Subject Name Solutions

4311602 – Summer 2023

Semester 1 Study Material

Detailed Solutions and Explanations

Question 1(a) [3 marks]

Discuss the main components of the Computer.

Solution

Table 1: Main Components of Computer

Component	Function	Example
Input Unit	Receives data and instructions	Keyboard, Mouse
CPU	Processes data and controls operations	Intel i5, AMD Ryzen
Memory	Stores data temporarily/permanently	RAM, Hard Disk
Output Unit	Displays processed results	Monitor, Printer

Key Components:

- **Hardware**: Physical parts like CPU, RAM, motherboard
- **Software**: Programs and operating systems
- **Data**: Information processed by computer

Mnemonic

"I Can Make Output" (Input-CPU-Memory-Output)

Question 1(b) [4 marks]

Explain the web browser and its type.

Solution

A **web browser** is software that accesses and displays web pages from the internet.

Table 2: Types of Web Browsers

Browser Type	Features	Examples
Graphical	GUI interface, multimedia support	Chrome, Firefox
Text-based	Command line, fast loading	Lynx, Links
Mobile	Touch interface, optimized for phones	Safari Mobile, Chrome Mobile

Features:

- **Navigation**: Forward, back, refresh buttons
- **Bookmarks**: Save favorite websites
- **Tabs**: Multiple pages in one window
- **Security**: HTTPS support, popup blockers

Mnemonic

"Browse Safely Online" (Bookmarks-Security-Online)

Question 1(c) [7 marks]

Explain LAN, MAN and WAN with example.

Solution

Table 3: Network Types Comparison

Network	Coverage	Speed	Example	Cost
LAN	Building/Campus	High (100Mbps-1Gbps)	Office network	Low
MAN	City/Metropolitan	Medium (10-100Mbps)	Cable TV network	Medium
WAN	Country/Global	Variable (1-100Mbps)	Internet	High

Detailed Explanation:
LAN (Local Area Network):
- **Coverage**: Within building or small area
- **Technology**: Ethernet, Wi-Fi
- **Example**: Computer lab, home network

MAN (Metropolitan Area Network):
- **Coverage**: Across city or metropolitan area
- **Technology**: Fiber optic, microwave
- **Example**: City-wide cable internet

WAN (Wide Area Network):
- **Coverage**: Multiple cities/countries
- **Technology**: Satellite, fiber optic
- **Example**: Internet, bank ATM networks

Diagram:

Mermaid Diagram (Code)

```
{Shaded}
{Highlighting}[]
graph LR
    A[LAN {- Building] {-}{-}{} B[MAN {-} City]}
    B {-{-}{} C[WAN {-} Global]}
    A {-{-}{} D[Office Network]}
    B {-{-}{} E[City Cable TV]}
    C {-{-}{} F[Internet]}
{Highlighting}
{Shaded}
```

Mnemonic

"Local Metro World" (LAN-MAN-WAN)

Question 1(c OR) [7 marks]

Difference between DOS and Unix Operating system.

Solution

Table 4: DOS vs Unix Comparison

Feature	DOS	Unix
Interface	Command Line (text-based)	Command Line + GUI
Multi-user	Single user	Multi-user support
Multitasking	Limited	Full multitasking
Security	Basic	Advanced security
File System	FAT16/FAT32	Various (ext3, ext4)

Cost	Commercial (Microsoft)	Free/Open source variants

Key Differences:
DOS (Disk Operating System):
- **Architecture**: 16-bit, single-user
- **Memory**: Limited to 640KB conventional
- **Commands**: DIR, COPY, DEL
- **File naming**: 8.3 format limitation

Unix:
- **Architecture**: 32/64-bit, multi-user
- **Memory**: Advanced memory management
- **Commands**: ls, cp, rm, grep
- **File naming**: Case-sensitive, long names

Examples:
- **DOS**: MS-DOS, PC-DOS
- **Unix**: Linux, Solaris, AIX

Mnemonic

"DOS Simple, Unix Powerful" (Single vs Multi-user)

Question 2(a) [3 marks]

List out features of operating system.

