address table dynamically
- **Collision Domain**: Each port creates separate collision domain
- **Full-duplex**: Simultaneous send/receive on each port

Advantages:

- **Bandwidth**: Full bandwidth per port
- **Security**: Frames sent only to intended recipient
- **Collision**: Eliminates collisions

Mnemonic: "Switch Smartly Sends"

Question 4(c OR) [7 marks]

What is Computer Network? Explain types of Computer Network.

Answer:

Computer Network Definition:
Interconnected collection of autonomous computers that can communicate and share resources.

Types of Computer Networks:

Type	Coverage	Examples	Characteristics
LAN	Local area (building)	Office network	High speed, low cost
MAN	Metropolitan area (city)	City-wide network	Medium speed, moderate cost
WAN	Wide area (country/world)	Internet	Lower speed, high cost

Detailed Explanation:

1. Local Area Network (LAN):

- **Coverage**: Single building or campus
- **Speed**: High (100 Mbps to 10 Gbps)
- **Technology**: Ethernet, Wi-Fi
- **Ownership**: Single organization

2. Metropolitan Area Network (MAN):

- **Coverage**: City or metropolitan area
- **Speed**: Medium (10-100 Mbps)
- **Technology**: Fiber optic, microwave
- **Examples**: Cable TV networks

3. Wide Area Network (WAN):

- **Coverage**: Countries or continents
- **Speed**: Variable (depends on technology)
- **Technology**: Satellite, leased lines
- **Examples**: Internet, corporate networks

Network Benefits:

- **Resource Sharing**: Files, printers, applications
- **Communication**: Email, messaging, video conferencing
- **Cost Reduction**: Shared resources reduce costs
- **Data Backup**: Centralized backup systems

Mnemonic: "Local Loves, Metro Manages, Wide Wanders"

Question 5(a) [3 marks]

Explain the need for information security.

Answer:

Information Security Needs:

Threat	Impact	Protection Need
Data Theft	Financial loss	Confidentiality
Unauthorized Access	Privacy breach	Access control
System Attacks	Service disruption	Availability

Key Requirements:

- **Confidentiality**: Protecting sensitive information from unauthorized access
- **Data Protection**: Preventing loss or corruption of valuable data
- **Business Continuity**: Ensuring systems remain operational

Mnemonic: "Security Secures Sensitive Systems"

Question 5(b) [4 marks]

Write advantages and disadvantages of Fiber Optic Cable.

Answer:

Advantages	Disadvantages
High Bandwidth	**High Cost**
Immunity to EMI	**Difficult Installation**
Long Distance	**Fragile Nature**
Secure Transmission	**Specialized Equipment**

Advantages:

- **Speed**: Highest data transmission rates
- **Distance**: Can span long distances without signal degradation
- **Security**: Difficult to tap, providing secure communication

Disadvantages:

- **Cost**: Expensive cable and equipment
- **Installation**: Requires skilled technicians
- **Maintenance**: Difficult to repair and splice

Mnemonic: "Fiber is Fast but Fragile"

Question 5(c) [7 marks]

List out types of Attack. And Explain any two web based attack.

Answer:

Types of Attacks:

Category	Attack Types	Target
Web-based	SQL Injection, XSS, CSRF	Web applications
Network	DoS, DDoS, Man-in-Middle	Network infrastructure
Malware	Virus, Trojan, Ransomware	Systems and data
Social	Phishing, Social Engineering	Human users

Web-based Attacks Explained:

1. SQL Injection:

- **Method**: Inserting malicious SQL code into web application inputs
- **Impact**: Unauthorized database access, data theft
- **Example**: Entering `'; DROP TABLE users;--` in login form
- **Prevention**: Input validation, parameterized queries
- **Severity**: Can compromise entire database

2. Cross-Site Scripting (XSS):

- **Method**: Injecting malicious scripts into web pages
- **Impact**: Session hijacking, cookie theft, page defacement
- **Types**: Stored XSS, Reflected XSS, DOM-based XSS
- **Prevention**: Input sanitization, output encoding
- **Target**: Affects users visiting compromised websites

Attack Characteristics:

- **SQL Injection**: Targets database through web application
- **XSS**: Targets users through compromised web pages
- **Common Factor**: Both exploit insufficient input validation

Prevention Measures:

- **Input Validation**: Check all user inputs
- **Regular Updates**: Keep software and systems updated
- **Security Training**: Educate users about attack methods

Mnemonic: "SQL Steals, XSS eXploits Scripts"

Question 5(a OR) [3 marks]

Explain Confidentiality, Integrity and Availability.

