SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

RAMAPURAM CAMPUS

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CONTINUOUS LEARNING ASSESSMENT – II

Sub Code/Name : 18CSC302J – Computer Networks **Set : A**
Class : III Yr. / V Sem. / B.Tech (IT)/ CSE/CSE Specializations **Date : 18.10.2022(AN)**
Max Marks : 50 **Duration : 90 Mins.**

ANSWER KEY

PART-A (10 x 1 = 10 marks)

(ANSWER ALL THE QUESTIONS)

Q. No.	Questions	Marks	CO	BL	PI
1.	To use _____, a program must create a socket, bind addresses to it, accept incoming connections, and then communicate using the read or write primitives. **a) TCP** b) FTP c) UDP d) IP	1	2	1	2.5.1
2.	Transport layer aggregates data from different applications into a single stream before passing it to _____ a) Data Link layer **b) Network layer** c) Application layer d) physical layer	1	2	1	2.6.2
3.	User datagram protocol is called connectionless because _____ **a) all UDP packets are treated independently by transport layer** b) it sends data as a stream of related packets c) it is received in the same order as sent order d) it sends data very quickly	1	2	1	2.5.3
4.	An endpoint of an inter-process communication flow across a computer network is called_____ a) pipe **b) socket** c)Port d) machine	1	2	1	2.5.1
5.	In Transmission Control Protocol (TCP) each connection have a) 1 Stream **b) 2 Streams** c) 3 Streams d) Infinite Streams	1	2	1	2.5.2
6.	The characters are sent to the TELNET client, which transforms the characters to a universal character set called ----------characters and delivers them to the local TCP/IP stack. **a) Network Virtual Terminal** b) Data Terminal c) Command line interface d) Remote flow control	1	3	1	4.4.3
7.	The well-known port_____is used for the control connection and the well-known port _____ for the data connection. **a) 21,20** b) 20,21	1	3	1	4.4.2

	c) 20,20 **d) 21,20**				
8.	Which is a standard locator for specifying any kind of information on the Internet? **a) Uniform Resource Locator** b) Uniform Resource Location c) User Resource Locator d) User Resource Location	1	3	1	4.6.3
9.	HTTP is _____ protocol. **a) Application layer** b) Transport layer c) Network layer d) Data Link layer	1	3	1	4.6.2
10.	A proxy server can act as _____ a) Client b) Server **c) Both client and server** d) Header	1	3	1	4.6.3

PART- B (4 x 4 = 16)

(ANSWER ANY FOUR OUT OF SIX QUESTIONS)

Q. No.	Question	Marks	CO	BL	PI
11.	**Write short notes on TCP package with a neat sketch.**	4	2	1	2.5.1

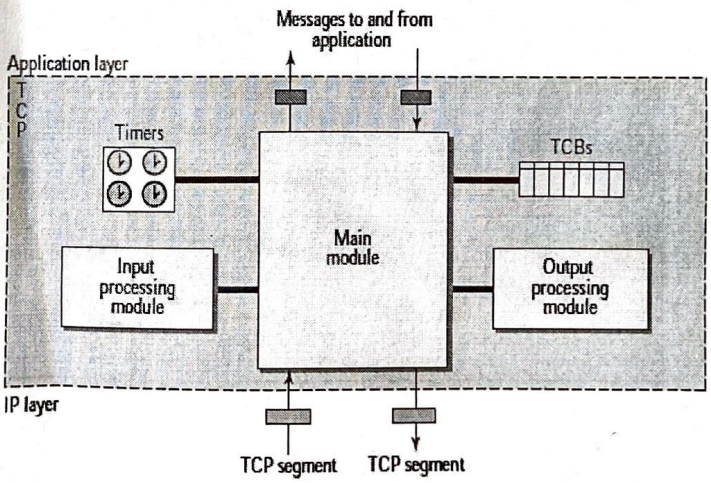
TCP is a complex protocol. It is a stream-service, connection-oriented protocol with an involved state transition diagram. It uses flow and error control. It is so complex that actual code involves tens of thousands of lines. The package involves tables called transmission control blocks, a set of timers, and three software modules: a main module, an input processing module, and an output processing module. Figure shows these five components and their interactions.

Transmission Control Blocks (TCBs)

TCP is a connection-oriented transport protocol. A connection may be open for a long period of time. To control the connection, TCP uses a structure to hold information about each connection.

Main Module

The main module is invoked by an arriving TCP segment, a time-out event, or a message from an application program. This is a very complicated module because the action to be taken depends on the current state of the TCP



Input Processing Module

The input processing module handles all the details needed to process data or an acknowledgment received when TCP is in the ESTABLISHED state. This module sends an ACK if needed, takes care of the window size announcement, does error checking, and so on

Output Processing Module

The output processing module handles all the details needed to send out data received from application program when TCP is in the ESTABLISHED state. This module handles retransmission time-outs, persistent time-outs, and so on.

12.	**Distinguish between TCP and UDP.**	4	2	2	2.6.5

	TCP	UDP
Full form	It stands for **Transmission Control Protocol.**	It stands for **User Datagram Protocol.**
Type of connection	It is a connection-oriented protocol, which means that the connection needs to be established before the data is transmitted over the network.	It is a connectionless protocol, which means that it sends the data without checking whether the system is ready to receive or not.
Reliable	TCP is a reliable protocol as it provides assurance for the delivery of data packets.	UDP is an unreliable protocol as it does not take the guarantee for the delivery of packets.
Speed	TCP is slower than UDP as it performs error checking, flow control, and provides assurance for the delivery of	UDP is faster than TCP as it does not guarantee the delivery of data packets.
Header size	The size of TCP is 20 bytes.	The size of the UDP is 8 bytes.
Acknowledgment	TCP uses the three-way-handshake concept. In this concept, if the sender receives the ACK, then the sender will send the data. TCP also has the ability to resend the lost data.	UDP does not wait for any acknowledgment; it just sends the data.
Flow control mechanism	It follows the flow control mechanism in which too many packets cannot be sent to the receiver at the same time.	This protocol follows no such mechanism.
Error checking	TCP performs error checking by using a checksum. When the data is corrected, then the data is retransmitted to the receiver.	It does not perform any error checking, and also does not resend the lost data packets.
Applications	This protocol is mainly used where a secure and reliable communication process is required, like military services, web browsing, and e-mail.	This protocol is used where fast communication is required and does not care about the reliability like VoIP, game streaming, video and music streaming, etc.

