UNIT IV

COMPUTER NETWORKS

EXAM ANALYSIS

Exam year	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**
1 Marks Ques.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	5	1	2	2	0	2	1	4	2	7
2 Marks Ques.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	5	2	4	5	4	3	3	2	3	2	9
5 Marks Ques.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Marks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**12**	**9**	**9**	**12**	**10**	**6**	**8**	**5**	**10**	**6**	**25**
Fundamental and SWP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	0	0	2	1	0	1	0	2
LAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	4	0	0	0	0	0	1	2
TCP/IP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	5	4	2	1	5	1	2	0	5	2	10
Application Layer and Routing Algorithms	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	2	3	1	1	2

Chapter 1

Fundamentals and SWP

One-mark Questions

1. Which of the following are used to generate a message digest by the network security protocols? **[2014]**

(a) RSA (b) SHA-1
(c) DES (d) MD5

Solution: (c)

Message digest function is generated by SHA-1 and MD-5 only.

RSA and DES are used for encryption and decryption.

Hence, the correct option is (c)

2. Which of the following is not client server application? **[2010]**

(a) Internet chat (b) Web browsing
(c) e-mail (d) Ping

Solution: (d)

PING is utility, to check connectivity either between client-client or client server.

Hence, the correct option is (d)

3. The maximum window size for data transmission using the selective reject protocol with n-bit frame sequence numbers is **[2005]**

(a) 2^n (b) 2^{n-1}
(c) $2^n - 1$ (d) 2^{n-2}

Solution: (b)

WS+WR = 2^n ; If WS = WR then maximum window 2^{n-1}.

Hence, the correct option is (b)

4. Choose the best matching group between Group-I and Group-II **[2004]**

Group-I	**Group-II**
P. Data Link Layer	1. Ensure reliable transport of data over a physical point-to-point network
Q. Network layer	2. Encodes/decodes data for physical transmission
R. Transport Layer	3. Allows end-to-end communication between two processes
	4. Routes data from one network node to next node

(a) P-1, Q-4, R-3 (b) P-2, Q-4, R-1
(c) P-2, Q-3, R-1 (d) P-1, Q-3, R-2

Solution: (a)

Data link layer offers reliability on link to link basis. Where as transport layers offers the same on end to end basis. And network layer is responsible for routing.

Hence, the correct option is (a)

Two-marks Questions

1. Consider a selective repeat sliding window protocol that uses a frame of size of 1KB to send data on a 1.5 mbps link with one wave latency of 50 msec. To achieve a link utilization of 60% , l is minimum number of bits required to represent the sequence number field is_____. **[2014]**

Solution:

RTT = 100msec, within 1 msec link can be 0.9 Mbps, therefore 100 msec it can transfer 90 x 10^3 bits = window size in bits.

Window size in packets = $\frac{90 \times 10^3}{1024} = 11$ packets.

Total sequence number required in SR = 22, hence it requires 5 bits.

2. An Internet service provider has the following chunk of CIDR-based IP address available with it: 245:248:128.0/20. The ISP wants to give half of this chunk of address to organization A and a quarter to organization B, while retaining the remaining with itself. Which of the following is value allocation of address A and B? **[2012]**

(a) 245.248.136.0/21 and 245.248.128.0/22
(b) 245.248.128.0/21 and 245.248.128.0/22
(c) 245.248.132.0/22 and 245.248.132.0/21
(d) 245.248.136.0/21 and 245.248.132.0/21

Solution: (b)

20 address indicates that 20-bits are allocated for NID and remaining 12-bits are left over hosts. Therefore, total possible hosts are 40. If half of them are allocated to network, then it will have 2048 hosts with 11 hosts bits and network B will have 1024 hosts with 10 host ID bits. Therefore /21 is for network A and /22 for network B. Since it is class network and first 20-bits are allocated for N, hence by keeping 245.248.128 as it is generate above IDs through VLSM.

Hence, the correct option is (b)

Common Data for Questions 3 and 4

Frames of 1000-bits are sent over a 10^6 bps duplex link between two hosts. The propagation time is 25ms. Frames are to be transmitted into this link to maximally pack them in transit(within the link) **[2009]**

3. What is the minimum number of bits (l) that will be required to represent the sequence numbers distinctly? Assume that no time gap needs to be given between transmissions of two frames.

(a) l = 2 (b) l = 3
(c) l = 4 (d) l = 5

Solution: (d)

RTT = 25μsec × 2 = 50μsec.

1 sec – link is capable of delivering $10^6/2$ bps.