Solution

Table 5: Operating System Features

Feature	Description
Process Management	Controls program execution
Memory Management	Allocates RAM efficiently
File Management	Organizes data storage
Device Management	Controls hardware devices

Core Features:
- **User Interface**: GUI or command line
- **Security**: User authentication, access control
- **Multitasking**: Run multiple programs simultaneously
- **Resource Allocation**: CPU, memory distribution

Mnemonic

"Please Manage Files Properly" (Process-Memory-File-Device)

Question 2(b) [4 marks]

Define half duplex and full duplex transmission modes.

Solution

Table 6: Transmission Modes Comparison

Mode	Direction	Example	Efficiency
Half Duplex	Bidirectional (one at a time)	Walkie-talkie	Medium
Full Duplex	Bidirectional (simultaneous)	Telephone	High

Definitions:
Half Duplex:
- **Communication**: Two-way but not simultaneous
- **Example**: Radio communication, old Ethernet hubs
- **Limitation**: Turn-taking required

Full Duplex:
- **Communication**: Two-way simultaneous
- **Example**: Modern Ethernet, telephone calls
- **Advantage**: No waiting time

Diagram:

```
Half Duplex:
A {-{-}{-}{-}{-} B  (A sends)}
A {{-}{-}{-}{-}{-} B  (B sends {-} A waits)}

Full Duplex:
A {{-}{-}{-}{-} B  (Both send/receive simultaneously)}
```

Mnemonic

"Half waits, Full flows" (Half=waiting, Full=simultaneous)

Question 2(c) [7 marks]

Difference between open source and proprietary software.

Solution

Table 7: Open Source vs Proprietary Software

Aspect	Open Source	Proprietary
Source Code	Freely available	Hidden/Protected
Cost	Usually free	Paid licenses
Modification	Allowed	Restricted
Support	Community-based	Vendor support
Security	Transparent	Security through obscurity
Examples	Linux, Firefox, Apache	Windows, MS Office

Detailed Comparison:
Open Source Software:
- **Definition**: Source code publicly available
- **Licensing**: GPL, MIT, Apache licenses
- **Benefits**: Cost-effective, customizable, transparent
- **Examples**: LibreOffice, GIMP, MySQL

Proprietary Software:
- **Definition**: Owned by individual/company
- **Licensing**: End User License Agreement (EULA)
- **Benefits**: Professional support, guaranteed updates
- **Examples**: Adobe Photoshop, Oracle Database

Advantages & Disadvantages:
Open Source Pros: Free, flexible, community support **Open Source Cons:** Limited professional support
Proprietary Pros: Professional support, warranty **Proprietary Cons:** Expensive, vendor lock-in

Mnemonic

"Open = Free to See, Proprietary = Pay to Use"

Question 2(a OR) [3 marks]

Differentiate between RAM and ROM.

Solution

Table 8: RAM vs ROM Comparison

Feature	RAM	ROM
Full Form	Random Access Memory	Read Only Memory
Volatility	Volatile (loses data)	Non-volatile (retains data)
Access	Read/Write	Read only
Speed	Very fast	Slower than RAM

Key Differences:

- **Purpose**: RAM for temporary storage, ROM for permanent
- **Cost**: RAM more expensive per GB
- **Usage**: RAM for programs, ROM for firmware

Mnemonic

"RAM Runs, ROM Remembers" (temporary vs permanent)

Question 2(b OR) [4 marks]

Explain AND logic gate with Example.

Solution

AND Gate Definition: Output is HIGH only when ALL inputs are HIGH.
Truth Table:

Input A	Input B	Output (A AND B)
0	0	0
0	1	0
1	0	0
1	1	1

Symbol:

```
A {-{-}{-}{-}}
        {{-}{-}{-}{-} Output}
B {-{-}{-}{-}/}
```

Example Applications:

- **Security System**: Door opens only with key AND card
- **Car Starting**: Engine starts with key AND foot on brake
- **Boolean Expression**: $Y = A \cdot B$ or $Y = A \wedge B$

Real-life Example: Washing machine starts only when door is closed AND power button is pressed.

Mnemonic

"ALL inputs True = Output True"

Question 2(c OR) [7 marks]

Explain the Ethernet Cable Color code.