13.	**Explain any two services of SCTP.**	4	2	2	2.6.2

Process-to-Process Communication

SCTP uses all well-known ports in the TCP space. Table 16.1 lists some extra port numbers used by SCTP.

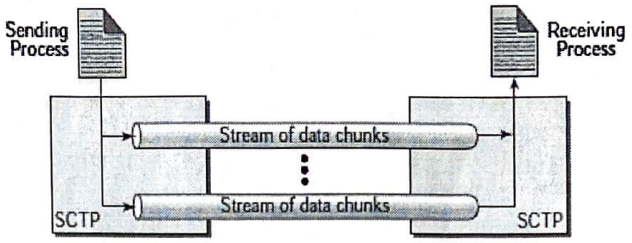
Table 16.1 *Some SCTP applications*

Protocol	*Port Number*	*Description*
IUA	9990	ISDN over IP
M2UA	2904	SS7 telephony signaling
M3UA	2905	SS7 telephony signaling
H.248	2945	Media gateway control
H.323	1718, 1719, 1720, 11720	IP telephony
SIP	5060	IP telephony

Multiple Streams

Each connection between a TCP client and a TCP server involves one single stream. The problem with this approach is that a loss at any point in the stream blocks the delivery of the rest of the data. This can be acceptable when we are transferring text; it is not when we are sending real-time data such as audio or video. SCTP allows multistream service in each connection, which is called association in SCTP terminology. If one of the streams is blocked, the other streams can still deliver their data

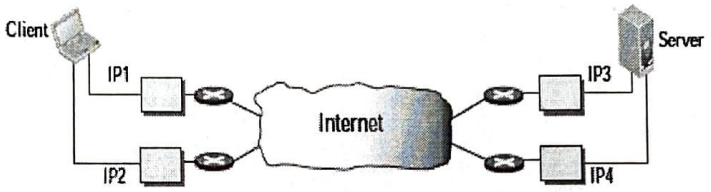
Figure 16.2 *Multiple-stream concept*



Multihoming

An SCTP association, on the other hand, supports multihoming service. The sending and receiving host can define multiple IP addresses in each end for an association. In this fault-tolerant approach, when one path fails, another interface can be used for data delivery without interruption. This fault-tolerant feature is very helpful when we are sending and receiving a real-time payload such as Internet telephony. Figure 16.3 shows the idea of multihoming.

Figure 16.3 *Multihoming concept*



Full-Duplex Communication

Like TCP, SCTP offers full-duplex service, where data can flow in both directions at the same time. Each SCTP then has a sending and receiving buffer and packets are sent in both directions.

Connection-Oriented Service

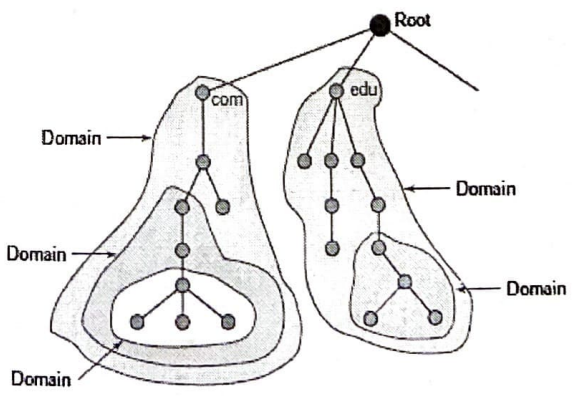
Like TCP, SCTP is a connection-oriented protocol. However, in SCTP, a connection is called an association. When a process at site A wants to send and receive data from another process at site B, the following occurs:

1. The two SCTPs establish an association between each other.
2. Data are exchanged in both directions.
3. The association is terminated.

14.	**Define the concept of domains and domain name space**	4	3	1	4.4.1

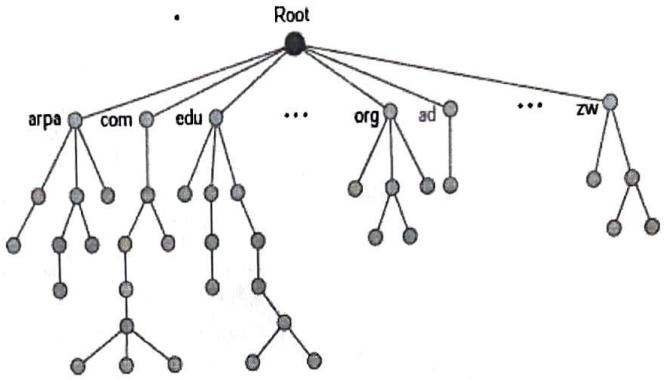
Domain

A domain is a subtree of the domain name space. The name of the domain is the name of the node at the top of the subtree. Figure shows some domains. Note that a domain may itself be divided into domains (or subdomains as they are sometimes called).



Domain Name Space

To have a hierarchical name space, a domain name space was designed. In this design the names are defined in an inverted-tree structure with the root at the top. The tree can have only 128 levels: level 0 (root) to level 127



Label

Each node in the tree has a label, which is a string with a maximum of 63 characters. The root label is a null string (empty string). DNS requires that children of a node (nodes that branch from the same node) have different labels, which guarantees the uniqueness of the domain names.

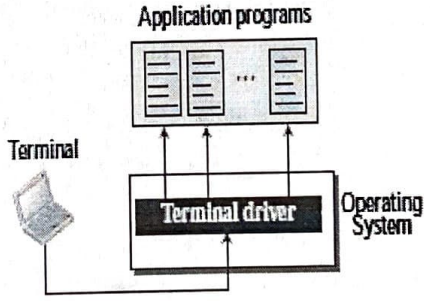
Domain Name

Each node in the tree has a domain name. A full domain name is a sequence of labels separated by dots (.). The domain names are always read from the node up to the root. The last label is the label of the root (null). This means that a full domain name always ends in a null label, which means the last character is a dot because the null string is nothing

15.	**Illustrate the process of local login and remote login in TELNET**	4	3	3	4.4.3