Then within 50μsec it is capable of delivering

$= 50^* 10 - 3^*106 = 25 \times 10^3$

$W_{packets} = W_{bits}$ / Packet size in bits

$2^n = 25$

$N = 5$ bits.

Hence, the correct option is (d)

4. Suppose the sliding window protocol is used with the sender window size of 2^l, where l is the number of bits identified in the earlier part and acknowledgement are always piggy backed. After sending 2^l frames, what is the minimum time the sender will have to wait before starting transmission of the next frames?

(Identify the closest choice ignoring the frame processing time).

(a) 16 ms (b) 18 ms
(c) 20 ms (d) 22 ms

Solution: (b)

Transmission delay for a packet = C/B = 1μsec.

If l = 5, then sequence numbers

$2^5 = 32$

For 32 packets it takes 32μsec.

RTT = 2 × 25 μsec = 50 μsec.

Hence minimum time sender has to wait to transfer next set of packet

= 50μsec – 32μsec = 18μsec.

Hence, the correct option is (b)

5. Station A needs to send a message consisting of 9 packets to station B using sliding window(window size 3) and 'go-back-n-error control strategy'. All packets are ready & and immediately available for transmission. If every 5th packet that A transmit gets lost (but no acks from B ever lost), then what is the number of packets that A will transmit from sending the message to B? **[2006]**

(a) 12 (b) 14
(c) 16 (d) 18

Solution: (c)

Hence, the correct option is (c)

6. Station A uses a 32 byte packets to transmit messages to Station B using a sliding window protocol. The round trip delay between A & B is 80 milliseconds and bottleneck path between A & B

is 128 kbps. What is the optimal window size that A should use? **[2006]**

(a) 20 (b) 40
(c) 160 (d) 320

Solution: (b)

RTT = 80 μsec, packet size

$= 32 \times 8$-bits B = 128 kbps.

Optimal window size in terms bits

$= 128*103*80*10^{-3} = 128 \times 80.$

Window in term of packets

$= 128*80/32*8$

$= 40$

Hence, the correct option is (b)

7. Host A is sending data to host B over a full duplex link. A and B are using the sliding window protocol for flow control. The send and receive window sizes are 5 packets each. Data packets (sent only from A to B) are all 1000 bytes long and the transmission time for such a packet is 50μs. Acknowledgement packets (sent from B to A) are very small & request negligible transmission time. The propagation delay over the link is 200 μs. What is the maximum achievable throughput in this communication? **[2003]**

(a) 7.69×10^6 bps (b) 11.11×10^6 bps
(c) 12.33×10^6 bps (d) 15.00×10^6 bps

Solution: (b)

L = 1000 bytes

Tr delay = 50μ sec

Prop delay = 200 μsec

Window size = 5 packets

RTT = Tr delay + 2x prop delay

= 450μsec

Throughput = 1 window/RTT

$= 5 \times 1000 \times 8$ bits/sec

OR

Throughput = 1 window/RTT

$= 5 \times 1000$ bytes/ 450 μsec

$= 11.11 \times 10^6$ bytes/sec.

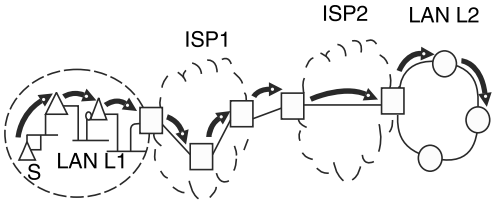
Hence, the correct option is (b)

Chapter 2

Local Area Network

One-mark Questions

1. In the diagram shown below, L1 is an Ethernet LAN and L2 is a token-ring LAN. An IP packet originates from sender S and traverse to R, as shown. The links within each ISP and across two ISPs are all point-to-point optical links. The initial value of TTL field is 32. The maximum possible value of TTL field when R receives the datagram is _____ . **[2014]**



Solution:

For each hop TTL is reduced by 1 and there are 6 hops here hence 32 – 6.

2. In Ethernet when Manchester encoding is used, the bit rate is: **[2007]**

(a) Half the baud rate
(b) Twice the baud rate
(c) Same as baud rate
(d) None of the above

Solution: (a)

In Manchester encoding, we use two signal changes to represent a bit. So, baud rate is twice the bit rate.

