Question 1(a) [3 marks]

Define Peer to Peer network

Answer:
A Peer-to-Peer (P2P) network is a distributed network architecture where each node (peer) acts as both client and server, sharing resources directly without centralized control.

Table:

Aspect	Description
Structure	Decentralized network
Role	Each peer is client and server
Control	No central authority
Examples	BitTorrent, Skype

Mnemonic: "Peers Share Equally"

Question 1(b) [4 marks]

Compare SMTP, POP and IMAP

Answer:
Email protocols serve different purposes in email communication system.

Table:

Feature	SMTP	POP3	IMAP
Purpose	Send emails	Download emails	Access emails
Port	25, 587	110, 995	143, 993
Storage	Server forwards	Local storage	Server storage
Access	One-way sending	Single device	Multiple devices

Mnemonic: "Send-Pop-Internet Mail Access"

Question 1(c) [7 marks]

Illustrate OSI model with responsibilities of each layer

Answer:

The OSI (Open Systems Interconnection) model has seven layers, each with specific responsibilities for network communication.

Diagram:

| Application Layer | → | Presentation Layer 6 | → | Session Layer 5 | → | Transport Layer 4 | → | Network Layer 3 | → | Data Link Layer | → | Physical Layer |

Table:

Layer	Name	Responsibilities
7	Application	User interface, network services
6	Presentation	Data encryption, compression
5	Session	Session management, dialogue control
4	Transport	End-to-end delivery, error control
3	Network	Routing, logical addressing
2	Data Link	Frame formatting, error detection
1	Physical	Bit transmission, hardware

Key Points:

- **Application Layer**: Provides network services to applications
- **Transport Layer**: Ensures reliable data delivery
- **Network Layer**: Handles routing between networks

Mnemonic: "All People Seem To Need Data Processing"

Question 1(c OR) [7 marks]

Compare the TCP/IP model with OSI model

Answer:

TCP/IP and OSI models are network architecture frameworks with different layer structures.
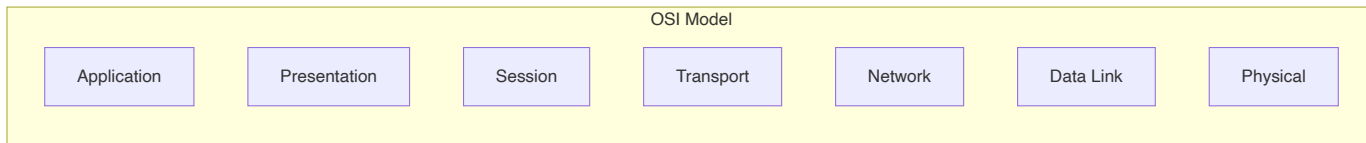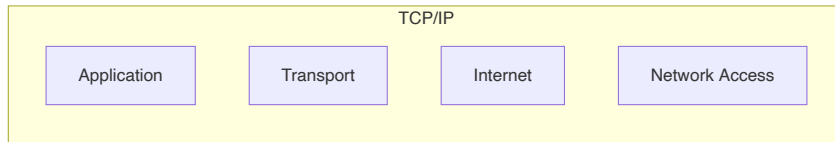
Diagram:

Table:

Aspect	OSI Model	TCP/IP Model
Layers	7 layers	4 layers
Development	Theoretical	Practical
Usage	Reference model	Internet standard
Complexity	More detailed	Simplified

Key Points:

- **OSI**: Theoretical framework with detailed separation
- **TCP/IP**: Practical implementation for internet
- **Mapping**: Top 3 OSI layers = Application layer in TCP/IP
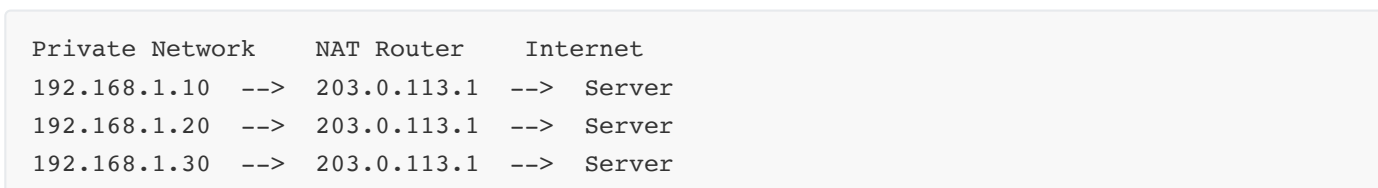
Mnemonic: "OSI Seven, TCP Four"

Question 2(a) [3 marks]

Explain Network Address Translation (NAT)

Answer:
NAT translates private IP addresses to public IP addresses, enabling multiple devices to share a single public IP.