Local Login

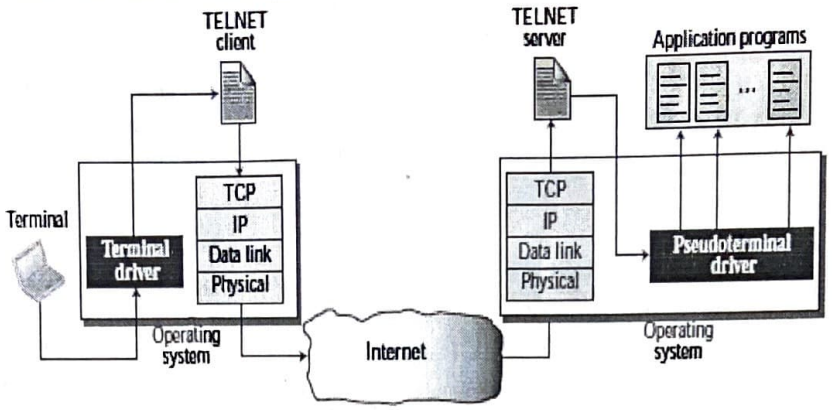
When a user logs into a local time-sharing system, it is called local login. As a user types at a terminal or at a workstation running a terminal emulator, the keystrokes are accepted by the terminal driver.



The terminal driver passes the characters to the operating system. The operating system, in turn, interprets the combination of characters and invokes the desired application program or utility

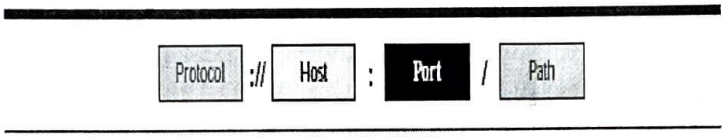
Remote Login

When a user wants to access an application program or utility located on a remote machine, he or she performs remote login. Here the TELNET client and server programs come into use. The user sends the keystrokes to the terminal driver where the local operating system accepts the characters but does not interpret them. The characters are sent to the TELNET client, which transforms the characters to a universal character set called Network Virtual Terminal (NVT) characters and delivers them to the local TCP/IP stack

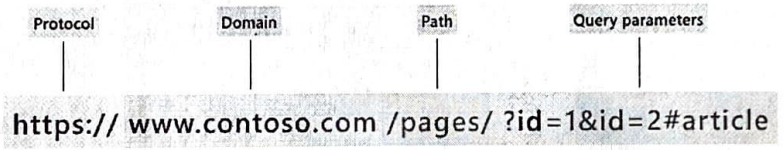


16.	**Interpret components of an URL with an example**	4	3	3	12.5.1

A client that wants to access a Web page needs the file name and the address. To facilitate the access of documents distributed throughout the world, HTTP uses locators. The uniform resource locator (URL) is a standard locator for specifying any kind of information on the Internet. The URL defines four things: protocol, host computer, port, and path



The **protocol** is the client-server application program used to retrieve the document. Many different protocols can retrieve a document; among them are Gopher, FTP, HTTP, News, and TELNET. The most common today is HTTP.



The **host** is the domain name of the computer on which the information is located. Web pages are usually stored in computers, and computers are given domain name aliases that usually begin with the character "www". This is not mandatory, however, as the host can have any domain name.

The **URL** can optionally contain the port number of the server. If the **port** is included, it is inserted between the host and the path, and it is separated from the host by a colon.

Path is the pathname of the file where the information is located. Note that the path can itself contain slashes that, in the UNIX operating system, separate the directories from the subdirectories and files. In other words, the path defines the complete file name where the document is stored in the directory system.

PART- C (2 x 12 = 24)

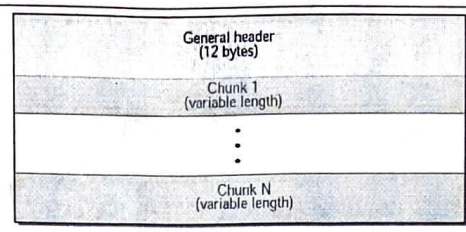
ANSWER EITHER OF OR IN EACH UNIT

Q. No.	Question	Marks	CO	BL	PI
17 (a).	Describe in detail packet format of SCTP and its working with neat diagram. **(OR)**	12	2	2	2.7.2

An SCTP packet has a mandatory general header and a set of blocks called chunks.

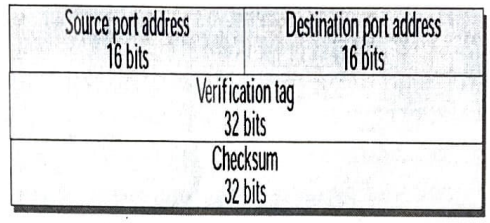
There are two types of chunks:

control chunks and data chunks. A control chunk controls and maintains the association; a data chunk carries user data.In a packet, the control chunks come before the data chunks. Figure shows the general format of an SCTP packet.



General Header

The general header (packet header) defines the end points of each association to which the packet belongs, guarantees that the packet belongs to a particular association, and preserves the integrity of the contents of the packet including the header itself. The format of the general header is shown in Figure.



There are four fields in the general header:

Source port address. This is a 16-bit field that defines the port number of the process sending the packet.

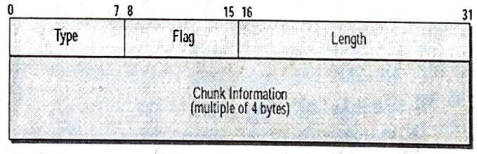
Destination port address. This is a 16-bit field that defines the port number of the process receiving the packet.

Verification tag. This is a number that matches a packet to an association. This prevents a packet from a previous association from being mistaken as a packet in this association. It serves as an identifier for the association; it is repeated in every packet during the association. There is a separate verification used for each direction in the association.

Checksum. This 32-bit field contains a CRC-32 checksum

Chunks

The first three fields are common to all chunks; the information field depends on the type of chunk. The important point to remember is that SCTP requires the information section to be a multiple of 4 bytes; if not, padding bytes (eight 0s) are added at the end of the section.



The description of the common fields are as follows:

Type. This 8-bit field can define up to 256 types of chunks. Only a few have been defined so far; the rest are reserved for future use. See Table 16.2 for a list of chunks and their descriptions.