Hence, the correct option is (a)

3. In a network of LANs connected by bridges, packets are sent from one LAN to another through intermediate bridges. Since more than one path may exists between two LANs packets may have to be routed through multiple bridges. Why is the spanning tree algorithm used for bridge-routing? **[2005]**

(a) For the shortest path routing between LANs
(b) For avoiding loops in routing paths
(c) For fault tolerance
(d) For minimizing collisions

Solution: (b)

TTL is used by network layer to avoid infinite looping.

Hence, the correct option is (b)

Two-marks Questions

1. Consider a token ring network with a length of 2 km having 10 stations including a monitoring station. The propagation speed of signal is 2×10^8 m/s and the token transmission time is ignored if each station is allowed to hold the token for 2 μsec, the minimum time for which the monitoring station should wait(in μsec) before assuming that the token is lost is_____. **[2014]**

Solution:

Token rotation time

= propagation delay in the ring + Number of active stations × THT

$= 2 \times 10^3 / (2 \times 10^8) + 10 \times 2$ micro sec

= 30 micro sec.

Minimum time monitoring station should wait

= Token rotation time

= 30 micro sec.

2. Determine the maximum length of the cable (in km) for transmitting data at a rate of 500Mbps in an Ethernet LAN with frames of size 10,000-bits. Assume the signal speed in the cable to be 2,00,000 km/s. **[2013]**

(a) 1 (b) 2
(c) 2.5 (d) 5

Solution: (b)

To find all collision in Ethernet Transmission delay must be equal to RTT.

$L/B = 2 \times D/V.\ 10000/500 \times 10^6$

$= 2 \times D/200000 = 2$ KM

Hence, the correct option is (b)

3. The distance between two stations M and N is L kilometers. All frames are K-bits long. The propagation delay per kilometers is t seconds. Let R bits/second be the channel capacity. Assuming that processing delay is negligible, the minimum number of bits for the sequence number field in a frame for maximum utilization, when the sliding window protocol is used, is: **[2007]**

(a) $[\log_2 2LtR + 2k/k]$
(b) $[\log_2 2LtR/k]$
(c) $[\log_2 2LtR + k/k]$
(d) $[\log_2 2LtR + 2/2k]$

Solution:

Utilizing = Tr delay for W packets/Tr delay + RTT

$$\frac{(W\ X\ K/R)}{\frac{K}{R} + 2LT} = 1$$

For a maximum utilization it should be equal to 1.

$W = K + 2LRt$

Sequence number required = W. Therefore

$2^n = K + 2LRt/\ K$

$N = \log_2(K + 2LRt)/K$

Where n number of bits in sequence number field.

4. In a token ring network, the transmission speed is 10^7 bps and the propagation speed is 200 meters/µs. The 1-bit delay in this network is equivalent to: **[2007]**

(a) 500 meters of cable
(b) 200 meters of cable
(c) 20 meters of cable
(d) 64 meters of cable

Solution: (c)

1 Bit delay = $1/B = 1/10 \times 10^6 = 0.1$ µsec.

Propagation speed = 200m/µsec.

Hence, within 0.1 µsec we are able to travel upto 20m.

Hence, the correct option is (c)

5. There are n stations in a slotted LAN. Each station attempts to transmit with a probability p in each time slot. What is the probability that ONLY one station transmits in a given time slot? **[2007]**

(a) $np(1-p)^{n-1}$ (b) $(1-p)^{n-1}$
(c) $p(1-p)^{n-1}$ (d) $1-(1-p)^{n-1}$

Solution: (a)

Probability of a station not to transfer packet = $1 - P$.

For a successful transmission, remaining $n-1$ stations should not transfer a packet.

Probability for $n-1$ station not to transfer packet $= (1-p)^{n-1}$

So, for a successful transmission for a single station among n stations

$= np(1-p)^{n-1}$

Hence, the correct option is (a)

6. A and B are only two stations on an Ethernet. Each has a steady queue of frames to send. Both A & B attempt to transmit a frame, collide and A wins the first back off race. At the end of this successful transmission by A, both A and B attempt to transmit and collide. The probability that A wins second backoff race is **[2004]**

(a) 0.5 (b) 0.625
(c) 0.75 (d) 1.0

Solution: (b)

Collision number for 'A' is 1, and for 'B' it is 2. Possible numbers for 'A' from back off algorithm is (0, 1), for 'B' they are (0, 1, 2, 3). Going by the combinations, A will have 5 chances and 'B' has 1 chance out of 8. Rest of the two is Undecided.