Diagram:

```
Private Network    NAT Router     Internet
192.168.1.10  -->  203.0.113.1  -->  Server
192.168.1.20  -->  203.0.113.1  -->  Server
192.168.1.30  -->  203.0.113.1  -->  Server
```

Key Points:

- **Purpose**: IP address translation between networks
- **Benefit**: Conserves public IP addresses

- **Security**: Hides internal network structure

Mnemonic: "Network Address Translation"

Question 2(b) [4 marks]

Define Subnetting and Supernetting

Answer:
Subnetting and Supernetting are IP addressing techniques for efficient network management.

Table:

Technique	Definition	Purpose
Subnetting	Dividing network into smaller subnets	Better organization
Supernetting	Combining multiple networks	Route aggregation

Key Points:

- **Subnetting**: Increases network bits, reduces host bits
- **Supernetting**: Decreases network bits, increases routing efficiency
- **CIDR**: Classless Inter-Domain Routing enables both

Mnemonic: "Sub-divides, Super-combines"

Question 2(c) [7 marks]

Demonstrate Classful and Classless notation addressing scheme of IPv4

Answer:
IPv4 addressing uses classful and classless schemes for network identification.

Table - Classful Addressing:

Class	Range	Default Mask	Networks	Hosts
A	1-126	/8 (255.0.0.0)	126	16M
B	128-191	/16 (255.255.0.0)	16K	65K
C	192-223	/24 (255.255.255.0)	2M	254

Classless (CIDR) Examples:

- **192.168.1.0/25**: 128 hosts
- **10.0.0.0/16**: 65,536 hosts
- **172.16.0.0/20**: 4,096 hosts

Key Points:

- **Classful**: Fixed network/host boundaries
- **Classless**: Variable Length Subnet Mask (VLSM)
- **CIDR**: More efficient address allocation

Mnemonic: "Class-Fixed, CIDR-Flexible"

Question 2(a OR) [3 marks]

Discuss goals of mobile IP

Answer:
Mobile IP enables seamless connectivity for mobile devices across different networks.

Key Points:

- **Transparency**: Applications unaware of mobility
- **Compatibility**: Works with existing protocols
- **Efficiency**: Minimal routing overhead

Mnemonic: "Transparent Compatible Efficient"

Question 2(b OR) [4 marks]

Define ARP and RARP

Answer:
ARP and RARP are address resolution protocols for mapping between different address types.

Table:

Protocol	Full Name	Purpose	Direction
ARP	Address Resolution Protocol	IP to MAC mapping	Logical to Physical
RARP	Reverse ARP	MAC to IP mapping	Physical to Logical

Mnemonic: "ARP-asks, RARP-reverses"

Question 2(c OR) [7 marks]

Demonstrate Stop and Wait, Stop and Wait ARQ data link layer protocols

Answer:
These protocols ensure reliable data transmission at the data link layer.
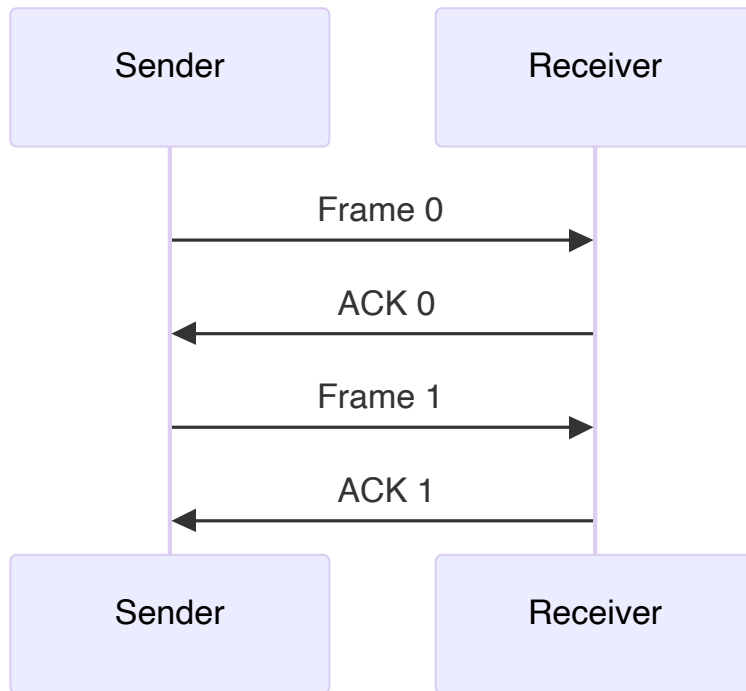
Diagram - Stop and Wait:

Table:

Protocol	Error Detection	Efficiency	Complexity
Stop and Wait	Basic	Low	Simple
Stop and Wait ARQ	Advanced	Medium	Moderate

Key Points:

- **Stop and Wait**: Send frame, wait for acknowledgment
- **ARQ**: Automatic Repeat reQuest on errors
- **Timeout**: Resend if no acknowledgment received

Mnemonic: "Stop-Wait-Acknowledge"

Question 3(a) [3 marks]

Demonstrate Wireless networks

Answer:
Wireless networks use radio waves for communication without physical connections.

Key Points:

- **Technology**: Radio frequency transmission
- **Types**: WiFi, Bluetooth, Cellular
- **Benefits**: Mobility, easy installation

Mnemonic: "Wireless-Radio-Mobile"

Question 3(b) [4 marks]

Define Communication Middleware in mobile computing

Answer:
Communication middleware provides abstraction layer for mobile application communication.

Table:

Aspect	Description
Purpose	Simplify communication
Location	Between app and network
Features	Protocol handling, data conversion
Examples	CORBA, RMI

Mnemonic: "Middle-Communication-Layer"

Question 3(c) [7 marks]

Discuss the architecture of Mobile Computing

Answer:
Mobile computing architecture consists of multiple interconnected components supporting mobile applications.

Diagram:

Table:

Component	Function
Mobile Device	User interface, local processing
Wireless Network	Radio communication
Base Station	Network access point
MSS	Mobility management
Fixed Network	Backbone infrastructure

Key Points:

- **Three-tier**: Mobile device, wireless network, fixed network

- **Mobility Support**: Handoff management

- **Data Management**: Caching and synchronization

Mnemonic: "Mobile-Wireless-Fixed"

Question 3(a OR) [3 marks]

Demonstrate ad-hoc networks

Answer:
Ad-hoc networks are self-organizing wireless networks without fixed infrastructure.

Key Points:

- **Structure**: Peer-to-peer topology

- **Routing**: Dynamic route discovery

- **Applications**: Emergency, military

Mnemonic: "Ad-hoc-Self-Organizing"

Question 3(b OR) [4 marks]

Define Transaction Processing Middleware in mobile computing

Answer:
Transaction processing middleware ensures ACID properties in mobile database transactions.

Table:

Property	Description
Atomicity	All or nothing execution
Consistency	Database integrity maintained
Isolation	Concurrent transaction separation
Durability	Permanent transaction effects

Mnemonic: "ACID-Properties"

Question 3(c OR) [7 marks]

Discuss the applications and services of mobile computing

Answer:
Mobile computing enables diverse applications across multiple domains.

Table:

Domain	Applications	Services
Business	CRM, ERP	Data synchronization
Healthcare	Patient monitoring	Remote diagnosis
Education	E-learning	Content delivery
Entertainment	Gaming, streaming	Media services
Navigation	GPS, maps	Location services

Key Points:

- **Location-based**: GPS navigation, geo-fencing
- **Communication**: Email, messaging, video calls
- **Commerce**: Mobile banking, shopping

Mnemonic: "Business-Health-Education-Entertainment"

Question 4(a) [3 marks]

Describe Indirect TCP in mobile computing

Answer:
Indirect TCP splits TCP connection to handle mobile host mobility efficiently.

Diagram:

```
Fixed Host --> Base Station --> Mobile Host
    TCP1           TCP2
```

Key Points:

- **Split Connection**: Two separate TCP connections
- **Base Station**: Acts as proxy
- **Advantage**: Faster handoff

Mnemonic: "Indirect-Split-Proxy"

Question 4(b) [4 marks]

Explain the steps of the packet delivery in Mobile IP

Answer:
Mobile IP packet delivery involves registration, tunneling, and delivery steps.