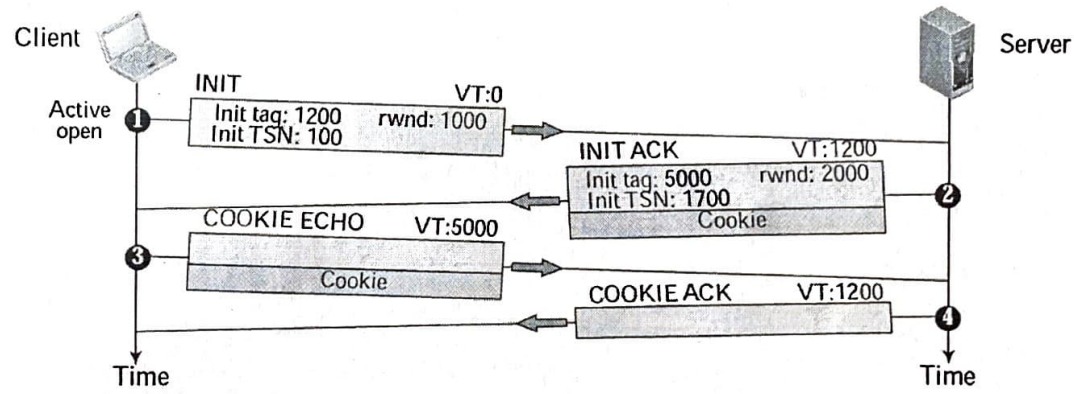
Flag. This 8-bit field defines special flags that a particular chunk may need. Each bit has a different meaning depending on the type of chunk.

Length. Since the size of the information section is dependent on the type of chunk, we need to define the chunk boundaries. This 16-bit field defines the total size of the chunk, in bytes, including the type, flag, and length fields. If a chunk carries no information, the value of the length field is 4 (4 bytes). If the value is not a multiple of 4, the receiver knows there is padding. For example, when the receiver sees a length of 17, it knows the next number that is a multiple of 4 is 20, so there are 3 bytes of padding that must be discarded. But if the receiver sees a length of 16, it knows that there is no padding.

Type	Chunk	Description
0	DATA	User data
1	INIT	Sets up an association
2	INIT ACK	Acknowledges INIT chunk
3	SACK	Selective acknowledgment
4	HEARTBEAT	Probes the peer for liveliness
5	HEARTBEAT ACK	Acknowledges HEARTBEAT chunk
6	ABORT	Abort an association
7	SHUTDOWN	Terminates an association
8	SHUTDOWN ACK	Acknowledges SHUTDOWN chunk
9	ERROR	Reports errors without shutting down
10	COOKIE ECHO	Third packet in association establishment
11	COOKIE ACK	Acknowledges COOKIE ECHO chunk
14	SHUTDOWN COMPLETE	Third packet in association termination
192	FORWARD TSN	For adjusting cumulating TSN

Association Establishment

Association establishment in SCTP requires a four-way handshake. In this procedure, a process, normally a client, wants to establish an association with another process, normally a server, using SCTP as the transport layer protocol. Similar to TCP, the SCTP server needs to be prepared to receive any association (passive open). Association establishment, however, is initiated by the client (active open). SCTP association establishment is shown in Figure



The steps, in a normal situation, are as follows:

1. The client sends the first packet, which contains an INIT chunk. The verification tag (VT) of this packet (defined in the general header) is 0 because no verification tag has yet been defined for this direction (client to server).The INIT tag includes an initiation tag to be used for packets from the other direction (server to client). The chunk also defines the initial TSN for this direction and advertises a value for rwnd. The value of rwnd is normally advertised in a SACK chunk; it is done here because SCTP allows the inclusion of a DATA chunk in the third and fourth packets; the server must be aware of the available client buffer size. Note that no other chunks can be sent with the first packet.

2. The server sends the second packet, which contains an INIT ACK chunk. The verification tag is the value of the initial tag field in the INIT chunk. This chunk initiates the tag to be used in the other direction, defines the initial TSN, for data flow from server to client, and sets the servers' rwnd. The value of rwnd is defined to allow the client to send a DATA chunk with the third packet. The INIT ACK also sends a cookie that defines the state of the server at this moment.

3. The client sends the third packet, which includes a COOKIE ECHO chunk. This is a very simple chunk that echoes, without change, the cookie sent by the server. SCTP allows the inclusion of data chunks in this packet.

4. The server sends the fourth packet, which includes the COOKIE ACK chunk that acknowledges the receipt of the COOKIE ECHO chunk. SCTP allows the inclusion of data chunks with this packet.

17 (b).	Explain the working of client-server communication paradigm using TCP connection	12	2	2	2.7.1

Client Server Paradigm

The purpose of a network, or an internetwork, is to provide services to users: A user at a local site wants to receive a service from a computer at a remote site. One way to achieve this purpose is to run two programs. A local computer runs a program to request a service from a remote computer; the remote computer runs a program to give service to the requesting program. This means that two computers, connected by an internet, must each run a program, one to provide a service and one to request a service. At first glance, it looks simple to enable communication between two application programs, one running at the local site, the other running at the remote site. But many questions arise when we want to implement the approach

Server

A server is a program running on the remote machine providing service to the clients. When it starts, it opens the door for incoming requests from clients, but it never initiates a service until it is requested to do so. A server program is an infinite program. When it starts, it runs infinitely unless a problem arises. It waits for incoming requests from clients. When a request arrives, it responds to the request, either iteratively or concurrently as we will see shortly.