Hence, probability of A is 5/8 = 0.625

Hence, the correct option is (b)

7. A 2 km long broadcast has LAN has 10^7 bps band width and uses CSMA/CD. The signal travels along wire at 2×10^8 m/s. What is the minimum packet size that can be used on this network? **[2003]**

(a) 50 bytes
(b) 100 bytes
(c) 200 bytes
(d) None of the above

Solution: (d)

$d = 2$km

$v = 2 \times 10^8$ m/sec $= 2 \times 10^5$ km/sec

$B = 10^7$ kbps

Minimum packet size (L)

$= 2*(d/v)*B = 2 \times (2/2 \times 10^5) \times 10^7$

$= 200$ bits or 25 bytes.

So, answer is none of them.

Hence, the correct option is (d)

8. Suppose the round trip propagation delay for a 10 Mbps Ethernet having 48-bit jamming signal is 46.4 μs. The minimum frame size is: **[2003]**

(a) 94 (b) 416
(c) 464 (d) 512

Solution: (c)

L = 4.64 μsec $\times 10 \times 10^6 = 464$

Hence, the correct option is (c)

Chapter 3

TCP/IP

One-mark Questions

1. Identify the correct order in which the following actions take place in an interaction between a web browser and a web server. **[2014]**

1. The web browser requests a web using HTTP.
2. The web browser establishes a connection with a web server.
3. The web server sends the request web pages using HTTP.
4. The web browser resolves the domain name using DNS.

(a) 4, 2, 1, 3 (b) 1, 2, 3, 4
(c) 4, 1, 2, 3 (d) 2, 4, 1, 3

Solution: (a)

First name is done by DNS, then connection is established through TCP to request and get HTTP objects.

Hence, the correct option is (a)

2. Which one of the following socket functions converts an unconnected and TCP sockets into a passive socket? **[2014]**

(a) Connect (b) Bind
(c) Listen (d) Accept

Solution: (c)

The listen function is called by only TCP server and it performs two action – the listen function converts an unconnected socket into a passive socket, indicating it should accept incoming connection requests directed to this socket. It also specifies the maximum number of connections in the queue for this socket.

Hence, the correct option is (c)

3. A bit-stuffing based framing protocol uses 8-bit delimiter pattern of 01111110. If output bit-string after stuffing is 01111100101, then the input bit-string is **[2014]**

(a) 0111110100 (b) 0111110101
(c) 0111111101 (d) 0111111111

Solution: (b)

Stuffed bit is 4^{th} bit from the last.

Hence, the correct option is (b)

4. Host A (on TCP/IP v4 network A) sends IP diagram D to host B(also on TCP/IP network B). Assume that no error occurs during the transmission of D, when D reaches B, which of the following IP header field may be different from that of the original datagram D? **[2014]**

(i) TTL
(ii) Checksum
(iii) Fragment offset

(a) (i) only
(b) (i) and (ii) only
(c) (ii) and (iii) only
(d) (i), (ii) and (iii)

Solution: (d)

In IP datagram, checksum is recalculated at each and every router because 16-bit datagram length, TTL, MF, offset and options are changing at every router.

Hence, the correct option is (d)

5. The transport layer protocols used for real time multimedia, file transfer, DNS and e-mail, respectively, are **[2013]**

(a) TCP, UDP, UDP and TCP
(b) UDP, TCP, TCP and UDP

(c) UDP, TCP, UDP and TCP
(d) TCP, UDP, TCP and UDP

Solution: (c)

UDP : Multimedia

TCP, DNS : File transfer

TCP: Email

Hence, the correct option is (c)

6. The Protocol Data Unit (PDU) for the application layer in the Internet stack is **[2012]**
(a) Segment (b) Datagram
(c) Message (d) Frame

Solution: (c)

Hence, the correct option is (c)

7. The decimal value 0.5 in IEEE single precision floating points representation has **[2012]**
(a) fraction bits of 000…000 and exponent value of 0.
(b) fraction bits of 000…000 and exponent value of −1.
(c) fraction bits of 100…000 and exponent value of 0
(d) no exact repvresentation.

Solution: (b)
Exponent value is 0 1 1 1 1 1 1 0
True Fraction is -1
Also fraction 0000....00000 = exponent

Hence, the correct option is (b)

8. In the IPv4 addressing format, the number of networks all allowed under Class C addresses is **[2012]**
(a) 2^{14} (b) 2^{7}
(c) 2^{21} (d) 2^{24}

Solution: (c)

In class C network, NID bits are 24, but first three bits are reserved as 110. Hence, network possible is 2^{21}.