Solution

Standard: TIA/EIA-568B Color Code

Table 9: Wire Color Sequence

Pin	Color	Function
1	White/Orange	Transmit+
2	Orange	Transmit-
3	White/Green	Receive+
4	Blue	Not used
5	White/Blue	Not used
6	Green	Receive-
7	White/Brown	Not used
8	Brown	Not used

Cable Types:
Straight-Through Cable (568B both ends):
- **Use**: Computer to switch/hub
- **Color sequence**: Same on both ends

Cross-Over Cable (568A one end, 568B other):
- **Use**: Computer to computer direct
- **Pins swapped**: $1 \leftrightarrow 3, 2 \leftrightarrow 6$

Wiring Diagram:

```
RJ{-45 Connector (568B):}
Pin 1: White/Orange
Pin 2: Orange
Pin 3: White/Green
Pin 4: Blue
Pin 5: White/Blue
Pin 6: Green
Pin 7: White/Brown
Pin 8: Brown
```

Preparation Steps:
1. Strip outer jacket (1 inch)
2. Arrange wires in color order
3. Cut wires evenly
4. Insert into RJ-45 connector
5. Crimp with crimping tool

Mnemonic

"White Orange, Orange, White Green, Blue, White Blue, Green, White Brown, Brown"

Question 3(a) [3 marks]

Compare wired and Wireless Communication.

Solution

Table 10: Wired vs Wireless Communication

Aspect	Wired	Wireless
Medium	Cables (copper/fiber)	Radio waves/infrared
Speed	Higher (up to 100Gbps)	Lower (up to 1Gbps)
Security	More secure	Less secure
Mobility	Limited	High mobility
Cost	Higher installation	Lower installation
Interference	Minimal	Signal interference

Key Points:
- **Wired**: Reliable, fast, secure but limited mobility
- **Wireless**: Mobile, flexible but security concerns

Mnemonic

"Wires are Fast, Wireless is Free" (speed vs mobility)

Question 3(b) [4 marks]

Discuss the different types of computer systems.

Solution

Table 11: Computer System Types

Type	Size	Processing Power	Example
Supercomputer	Room-sized	Extremely high	Weather forecasting
Mainframe	Large cabinet	Very high	Bank transactions
Minicomputer	Desk-sized	Medium	Small business
Microcomputer	Desktop/laptop	Low to medium	Personal use

Classifications:
By Size & Power:

- **Supercomputer**: Scientific calculations, research
- **Mainframe**: Large organizations, concurrent users
- **Personal Computer**: Individual users, office work
- **Embedded Systems**: Specific functions (washing machines)

By Purpose:

- **General Purpose**: Versatile, multiple applications
- **Special Purpose**: Dedicated tasks (ATM, gaming console)

Mnemonic

"Super Main Mini Micro" (decreasing size order)

Question 3(c) [7 marks]

Write short note on TDM, FDM, and OFDM.

Solution

Multiplexing Techniques for Efficient Communication

Table 12: Multiplexing Comparison

Technique	Division Method	Application	Advantage
TDM	Time slots	Digital telephony	Simple implementation
FDM	Frequency bands	Radio/TV broadcasting	Simultaneous transmission
OFDM	Multiple carriers	Wi-Fi, 4G/5G	High data rates

Time Division Multiplexing (TDM):

- **Principle**: Each user gets fixed time slot
- **Implementation**: Sequential data transmission
- **Example**: Digital telephone systems, GSM
- **Advantage**: Efficient use of bandwidth

Frequency Division Multiplexing (FDM):

- **Principle**: Each user gets unique frequency band
- **Implementation**: Simultaneous transmission
- **Example**: FM radio, cable TV
- **Advantage**: No timing coordination needed

Orthogonal Frequency Division Multiplexing (OFDM):

- **Principle**: Multiple orthogonal subcarriers
- **Implementation**: Parallel data streams
- **Example**: Wi-Fi (802.11), LTE, DSL
- **Advantage**: High spectral efficiency, robust against interference

Diagram:

Mermaid Diagram (Code)

```
{Shaded}
{Highlighting}[]
graph TD
    A[Data Stream] {-{-}{} B[TDM {-} Time Slots]}
    A {-{-}{} C[FDM {-} Frequency Bands]}
    A {-{-}{} D[OFDM {-} Multiple Carriers]}
    B {-{-}{} E["T1|T2|T3|T4"]}
    C {-{-}{} F[F1 + F2 + F3 + F4]}
    D {-{-}{} G[Orthogonal Subcarriers]}
{Highlighting}
{Shaded}
```

Applications:

- **TDM**: ISDN, T1/E1 lines
- **FDM**: Analog TV, radio
- **OFDM**: Modern wireless systems

Mnemonic

"Time Frequency Orthogonal" (TDM-FDM-OFDM)

Question 3(a OR) [3 marks]

Discuss FSK and PSK.