Client

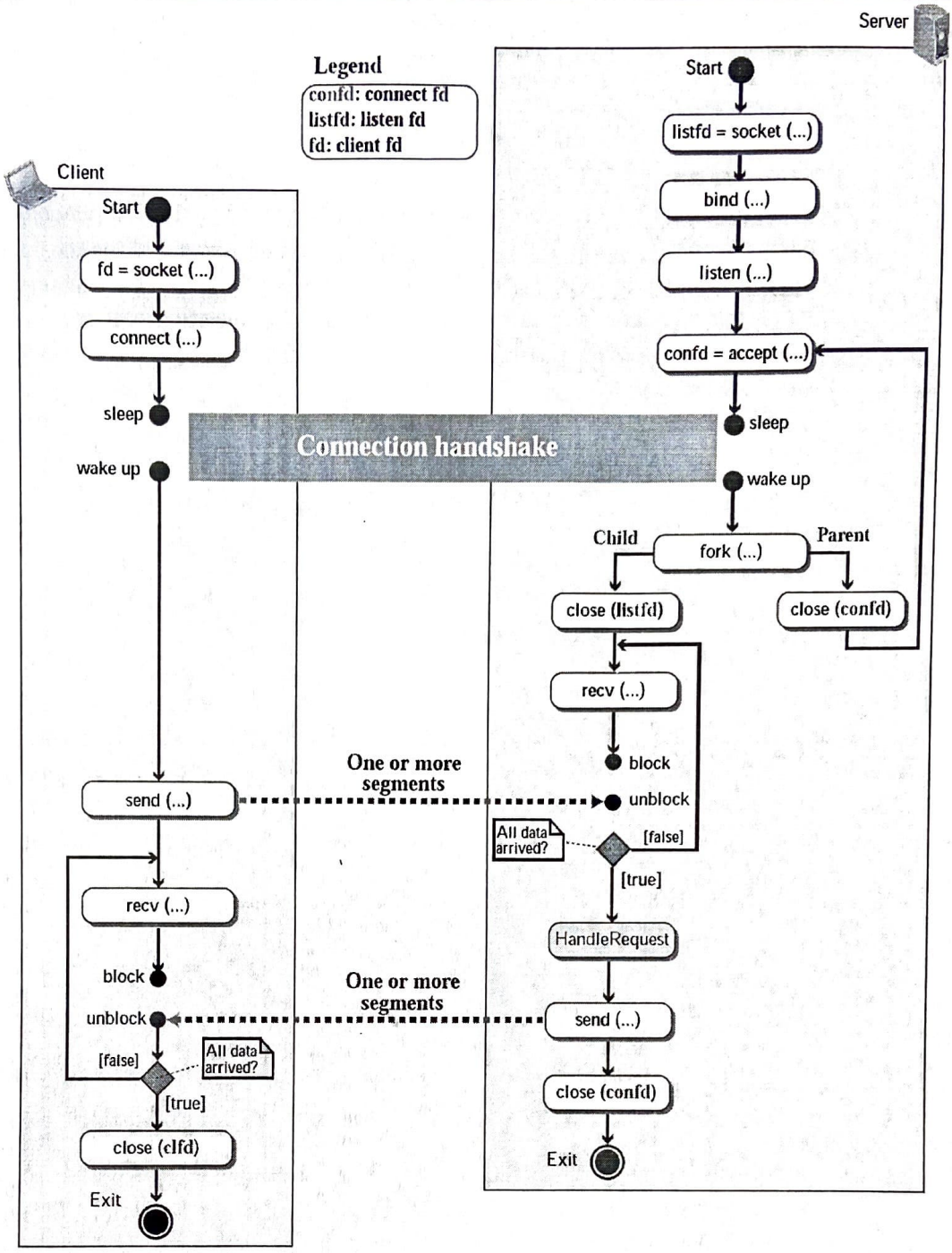
A client is a program running on the local machine requesting service from a server. A client program is finite, which means it is started by the user (or another application program) and terminates when the service is complete. Normally, a client opens the communication channel using the IP address of the remote host and the well-known port address of the specific server program running on that machine. After a channel of communication is opened, the client sends its request and receives a response. Although the request-response part may be repeated several times, the whole process is finite and eventually comes to an end.

Communication Using TCP

Server Process

The server process starts first. It calls the socket function to create a socket, which we call the listen socket. This socket is only used during connection establishment. The server process then calls the bind function to bind this connection to the socket address of the server computer. The server program then calls the accept function. This function is a blocking function; when it is called, it is blocked until the TCP receives a connection request (SYN segment) from a client. The accept function then is unblocked and creates a new socket called the connect socket that includes the socket address of the client that sent the SYN segment. After the accept function is unblocked, the server knows that a client needs its service. To provide concurrency, the server process (parent process) calls the fork function. This function creates a new process (child process), which is exactly the same as the parent process. After calling the fork function, the two processes are running concurrently, but each can do different things.

Each process now has two sockets: listen and connect sockets. The parent process entrusts the duty of serving the client to the hand of the child process and calls the accept function again to wait for another client to request connection. The child process is now ready to serve the client. It first closes the listen socket and calls the recv function to receive data from the client. The recv function, like the recv from function, is a blocking function.



Client Process

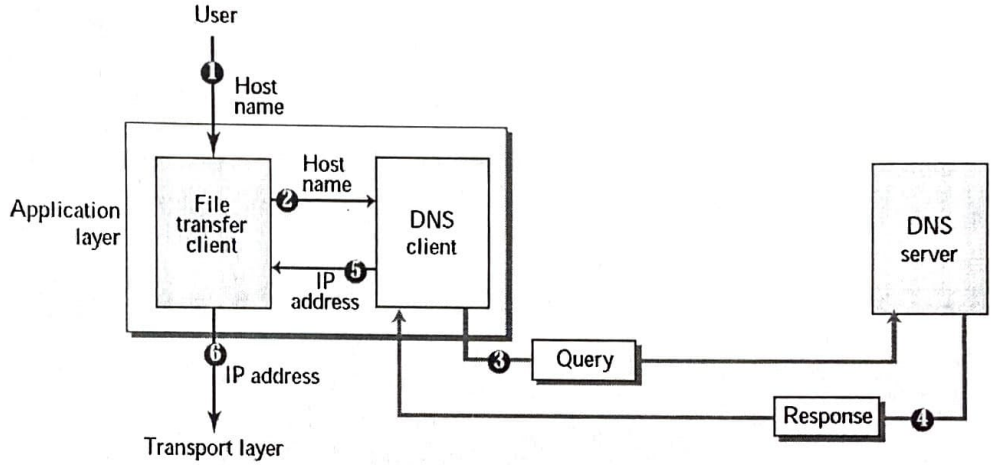
The client process is simpler. The client calls the socket function to create a socket. It then calls the connect function to request a connection to the server. The connect function is a blocking function; it is blocked until the connection is established between two TCPs. When the connect function returns, the client calls the send function to send data to the server. We use only one call to the send function, assuming that data can be sent with one call. Based on the type of the application, we may need to call this function repeatedly (in a loop). The client then calls the recv function, which is blocked until a segment arrives and data are delivered to the process by TCP. Note that, although the data are sent by the server in one single call to the send function, the TCP at the server site may have used several segments to send data. This means we may need to call the recv function repeatedly to receive all data. The loop can be controlled by the return value of the recv function.