Hence, the correct option is (c)

9. Which of the following transport layer protocol is used to support electronic mail? **[2012]**
(a) SMTP (b) IP
(c) TCP (d) UDP

Solution: (c)

Hence, the correct option is (c)

10. One of the header field in an IP datagram is the Time-To-Live(TTL) field. Which of the following statements best explains the need for this field? **[2010]**
(a) It can be used to prioritize packets.
(b) It can be used to reduce delays.
(c) It can be used to optimized throughput.
(d) It can be used to prevent packet looping.

Solution: (d)

Router is using default route to transfer packet if DIP of packet does not match with any of the entries of its routing table.

Default route leading to infinite looping sometimes, hence TTL is used to avoid infinite looping.

Hence, the correct option is (d)

11. What is the maximum size of data that the application layer can pass to the TCP layer below? **[2008]**
(a) Any size
(b) 2^{16} bytes – size of TCP header
(c) 2^{16} bytes
(d) 1500 bytes

Solution: (a)

Application layer can forward any size of packet but transport layer should ensure that each segment should be of 64 KB.

Hence, the correct option is (a)

12. For which one of the following reason does Internet Protocol (IP) use the Time-To-Live(TTL) field in the IP diagram header? **[2006]**
(a) Ensure packets reach destination within that time
(b) Discards packets that reach later than that time
(c) Prevents packets from looping indefinitely
(d) Limits the time for which a packet gets queued in intermediate routers

Solution: (c)

Router is using default route to transfer packet if DIP of packet does not match with any of the entries of its routing table.

Default route leading to infinite looping sometimes, hence TTL is used to avoid infinite looping.

Hence, the correct option is (c)

13. Packets of the same sessions may be routed through different paths in: **[2005]**
(a) TCP but not UDP
(b) TCP and UDP

(c) UDP, but not TCP
(d) Neither TCP, nor UDP

Solution: (c)

Therefore packets of the same sessions may be routed through different paths in UDP, bot not TCP because packets are flowing through different paths based on availability of paths and also UDP is connectionless.

Hence, the correct option is (c)

14. The Aaddress ReSolution Protocol(ARP) is used for: **[2005]**
(a) Finding the IP address from the DNS
(b) Finding the IP address of default gateway
(c) Finding the IP address that corresponds to a MAC address
(d) Finding the MAC address that corresponds to an IP address

Solution: (d)

Hence, the correct option is (d)

15. An organization has a class B network and wishes to form subnets for 64 departments. The subnet mask would be: **[2005]**
(a) 255.255.0.0 (b) 255.255.64.0
(c) 255.255.128.0 (d) 255.255.252.0

Solution: (d)

We need to borrow 6-bits to generate 64 subnet from Host ID.

Hence mark is: 255.255.255.0

Hence, the correct option is (d)

16. Which of the following is NOT true with respect to a transparent bridge and a router? **[2004]**
(a) Both bridge and router selectively forward data packets.
(b) A bridge uses IP addresses while a router uses MAC addresses.
(c) A bridge builds up its routing table by inspecting incoming packets.
(d) A router can connect between a LAN and a WAN.

Solution: (b)

Bridge works at data link layer, hence works on MAC address. Router works at network layer, hence uses IP address.

Hence, the correct option is (b)

17. Which of the following assertion is FALSE about the Internet Protocol (IP)? **[2003]**
(a) It is possible for a computer to have multiple IP addresses.
(b) IP packets from the same source to the same destination can take different routes in the network.
(c) IP ensures that a packet is discarded if it is unable to reach its destination within a given number of hops.
(d) The packet source cannot set the route of an outgoing packets; the route is determined only by the routing tables in the routers on the way.

Solution: (d)

Types of routing

- Router routing: Router decides outgoing route of the packet.
- Source mounting: Source can decide the route.

Hence, the correct option is (d)

18. Which of the following functionalities must be implemented by a transport protocol over and above the network protocol? **[2003]**
(a) Recovery from packet losses
(b) Detection of duplicate packets
(c) Packet delivery in the correct order
(d) End to end connectivity

Solution: (c)

TCP and UDP both are transport layer protocols. Detection of duplicate packets and end-to-end connectivity are responsibilities of TCP. Packet delivery in connect order is must for both TCP and UDP.

Hence, the correct option is (c)

19. Which of the following system calls results in sending of SYN packets? **[2008]**
(a) Socket (b) Bind
(c) Listen (d) Connect

Solution: (d)

The active endpoint sends a synchronize packet when connect() system call is invoked.