Solution

Digital Modulation Techniques

Table 13: FSK vs PSK

Aspect	FSK	PSK
Parameter	Frequency	Phase
Complexity	Simple	Complex
Noise Immunity	Good	Excellent
Bandwidth	Higher	Lower

FSK (Frequency Shift Keying):
- **Principle**: Different frequencies for 0 and 1
- **Implementation**: f1 for '0', f2 for '1'
- **Example**: Computer modems, RFID

PSK (Phase Shift Keying):
- **Principle**: Phase changes represent data
- **Implementation**: $0° for '0', 180° for '1'$
- **Example**: Wi-Fi, satellite communication

Mnemonic

"Frequency Shifts, Phase Shifts" (FSK-PSK)

Question 3(b OR) [4 marks]

Differentiate between Multitasking and Multi programming OS.

Solution

Table 14: Multitasking vs Multiprogramming

Feature	Multitasking	Multiprogramming
User Interaction	Interactive	Batch processing
Response Time	Fast	Slower
CPU Sharing	Time slicing	Job switching
Example	Windows, Linux	Early mainframes

Multitasking:
- **Definition**: Multiple tasks run seemingly simultaneously
- **Method**: Time sharing with quick switching
- **User Experience**: Interactive, responsive
- **Types**: Preemptive, cooperative

Multiprogramming:
- **Definition**: Multiple programs in memory
- **Method**: CPU switches when I/O operations occur
- **User Experience**: Batch job processing
- **Purpose**: CPU utilization improvement

Mnemonic

"Tasks are Interactive, Programs are Batched"

Question 3(c OR) [7 marks]

Write short note on network topologies.

Solution

Network Topology Types and Characteristics

Table 15: Topology Comparison

Topology	Structure	Advantages	Disadvantages	Cost
Bus	Linear	Simple, cost-effective	Single point failure	Low
Star	Central hub	Easy troubleshooting	Hub failure affects all	Medium
Ring	Circular	Equal access	Break affects network	Medium
Mesh	Interconnected	High reliability	Complex, expensive	High
Hybrid	Mixed	Flexible	Complex management	Variable

Detailed Descriptions:

Bus Topology:

- **Structure**: Single backbone cable
- **Termination**: Required at both ends
- **Example**: Early Ethernet (10BASE2)
- **Failure Impact**: Cable break stops entire network

Star Topology:

- **Structure**: Central switch/hub with spokes
- **Scalability**: Easy to add/remove nodes
- **Example**: Modern Ethernet networks
- **Failure Impact**: Only affected node fails

Ring Topology:

- **Structure**: Nodes connected in circle
- **Data Flow**: Unidirectional token passing
- **Example**: Token Ring, FDDI
- **Failure Impact**: Single break stops network

Mesh Topology:

- **Structure**: Every node connected to every other
- **Types**: Full mesh, partial mesh
- **Example**: Internet backbone, military networks
- **Reliability**: Multiple paths available

Hybrid Topology:

- **Structure**: Combination of topologies
- **Example**: Star-bus, star-ring
- **Flexibility**: Best features of each type

Diagram:

Mermaid Diagram (Code)

```
{Shaded}
{Highlighting}[]
graph TD
    A[Network Topologies] {-{-}{} B[Bus]}
    A {-{-}{} C[Star]}
    A {-{-}{} D[Ring]}
    A {-{-}{} E[Mesh]}
    A {-{-}{} F[Hybrid]}

    B {-{-}{} G[Linear Connection]}
    C {-{-}{} H[Central Hub]}
    D {-{-}{} I[Circular Connection]}
    E {-{-}{} J[Full Interconnection]}
    F {-{-}{} K[Mixed Structure]}
{Highlighting}
{Shaded}
```

Selection Criteria:

- **Cost**: Bus < Star < Ring < Mesh
- **Reliability**: Bus < Ring < Star < Mesh
- **Scalability**: Ring < Bus < Star < Mesh

Mnemonic

"Bus Star Ring Mesh Hybrid" (increasing complexity)

Question 4(a) [3 marks]

Explain Switch.

