1. Explain the following four types of communications; unicast, multicast, broadcast, and anycast.

* Unicast: One sender to one receiver
* Multicast: One or multiple senders to multiple receivers
* Broadcast: One sender to all receivers
* Anycast: One sender to multiple receivers where packets are routed to the topologically nearest node in a group of receivers that are all identified by the same destination address

1. Explain the following three communication mode with examples; full-duplex, half-duplex, and  
   simplex.

* Full-duplex: Each node can send and receive data simultaneously. Example: Multi thread Client - Server
* Half-duplex: Each node can send and receive data but not at the same time. Example: Single thread Client – Server
* Simplex: One node can only send and the other node can only receive data. Example: Log server

1. Give three major topologies used in LAN, and explain the characteristics of each topology.

* Ring: all nodes are connected to form a circle
* Star: a center node that connected with every other node. Node other than the center node can only be connected to the center node
* Mesh: every node is connected to every other node

1. How many links are required to form a n-node network for the following four types of  
   topologies: complete, bus, star, and ring?

* Complete/Mesh: n \* (n – 1) / 2
* Bus: n + 1
* Star: n – 1
* Ring: n if n > 2 else 1

1. What is the “switching”? Give a brief description of the concept of this technology?

* Switching: data transferred from source to destination is routed between various intermediate nodes

1. Explain the packet switching technology and circuit switching technology respectively.

* Cricut switching: a switching technique that establishes a path between sender and receiver. A complete end-to-end path must exist before the communication takes place and will remain until the connection is terminated. To begin transferring data, the sender sends a request signal to the receiver then the receiver replies with a acknowledgment signal to ensure the availability of the path. Fixed data can be transferred at a time.
* Packet switching: a switching technique that divide a message into smaller packets and send them individually. Every packet contains header information such add source & destination address and sequence number. Packets will travel across the network, taking the shortest path possible. All the packets are reassembled in correct order in the destination node. If any packet is corrupted or missing, a message will be sent to the source node to resent the message, else a acknowledgment message will be sent to complete the transfer.

1. Give some examples of following types of network applications and systems:  
   a) connection oriented and packet switching; and  
   b) connectionless and circuit switching.

* Connection-oriented and packet switching: TCP, SSH
* Connectionless and circuit switching: telephone network

1. What criteria are used to classify network systems into categories like LAN, WAN, and MAN?

* Size, owner ship, distance covered, physical structure

1. The OSI reference model clearly defined the concepts of service, interface and protocol.  
   Explain the meanings of these terms and draw a diagram to show the relationship between these  
   words.

* Service: a set of primitives/functions that a layer provides to the layer above it
* Protocol: a set of precise rules governing the format and meaning of the packets that are exchanged between the same layers in different systems
* Interface: the mechanism of communication between adjacent layers

1. What is the protocol stack? How the technique called encapsulation is used in the protocol  
   stacks?

* Protocol stack: a group of protocols that allow software or hardware to perform a function
* Encapsulation: each layer on the sending host wraps the payload from the layer above it by adds data to the packet header when the packet is going down the stack

1. Give the name and role of each layer in the OSI model.

* Application layer: Used by end-user software, provide protocols that allow software to send and receive information and present meaningful data to users.
* Presentation layer: Prepare data for the application layer and send it to the session layer. It defines how sender and receiver should communicate i.e encode, encrypt and decrypt protocols.
* Session layer: Create communication channels between devices, responsible for open sessions, ensure that the sessions opened remain functional and terminate sessions when transmission ended.
* Transport layer: Take the data from the session layer and breaks it into small segments for transmit. In the receiver end, it is responsible for reassemble the segments into the data that the session layer can process. This layer carried out flow control including transport rate and error checking.
* Network layer: Divide the segments from the transport layer into packets and perform routing across a physical network, discover the best path to destination using IP address.
* Data link layer: Establishes and terminates connections between 2 physically connected devices, breaks packets into frames and sends them from source to destination. Composed of
  + Logical Link Control: identifies network protocols, error-checking and synchronization
  + Media Access Control: Uses MAC address to connect devices and defines permissions to transmit and receive data
* Physical layer: Responsible for defines the physical connection between devices and transmission of raw bit data.

1. Five layer model is frequently used as a practical model for networking systems. Describe the  
   name, data unit, address and role for each of this five layer model.

* Application (Message): defines standard Internet services and network applications that anyone can use. These services work with the transport layer to send and receive data.
* Transport (Segment): ensure that packets arrive in sequence and without error, by swapping acknowledgments of data reception, and retransmitting lost packets. Transport layer protocols at this level are Transmission Control Protocol (TCP) and User Datagram Protocol (UDP).
* Internet (Datagram): Accepts and delivers packets for the network. This layer includes the powerful Internet Protocol (IP), the Address Resolution Protocol (ARP), and the Internet Control Message Protocol (ICMP).
* Data link (Frame): The data-link layer identifies the network protocol type of the packet, provides error control and framing.
* Physical network (Bit): The physical network layer specifies the characteristics of the hardware to be used for the network.

1. Explain the service primitives in the OSI model. Draw a diagram that shows the relationship  
   between the primitives.

* Service primitives: Operations that users can invoke to access the service. Generally service primitives are divided into four classes:
  + **Request**− A service node wants some service from its adjacent layer to pass the parameters to mention the requested service.
  + **Indication**− Another Service node or receiver node gets an indication that a procedure has been invoked by the adjacent service node.
  + **Response**− A receiver service node acknowledges or completes some procedure.
  + **Confirm**− service nodes acknowledge the permission to get connected or not.