18 (a).	Discuss the use of DNS on the Internet and describe the categories of domains **(OR)**	12	3	3	4.4.1

DNS

When the Internet was small, mapping was done using a host file. The host file had only two columns: name and address. Every host could store the host file on its disk and update it periodically from a master host file. When a program or a user wanted to map a name to an address, the host consulted the host file and found the mapping. Today, however, it is impossible to have one single host file to relate every address with a name and vice versa. The host file would be too large to store in every host. In addition, it would be impossible to update all the host files every time there is a change. One solution would be to store the entire host file in a single computer and allow access to this centralized information to every computer that needs mapping. But we know that this would create a huge amount of traffic on the Internet.

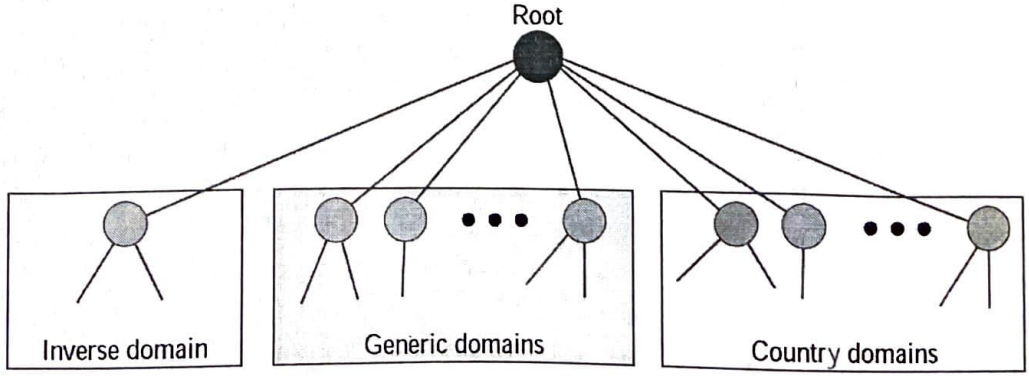
Another solution, the one used today, is to divide this huge amount of information into smaller parts and store each part on a different computer. In this method, the host that needs mapping can contact the closest computer holding the needed information. This method is used by the Domain Name System (DNS).



The following six steps map the host name to an IP address.

1. The user passes the host name to the file transfer client.
2. The file transfer client passes the host name to the DNS client.
3. We know from Chapter 18 that each computer, after being booted, knows the address of one DNS server. The DNS client sends a message to a DNS server with a query that gives the file transfer server name using the known IP address of the DNS server.
4. The DNS server responds with the IP address of the desired file transfer server.
5. The DNS client passes the IP address to the file transfer server.
6. The file transfer client now uses the received IP address to access the file transfer server

DNS is a protocol that can be used in different platforms. In the Internet, the domain name space (tree) is divided into three different sections: generic domains, country domains, and the inverse domain



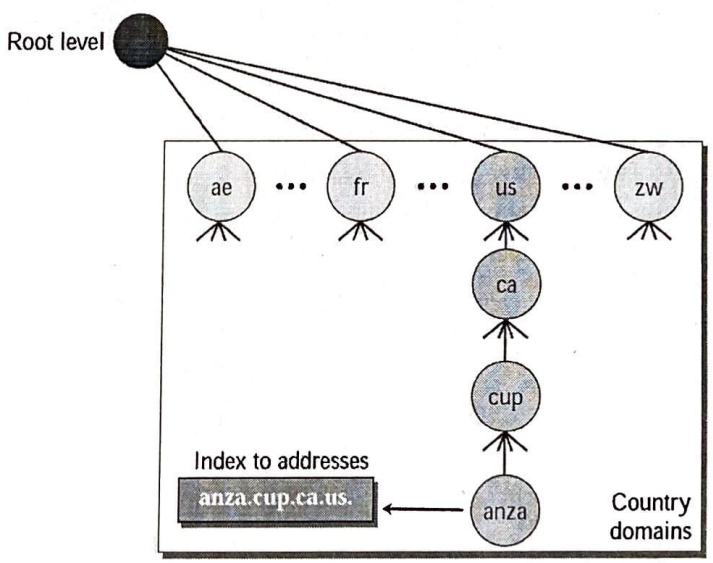
Generic Domains

The generic domains define registered hosts according to their generic behavior. Each node in the tree defines a domain, which is an index to the domain name space database

Label	*Description*
aero	Airlines and aerospace companies
biz	Businesses or firms (similar to "com")
com	Commercial organizations
coop	Cooperative business organizations
edu	Educational institutions
gov	Government institutions
info	Information service providers
int	International organizations
mil	Military groups
museum	Museums and other non-profit organizations
name	Personal names (individuals)
net	Network support centers
org	Nonprofit organizations
pro	Professional individual organizations

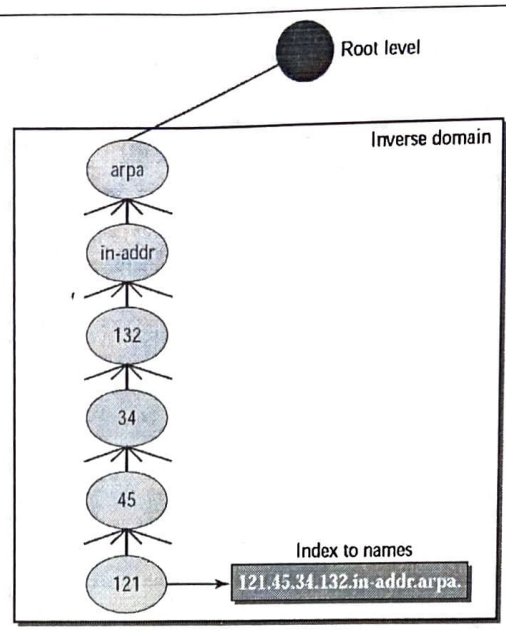
Country Domains

The country domains section uses two-character country abbreviations (e.g., us for United States). Second labels can be organizational, or they can be more specific, national designations. The United States, for example, uses state abbreviations as a subdivision of us (e.g., ca.us.).



Inverse Domain

The inverse domain is used to map an address to a name. This may happen, for example, when a server has received a request from a client to do a task. Although the server has a file that contains a list of authorized clients, only the IP address of the client (extracted from the received IP packet) is listed. The server asks its resolver to send a query to the DNS server to map an address to a name to determine if the client is on the authorized list.