Answer:

CIA Triad Components:

Component	Definition	Examples
Confidentiality	Information access only by authorized users	Encryption, access controls
Integrity	Data accuracy and completeness	Checksums, digital signatures
Availability	Systems accessible when needed	Redundancy, backup systems

Key Concepts:

- **Confidentiality**: Keeps information secret from unauthorized users
- **Integrity**: Ensures data hasn't been modified without authorization
- **Availability**: Guarantees systems are operational when required

Mnemonic: "CIA Completely Protects Information"

Question 5(b OR) [4 marks]

Find class of following IP addresses.

Answer:

IP Address Class Identification:

IP Address	First Octet	Class	Range
192.12.44.12	192	Class C	192-223
123.77.42.213	123	Class A	1-126
190.65.22.15	190	Class B	128-191
10.0.0.11	10	Class A (Private)	1-126

Class Characteristics:

- **Class A**: 1-126 (first bit 0), supports large networks
- **Class B**: 128-191 (first two bits 10), medium networks
- **Class C**: 192-223 (first three bits 110), small networks
- **Private IPs**: 10.x.x.x, 172.16-31.x.x, 192.168.x.x

Mnemonic: "A is Awesome, B is Better, C is Compact"

Question 5(c OR) [7 marks]

Explain Cryptography.

Answer:

Cryptography Definition:
Science of securing communication through encoding information so only authorized parties can access it.

Cryptography Types:

Type	Key Usage	Examples	Applications
Symmetric	Single shared key	DES, AES	Fast bulk encryption
Asymmetric	Public-private key pair	RSA, ECC	Digital signatures, key exchange
Hash Functions	One-way transformation	MD5, SHA	Data integrity, passwords

Key Concepts:

1. Symmetric Cryptography:

- **Single Key**: Same key for encryption and decryption
- **Speed**: Fast processing for large amounts of data
- **Challenge**: Secure key distribution
- **Examples**: AES-256, 3DES

2. Asymmetric Cryptography:

- **Key Pairs**: Public key (shareable) and private key (secret)
- **Digital Signatures**: Proves authenticity and non-repudiation
- **Key Exchange**: Secure method to share symmetric keys
- **Examples**: RSA, Elliptic Curve Cryptography

3. Hash Functions:

- **One-way**: Easy to compute hash, difficult to reverse
- **Fixed Output**: Always produces same length output
- **Collision Resistance**: Different inputs should produce different hashes
- **Applications**: Password storage, digital forensics

Cryptographic Process:
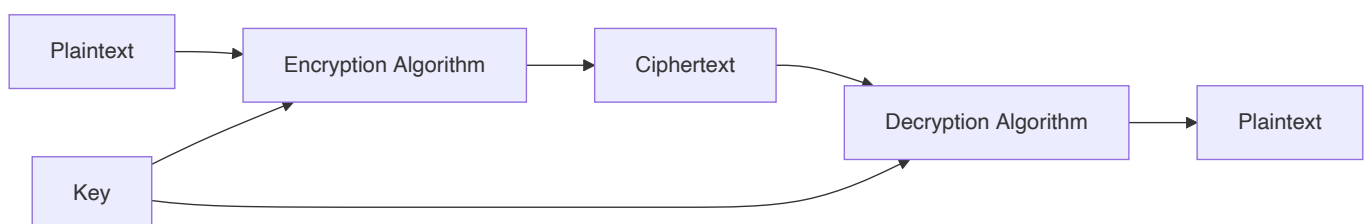
Applications:

- **Secure Communication**: HTTPS, VPN, email encryption

- **Data Protection**: File encryption, database security

- **Authentication**: Digital certificates, password hashing

- **Financial Systems**: Online banking, cryptocurrency

Modern Challenges:

- **Quantum Computing**: Threat to current encryption methods

- **Key Management**: Secure storage and distribution of keys

- **Performance**: Balancing security with system performance

Mnemonic: "Cryptography Creates Coded Communications"

- **Secure Communication**: HTTPS, VPN, email encryption

- **Data Protection**: File encryption, database security

- **Authentication**: Digital certificates, password hashing