Solution

Network Switch Definition and Functions

Table 16: Switch Characteristics

Feature	Description
Function	Connects devices in LAN
Layer	Data Link Layer (Layer 2)
Method	MAC address learning
Collision	Eliminates collisions

Key Features:
- **MAC Address Table**: Learns and stores device addresses
- **Full Duplex**: Simultaneous send/receive
- **Dedicated Bandwidth**: Each port gets full bandwidth
- **VLAN Support**: Virtual network segregation

Functions:
- **Frame Forwarding**: Sends data to specific port
- **Address Learning**: Builds MAC address table
- **Loop Prevention**: Spanning Tree Protocol

Mnemonic

"Switch Learns MAC Addresses"

Question 4(b) [4 marks]

Define Cyberthreat with an example.

Solution

Cyberthreat Definition: Malicious attempt to damage, disrupt, or gain unauthorized access to computer systems.

Table 17: Cyberthreat Types

Type	Method	Example	Impact
Malware	Malicious software	Virus, Trojan	Data corruption
Phishing	Fake emails/websites	Fake bank emails	Identity theft
Ransomware	Encrypt files	WannaCry attack	Financial loss
DDoS	Traffic overload	Server flooding	Service disruption

Example - Phishing Attack:
- **Method**: Fake email from "bank"
- **Request**: Login credentials
- **Result**: Account compromise
- **Prevention**: Verify sender authenticity

Common Indicators:
- **Suspicious emails**: Unknown senders, urgent requests
- **Unusual system behavior**: Slow performance, pop-ups
- **Unauthorized access**: Changed passwords, new files

Mnemonic

"Cyber Criminals Create Chaos" (threats cause damage)

Question 4(c) [7 marks]

Compare TCP/IP and OSI networking models.

Solution

Table 18: TCP/IP vs OSI Model Comparison

OSI Layer	OSI Function	TCP/IP Layer	TCP/IP Function
Application	User interface	**Application**	User services
Presentation	Data formatting	**Application**	(Combined)
Session	Session management	**Application**	(Combined)
Transport	Reliable delivery	**Transport**	End-to-end delivery
Network	Routing	**Internet**	IP addressing
Data Link	Frame handling	**Network Access**	Physical transmission
Physical	Electrical signals	**Network Access**	(Combined)

Key Differences:
OSI Model (7 layers):

- **Purpose**: Theoretical reference model
- **Development**: ISO standard
- **Layers**: Clearly separated functions
- **Usage**: Educational, troubleshooting

TCP/IP Model (4 layers):

- **Purpose**: Practical implementation
- **Development**: DARPA/Internet
- **Layers**: Combined functionality
- **Usage**: Internet, real networks

Advantages:
OSI Model:

- **Standardization**: Universal reference
- **Troubleshooting**: Layer-by-layer analysis
- **Education**: Clear concept separation

TCP/IP Model:

- **Simplicity**: Fewer layers
- **Practicality**: Internet-proven
- **Flexibility**: Protocol independence

Protocols Examples:

- **OSI**: Conceptual framework
- **TCP/IP**: HTTP, FTP, TCP, UDP, IP

Diagram:

Mermaid Diagram (Code)

```
{Shaded}
{Highlighting}[]
graph TD
    A[OSI {- 7 Layers] {-}{-}{} B[Application]}
    A {-{-}{} C[Presentation]  }
    A {-{-}{} D[Session]}
    A {-{-}{} E[Transport]}
    A {-{-}{} F[Network]}
    A {-{-}{} G[Data Link]}
    A {-{-}{} H[Physical]}

    I[TCP/IP {- 4 Layers] {-}{-}{} J[Application]}
    I {-{-}{} K[Transport]}
    I {-{-}{} L[Internet]}
    I {-{-}{} M[Network Access]}
{Highlighting}
{Shaded}
```

Mnemonic

"OSI is Perfect Theory, TCP/IP is Practical Reality"

Question 4(a OR) [3 marks]

Write main objectives of cyber security.