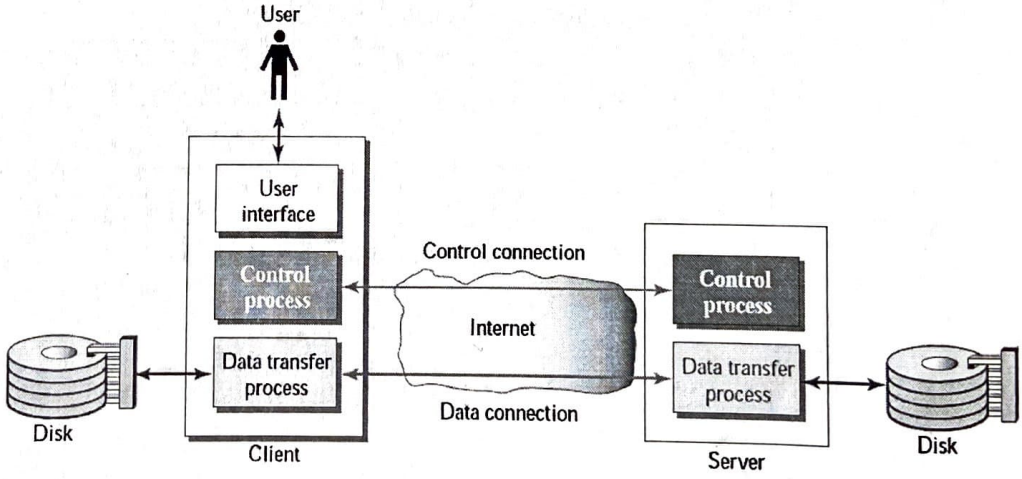
This type of query is called an inverse or pointer (PTR) query. To handle a pointer query, the inverse domain is added to the domain name space with the first-level node called arpa (for historical reasons). The second level is also one single node named in-addr (for inverse address). The rest of the domain defines IP addresses.

18 (b).	Brief about various connections and communications available in FTP. Explain the process of file transfer with neat sketch.	12	3	3	4.6.2

File Transfer Protocol (FTP) is the standard mechanism provided by TCP/IP for copying a file from one host to another.

Connections

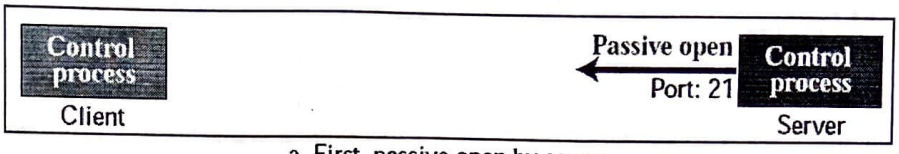
The two FTP connections, control and data, use different strategies and different port numbers.



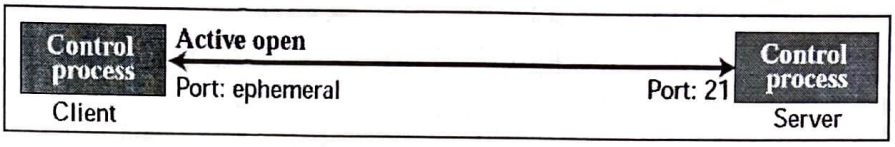
Control Connection

The control connection is created in the same way as other application programs described so far. There are two steps:

1. The server issues a passive open on the well-known port 21 and waits for a client.
2. The client uses an ephemeral port and issues an active open. The connection remains open during the entire process. The service type, used by the IP protocol, is minimize delay because this is an interactive connection between a user (human) and a server. The user types commands and expects to receive responses without significant delay. Figure shows the initial connection between the server and the client.



a. First, passive open by server



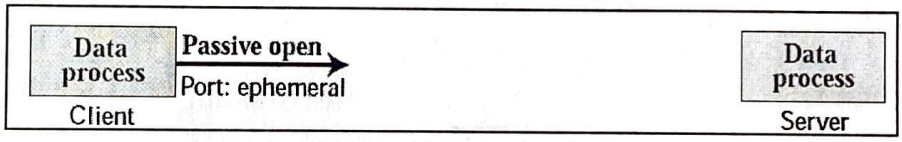
b. Later, active open by client

Data Connection

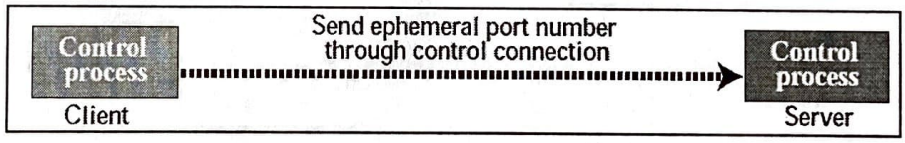
The data connection uses the well-known port 20 at the server site. However, the creation of a data connection is different from what we have seen so far. The following shows how FTP creates a data connection:

1. The client, not the server, issues a passive open using an ephemeral port. This must be done by the client because it is the client that issues the commands for transferring files.
2. The client sends this port number to the server using the PORT command
3. The server receives the port number and issues an active open using the well-known port 20 and the received ephemeral port number.

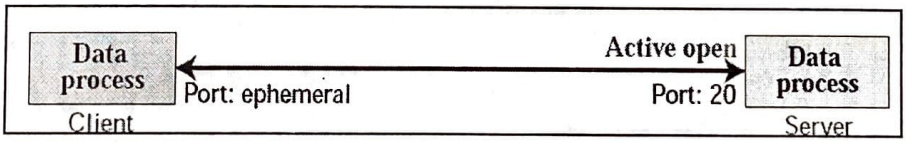
The steps for creating the initial data connection are shown in Figure.