Steps:

1. **Registration**: Mobile node registers with home agent

2. **Tunneling**: Home agent creates tunnel to foreign agent

3. **Encapsulation**: Original packet wrapped in new header

4. **Delivery**: Foreign agent delivers to mobile node

Mnemonic: "Register-Tunnel-Encapsulate-Deliver"

Question 4(c) [7 marks]

Write following three processes of mobile IP: (1) Registration (2) Tunneling (3) Encapsulation

Answer:

1. Registration Process:

- Mobile node discovers foreign agent

- Registers care-of address with home agent

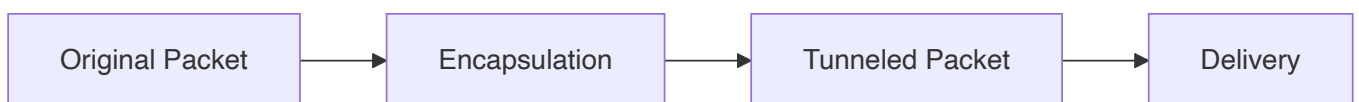- Authentication and binding update

2. Tunneling Process:

- Home agent creates virtual tunnel

- Packets forwarded through tunnel

- Maintains end-to-end connectivity

3. Encapsulation Process:

- Original packet becomes payload

- New IP header added with care-of address

- Packet delivered to foreign network

Diagram:

```
┌──────────────────┐      ┌──────────────────┐      ┌──────────────────┐      ┌──────────────────┐
│  Original Packet │ ───► │   Encapsulation  │ ───► │  Tunneled Packet │ ───► │     Delivery     │
└──────────────────┘      └──────────────────┘      └──────────────────┘      └──────────────────┘
```

Key Points:

- **Registration**: Location update mechanism

- **Tunneling**: Virtual connection establishment

- **Encapsulation**: Packet wrapping technique

Mnemonic: "Register-Tunnel-Encapsulate"

Question 4(a OR) [3 marks]

Describe Snooping TCP in mobile computing

Answer:
Snooping TCP improves performance by caching and monitoring TCP segments at base station.

Key Points:

- **Local Retransmission**: Base station handles losses
- **Buffer Management**: Caches unacknowledged segments
- **Transparency**: End-to-end TCP maintained

Mnemonic: "Snoop-Cache-Retransmit"

Question 4(b OR) [4 marks]

Explain the Handover Management in mobile IP

Answer:
Handover management maintains connectivity when mobile node changes networks.

Table:

Phase	Process
Discovery	Find new foreign agent
Registration	Update care-of address
Data Forwarding	Redirect packets
Cleanup	Release old resources

Mnemonic: "Discover-Register-Forward-Cleanup"

Question 4(c OR) [7 marks]

Write the goals and the requirements for the Mobile IP

Answer:

Goals:

- **Transparency**: Seamless mobility for applications
- **Compatibility**: Work with existing internet protocols
- **Scalability**: Support large number of mobile nodes
- **Security**: Authenticate mobile nodes and protect data

Requirements:

- **Home Agent**: Maintains mobile node location
- **Foreign Agent**: Provides local services
- **Care-of Address**: Temporary address in foreign network
- **Tunneling**: Packet forwarding mechanism

Table:

Aspect	Goals	Requirements
Mobility	Seamless movement	Care-of address
Connectivity	Maintain sessions	Tunneling
Performance	Minimal overhead	Efficient routing
Security	Authentication	Secure protocols

Mnemonic: "Transparent-Compatible-Scalable-Secure"

Question 5(a) [3 marks]

Write the features of 6G in mobile networks

Answer:
6G represents the next generation of mobile networks with advanced capabilities.

Key Points:

- **Speed**: 1 Tbps theoretical speed
- **Latency**: Sub-millisecond latency
- **AI Integration**: Native artificial intelligence

Mnemonic: "Tera-Speed-AI-Integration"

Question 5(b) [4 marks]

Describe Dynamic Host Configuration Protocol (DHCP)

Answer:
DHCP automatically assigns IP addresses and network configuration to devices.