Solution

Table 19: Cyber Security Objectives (CIA Triad)

Objective	Description	Example
Confidentiality	Protect data from unauthorized access	Encryption, passwords
Integrity	Ensure data accuracy and completeness	Digital signatures, checksums
Availability	Ensure system accessibility	Backup systems, redundancy

Additional Objectives:

- **Authentication**: Verify user identity
- **Authorization**: Control access rights
- **Non-repudiation**: Prevent denial of actions

Mnemonic

"CIA protects data" (Confidentiality-Integrity-Availability)

Question 4(b OR) [4 marks]

List out different types of networking devices used in the networking.

Solution

Table 20: Networking Devices

Device	Layer	Function	Example Use
Hub	Physical	Signal repeater	Legacy networks
Switch	Data Link	Frame forwarding	LAN connectivity
Router	Network	Packet routing	Internet connection
Bridge	Data Link	Network segmentation	LAN extension
Gateway	All layers	Protocol conversion	Network interconnection
Repeater	Physical	Signal amplification	Cable extension
Access Point	Data Link	Wireless connectivity	Wi-Fi networks
Firewall	Network+	Security filtering	Network protection

Functions:

- **Connectivity**: Hub, switch, bridge
- **Routing**: Router, gateway
- **Security**: Firewall, proxy
- **Wireless**: Access point, wireless router

Mnemonic

"Hubs Switch Routes Bridges Gateways"

Question 4(c OR) [7 marks]

Write different types of security attacks.

Solution

Classification of Security Attacks

Table 21: Attack Types and Characteristics

Attack Type	Method	Target	Example	Prevention
Passive	Eavesdropping	Information	Traffic analysis	Encryption
Active	System modification	Integrity	Data alteration	Authentication
Physical	Hardware access	Equipment	Device theft	Physical security
Social Engineering	Human manipulation	Users	Phishing	User education

Detailed Attack Categories:

1. **Network Attacks:**
   - **Man-in-the-Middle**: Intercept communication
   - **DDoS**: Overwhelm server with traffic
   - **Packet Sniffing**: Capture network data
   - **IP Spoofing**: Fake source addresses
2. **Application Attacks:**
   - **SQL Injection**: Database manipulation
   - **Cross-site Scripting (XSS)**: Web vulnerability
   - **Buffer Overflow**: Memory corruption
   - **Zero-day Exploits**: Unknown vulnerabilities
3. **Malware Attacks:**
   - **Virus**: Self-replicating code
   - **Worm**: Network-spreading malware
   - **Trojan**: Disguised malicious software
   - **Ransomware**: Data encryption for payment
4. **Social Engineering:**
   - **Phishing**: Fake emails/websites
   - **Pretexting**: False scenarios
   - **Baiting**: Malicious downloads
   - **Tailgating**: Physical access following
5. **Cryptographic Attacks:**
   - **Brute Force**: Try all combinations
   - **Dictionary Attack**: Common passwords
   - **Rainbow Tables**: Pre-computed hashes
   - **Side-channel**: Information leakage

Attack Vectors:

- **External**: Internet-based attacks
- **Internal**: Insider threats
- **Physical**: Direct hardware access
- **Wireless**: Wi-Fi vulnerabilities

Prevention Strategies:

- **Technical**: Firewalls, antivirus, encryption
- **Administrative**: Policies, procedures
- **Physical**: Locks, surveillance
- **Education**: User awareness training

Mnemonic

"Network Application Malware Social Crypto" (attack categories)

Question 5(a) [3 marks]

Calculate binary of (5AB.4) hexadecimal number.

Solution

Hexadecimal to Binary Conversion

Method: Convert each hex digit to 4-bit binary

Table 22: Hex to Binary Conversion

Hex Digit	Binary	Hex Digit	Binary
5	0101	B	1011
A	1010	4	0100

Step-by-step Conversion:
- **5** $\rightarrow$ **0101**
- **A** $\rightarrow$ **1010**
- **B** $\rightarrow$ **1011**
- **.** $\rightarrow$ **.**(*decimalpoint*)
- **4** $\rightarrow$ **0100**

Final Answer: $(5AB.4)_{16} = (010110101011.0100)_2$
Simplified: $(10110101011.01)_2$

Mnemonic

"Each Hex = 4 Bits"

Question 5(b) [4 marks]

List out the main features of Digi-Locker, e-rupi.