a. First, passive open by client



b. Second, sending of ephemeral port



c. Third, active open by server

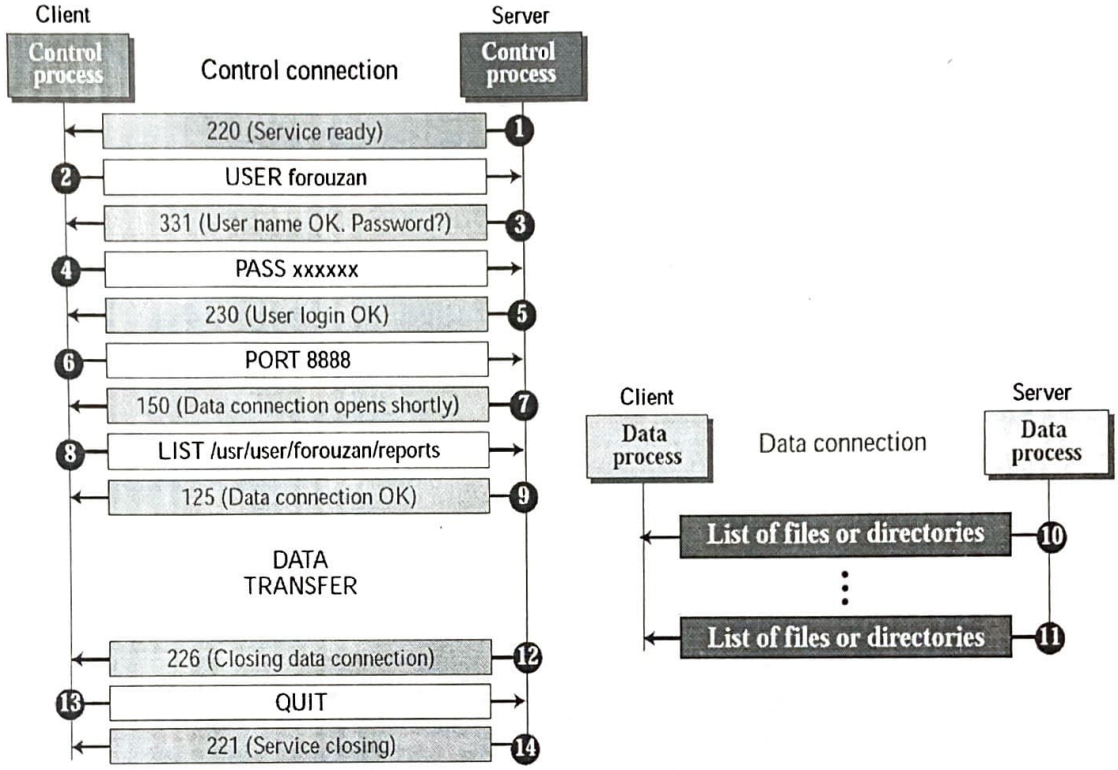
File Transfer

File transfer occurs over the data connection under the control of the commands sent over the control connection. However, we should remember that file transfer in FTP means one of three things

- A file is to be copied from the server to the client (download). This is called retrieving a file. It is done under the supervision of the RETR command.
- A file is to be copied from the client to the server (upload). This is called storing a file. It is done under the supervision of the STOR command.
- A list of directory or file names is to be sent from the server to the client. This is done under the supervision of the LIST command. Note that FTP treats a list of directory or file names as a file. It is sent over the data connection.

1. After the control connection to port 21 is created, the FTP server sends the 220 (service ready) response on the control connection.
2. The client sends the USER command.

3. The server responds with 331 (user name is OK, password is required).
4. The client sends the PASS command.
5. The server responds with 230 (user login is OK).
6. The client issues a passive open on an ephemeral port for the data connection and sends the PORT command (over the control connection) to give this port number to the server.
7. The server does not open the connection at this time, but it prepares itself for issuing an active open on the data connection between port 20 (server side) and the ephemeral port received from the client. It sends response 150 (data connection will open shortly).
8. The client sends the LIST message.



9. Now the server responds with 125 and opens the data connection.
10. The server then sends the list of the files or directories (as a file) on the data connection. When the whole list (file) is sent, the server responds with 226 (closing data connection) over the control connection.
11. The client now has two choices. It can use the QUIT command to request the closing of the control connection or it can send another command to start another activity (and eventually open another data connection). In our example, the client sends a QUIT command.
12. After receiving the QUIT command, the server responds with 221 (service closing) and then closes the control connection.

Outcome Alignment Matrix:

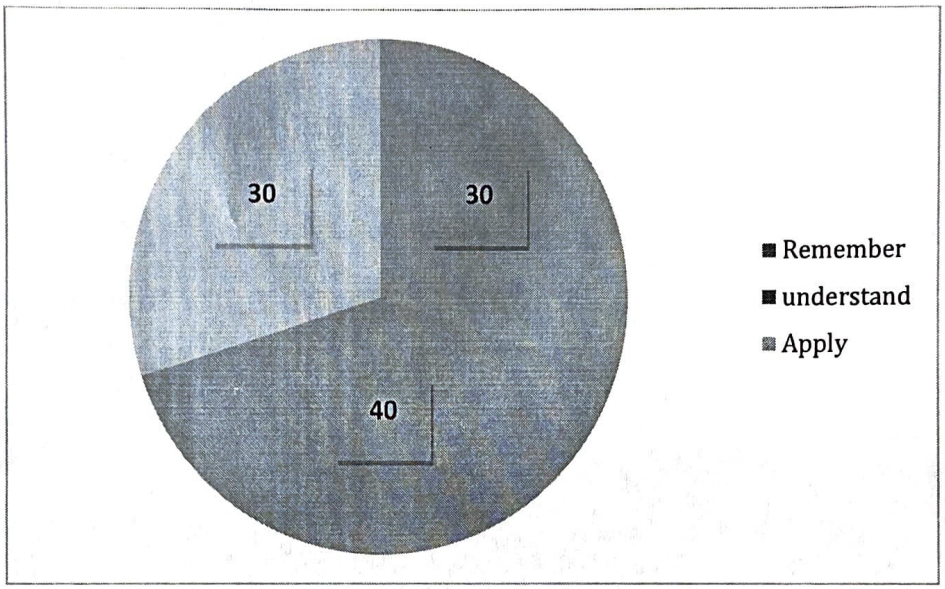
QUESTION NUMBER	CO distribution					
	CO1	CO2	CO3	CO4	CO5	CO6
1		1				
2		1				
3		1				
4		1				
5		1				
6			1			
7			1			
8			1			
9			1			
10			1			
11		4				
12		4				
13		4				
14			4			
15			4			
16			4			
17 a		12				
17 b		12				
18 a			12			
18 b			12			
Total		**41**	**41**			
%		**50%**	**50%**			

Quality Matrix:

Question No.	BL Distribution		
	L1	L2	L3
1	1		
2	1		
3	1		
4	1		
5	1		
6	1		
7	1		
8	1		
9	1		
10	1		
11	4		
12		4	
13		4	
14	4		
15			4

16			4
17 a		12	
17 b		12	
18 a			12
18 b			12
Total	**18**	**32**	**32**
%	**22%**	**39%**	**39%**

Bloom's level Distribution:



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