Table:

Process	Description
Discover	Client broadcasts request
Offer	Server offers IP address
Request	Client requests specific IP
Acknowledge	Server confirms assignment

Mnemonic: "Discover-Offer-Request-Acknowledge"

Question 5(c) [7 marks]

Describe the architecture of Wireless Personal Area Network (WLAN)

Answer:
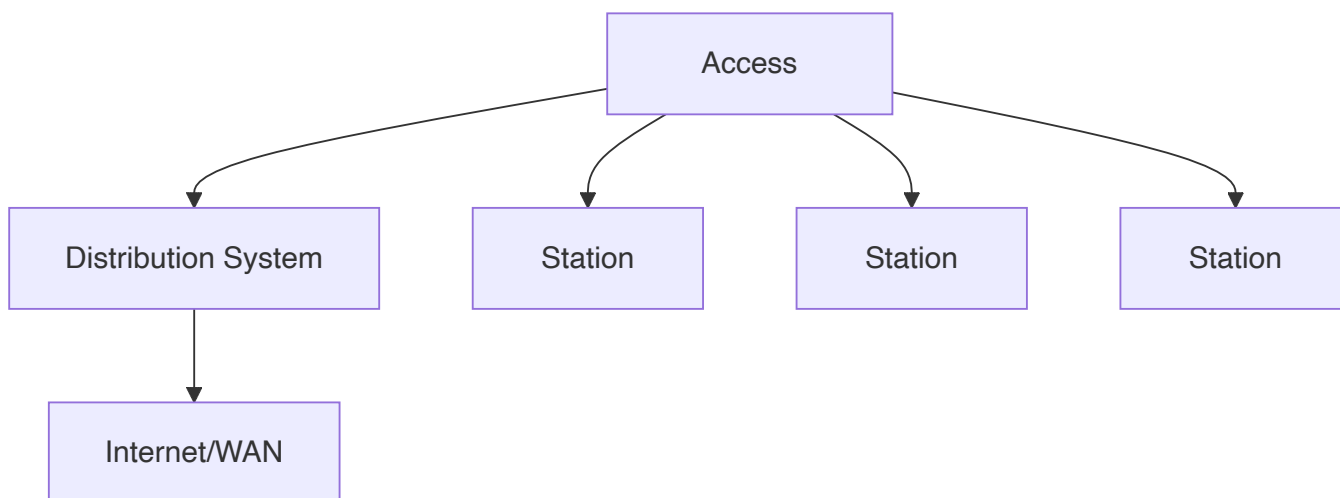WLAN architecture provides wireless connectivity within local area using IEEE 802.11 standards.

Diagram:

Table:

Component	Function
Access Point	Central wireless hub
Station	Wireless client device
Distribution System	Backbone network
BSS	Basic Service Set
ESS	Extended Service Set

Key Points:

- **Infrastructure Mode**: Uses access points
- **Ad-hoc Mode**: Direct device communication
- **Standards**: 802.11a/b/g/n/ac/ax protocols

Mnemonic: "Access-Station-Distribution"

Question 5(a OR) [3 marks]

Write the features of 5G in mobile networks

Answer:
5G provides enhanced mobile broadband with ultra-low latency.

Key Points:

- **Speed**: Up to 10 Gbps download
- **Latency**: 1ms ultra-low latency
- **Density**: 1 million devices per km²

Mnemonic: "10G-1ms-1Million"

Question 5(b OR) [4 marks]

Explain WWW and HTTP

Answer:
World Wide Web uses HTTP protocol for web page communication.

Table:

Aspect	WWW	HTTP
Purpose	Information sharing	Communication protocol
Components	Web pages, browsers	Request/response
Format	HTML documents	Text-based protocol
Port	Various	80, 443

Mnemonic: "Web-Hypertext-Transfer"

Question 5(c OR) [7 marks]

Describe the architecture of Bluetooth

Answer:
Bluetooth architecture provides short-range wireless communication using protocol stack.

Diagram:

| Application Layer | → | OBEX/SDP | → | L2CAP | → | HCI | → | Link Manager | → | Baseband | → | Radio |

Table:

Layer	Function
Radio	Physical transmission
Baseband	Timing and frequency hopping
Link Manager	Connection management
HCI	Host Controller Interface
L2CAP	Logical Link Control
Applications	User services

Key Points:

- **Piconet**: Master-slave network topology
- **Frequency Hopping**: 79 frequency channels
- **Power Classes**: Different transmission ranges

Mnemonic: "Radio-Baseband-Link-Host-Logic"