Solution

Table 23: Digital Platform Features

Platform	Purpose	Key Features	Benefits
Digi-Locker	Document storage	Cloud storage, digital certificates	Paperless verification
e-RUPI	Digital payment	QR/SMS voucher, pre-paid	Targeted welfare delivery

Digi-Locker Features:
- **Digital Wallet**: Store documents in cloud
- **Authentication**: Aadhaar-based verification
- **Integration**: Government department access
- **Sharing**: Secure document sharing

e-RUPI Features:
- **Prepaid Voucher**: Purpose-specific payments
- **Contact-less**: QR code/SMS based
- **Security**: No personal/bank details shared
- **Usage**: Healthcare, education, welfare schemes

Mnemonic

"Digi Stores, e-RUPI Pays" (storage vs payment)

Question 5(c) [7 marks]

Describe different generations of a computer system.

Solution

Computer Generations Evolution

Table 24: Computer Generations Comparison

Generation	Period	Technology	Size	Speed	Examples
First	1940-1956	Vacuum Tubes	Room-sized	Slow	ENIAC, UNIVAC

Second	1956-1963	Transistors	Smaller	Faster	IBM 1401, CDC 1604
Third	1964-1971	Integrated Circuits	Desk-sized	Much faster	IBM 360, PDP-8
Fourth	1971-1980s	Microprocessors	Personal	Very fast	Intel 4004, Apple II
Fifth	1980s-Present	AI/Parallel Processing	Portable	Extremely fast	Modern PCs, smartphones

Detailed Description:

First Generation (1940-1956):

- **Technology**: Vacuum tubes for logic/memory
- **Programming**: Machine language, punch cards
- **Characteristics**: Large, expensive, unreliable
- **Heat**: Generated enormous heat
- **Examples**: ENIAC (30 tons), UNIVAC I

Second Generation (1956-1963):

- **Technology**: Transistors replaced vacuum tubes
- **Programming**: Assembly language, FORTRAN, COBOL
- **Improvements**: Smaller, faster, more reliable
- **Memory**: Magnetic core memory
- **Examples**: IBM 1401, Honeywell 400

Third Generation (1964-1971):

- **Technology**: Integrated Circuits (ICs)
- **Programming**: High-level languages
- **Features**: Operating systems, multiprocessing
- **Size**: Mini-computer emergence
- **Examples**: IBM System/360, PDP-8

Fourth Generation (1971-1980s):

- **Technology**: Microprocessors (CPU on chip)
- **Development**: Personal computers born
- **Features**: GUI, networking capabilities
- **Storage**: Floppy disks, hard drives
- **Examples**: Intel 8080, Apple II, IBM PC

Fifth Generation (1980s-Present):

- **Technology**: AI, parallel processing, VLSI
- **Features**: Internet, multimedia, mobile computing
- **Characteristics**: User-friendly, portable, powerful
- **Current**: Smartphones, tablets, cloud computing
- **Examples**: Modern laptops, smartphones, supercomputers

Key Innovations by Generation:

- **1st**: Electronic computing
- **2nd**: Stored programs
- **3rd**: Operating systems
- **4th**: Personal computing
- **5th**: Internet and AI

Diagram:

```
timeline
    title Computer Generations
    1940{-1956 : First Generation}
              : Vacuum Tubes
              : Room{-sized}
    1956{-1963 : Second Generation}
              : Transistors
              : Smaller size
    1964{-1971 : Third Generation}
              : Integrated Circuits
              : Minicomputers
    1971{-1980s : Fourth Generation}
               : Microprocessors
               : Personal Computers
    1980s{-Present : Fifth Generation}
                  : AI \& Internet
                  : Mobile Computing
```

Mnemonic

"Vacuum Transistor IC Micro AI" (technology progression)

Question 5(a OR) [3 marks]

Write Difference between Data and Information with example.

Solution

Table 25: Data vs Information

Aspect	Data	Information
Definition	Raw facts/figures	Processed data
Meaning	No context	Has context
Example	85, 92, 78	Average score: 85%
Purpose	Input for processing	Output for decision-making

Examples:
- **Data**: Student marks (85, 92, 78, 88)
- **Information**: Class average is 85.75%

Characteristics:
- **Data**: Unorganized, raw, needs processing
- **Information**: Organized, meaningful, useful for decisions

Mnemonic

"Data is Raw, Information is Refined"

Question 5(b OR) [4 marks]

Compare analog modulation and digital modulation.

Solution

Table 26: Analog vs Digital Modulation

Feature	Analog Modulation	Digital Modulation
Signal Type	Continuous	Discrete (0s and 1s)
Noise Immunity	Poor	Excellent
Bandwidth	Lower	Higher
Quality	Degrades with distance	Maintains quality
Examples	AM, FM radio	FSK, PSK, QAM

Analog Modulation:
- **Types**: AM (Amplitude), FM (Frequency), PM (Phase)
- **Applications**: Radio broadcasting, analog TV
- **Advantages**: Simple, lower bandwidth
- **Disadvantages**: Noise susceptible, quality loss

Digital Modulation:
- **Types**: ASK, FSK, PSK, QAM
- **Applications**: Wi-Fi, cellular, satellite
- **Advantages**: Noise resistant, error correction
- **Disadvantages**: Complex, higher bandwidth

Mnemonic

"Analog is Simple, Digital is Smart"

Question 5(c OR) [7 marks]

Discuss the range of IP addresses in IPv4

Solution

IPv4 Address Range and Classification

Table 27: IPv4 Address Classes

Class	Range	Default Subnet	Networks	Hosts per Network	Usage
A	1.0.0.0 - 126.0.0.0	/8 (255.0.0.0)	126	16,777,214	Large organizations
B	128.0.0.0 - 191.255.0.0	/16 (255.255.0.0)	16,384	65,534	Medium organizations
C	192.0.0.0 - 223.255.255.0	/24 (255.255.255.0)	2,097,152	254	Small organizations
D	224.0.0.0 - 239.255.255.255	N/A	N/A	N/A	Multicast
E	240.0.0.0 - 255.255.255.255	N/A	N/A	N/A	Reserved/Experimental

Special Address Ranges:
Private IP Ranges (RFC 1918):

- **Class A**: 10.0.0.0 - 10.255.255.255 (/8)
- **Class B**: 172.16.0.0 - 172.31.255.255 (/12)

- **Class C**: 192.168.0.0 - 192.168.255.255 (/16)

Reserved Addresses:

- **Loopback**: 127.0.0.0 - 127.255.255.255
- **Link-local**: 169.254.0.0 - 169.254.255.255
- **Broadcast**: x.x.x.255 (last address in subnet)
- **Network**: x.x.x.0 (first address in subnet)

Address Structure:

- **Total IPv4 space**: 4,294,967,296 addresses (2^{32})
- **Format**: 32-bit address in dotted decimal
- **Example**: 192.168.1.100

Subnet Calculation Example:

- **Network**: 192.168.1.0/24
- **Subnet Mask**: 255.255.255.0
- **Host Range**: 192.168.1.1 - 192.168.1.254
- **Broadcast**: 192.168.1.255

CIDR Notation:

- **/8**: 255.0.0.0 (Class A default)
- **/16**: 255.255.0.0 (Class B default)
- **/24**: 255.255.255.0 (Class C default)
- **/30**: 255.255.255.252 (Point-to-point links)

IPv4 Exhaustion:

- **Problem**: Limited address space
- **Solution**: IPv6 (128-bit addresses)
- **Temporary fixes**: NAT, CIDR, private addressing

Diagram:

Mermaid Diagram (Code)

```
{Shaded}
{Highlighting}[]
graph TD
    A[IPv4 Address Space] {-{-}{} B[Class A: 1{-}126]}
    A {-{-}{} C[Class B: 128{-}191]  }
    A {-{-}{} D[Class C: 192{-}223]}
    A {-{-}{} E[Class D: 224{-}239 Multicast]}
    A {-{-}{} F[Class E: 240{-}255 Reserved]}

    B {-{-}{} G[Large Networks]}
    C {-{-}{} H[Medium Networks]}
    D {-{-}{} I[Small Networks]}
{Highlighting}
{Shaded}
```

Applications:

- **Public IPs**: Internet routing
- **Private IPs**: Internal networks
- **Multicast**: One-to-many communication
- **Loopback**: Local testing

Mnemonic

"A Big Company Delivered Everything" (Classes A-B-C-D-E)