Hence, the correct option is (d)

Two-marks Questions

1. An IP router with a Maximum Transmission Unit (MTU) of 1500 bytes has received an IP packet of size 4404 bytes with an IP header of length

20 bytes. The values of the relevant fields in the header of the third IP fragment generated by the router for this packet are: **[2014]**

(a) MF bit: 0, Datagram length: 1444; offset: 370
(b) MF bit: 1, Datagram Length: 1424; offset: 185
(c) MF bit: 1, Datagram Length: 1500; offset: 370
(b) MF bit: 1, Datagram Length: 1424; offset: 2960

Solution: (a)

Data + header size in datagram must be less than or equal to MTU size. Three fragments 1480, 1480, 1444 bytes with MF (1, 1, 0) offset (0, 1408/8 = 185), (1480 + 1480)/8 = 370.

Hence, the correct option is (a)

2. Let the size of congestion window of a TCP connection be 32 KB when a timeout occurs. The round trip time of the connection is 100msec and the maximum segment size used is 2KB. The time taken (in msec) by the TCP connection to get back to 32 KB congestion window is _____. **[2014]**

Solution:

Once timeout occurs, congestion window is set to one MSS and threshold value is set to half of the congestion window at timeout. Window now increase exponentially up to threshold value from there it increases linearly.

So, overall it takes 1100 msec.

3. Consider the store 7 forward packet switched network given below. Assume that the bandwidth of each link is 10^6 bytes/sec. A user on host A sends a file size 10^3 bytes to host B through routers R1 and R2 in three different ways. In the first case, a single packet containing the complete file is transmitted from A to B. In the second case, the file is split into 20 equal parts and these packets are sent from A to B. Each packet contains 100 bytes of header information along with use data. Consider only transmission time, ignoring processing, queuing and propagation delays. Also assume that there are no errors during transmission. Let T1, T2 and T3 be the times taken to transmit the file in the first, second and third case, respectively. Which one of the following is correct? **[2014]**

(a) T1 < T2 < T3 (b) T1 > T2 > T3
(c) T2 = T3, T3 < T1 (d) T1 = T3, T3 > T2

Solution: (d)

Case 1: L = 1000 + 100 bytes.

Transmission time = L/B = 1100bytes/10^6

There are 3 transmission time , total = 3300 micro sec.

Case 2: L = 100 + 100 bytes.

Transmission source = $10 \times 200/10^6$ = 2000 micro second at R1, 200 microsecond, at R2, 200 micro sec.

Case 3: L = 50 + 100 bytes.

Transmission Source = $20 \times 150/10^6$ = 3000 micro second. At R1, 150 micro sec, at R2, 150 micro sec.

When file size is too big or too small, response times are high due to retransmission and header overhead. Hence, T_1 and T_3 might be same as under these condition but definitely more than T_2.

Hence, the correct option is (d)

4. An IP machine Q has a path to another IP machine H via three IP routers R_1, R_2 & R_3.

Q-R1-R2-R3-H

H acts an HTTP server, and Q connects to H via HTTP and downloads a file. Session layer encryption is used, with DES as the shared key encryption protocol. Consider the following four pieces of information.

[I1] The URL of the file downloaded by Q

[I2] The TCP port numbers at Q and H

[I3] the IP address of Q and H

[I4] The link layer addresses of Q and H

Which of I1, I2, I3 and I4 can an intruder learn through sniffing at R2 alone? **[2014]**

(a) Only I1 and I2
(b) Only I1
(c) Only I2 and I3
(d) Only I3 and I4

Solution: (c)

Hence, the correct option is (c)

5. An IP router implementing Classless Inter-Domain Routing(CIDR) receives with a packet address 131.23.151.76. The router's routing table has the following entries:

Prefix	Output interface identifier
131.16.0.0/12	3
131.28.0.0/14	5
131.19.0.0/16	2

131.22.0.0/15 1

The identifier of the output interface on which this packet will be forwarded_____. **[2014]**

Solution:

Perform AND operation between IP and /12, /14, /16, /15 mask. If result matches, we "prefix" given in the table then that interface packet is forwarded. If it match with multiple mask, then use longest length mask.

6. Every host *n* an IPv4 network has a 1-second resolutionution real time clock battery back-up. Each host needs to generate up to 1000 unique identifiers per second. Assume that each host a globally unique IPv4 address. Design a 50-bit globally unique ID for this purpose. After what period (in seconds) will the identifiers generated by a host wrap around? **[2014]**

Solution: 256

IP4 is 32-bit address, so 18-bits are used for unique identification for 50-bits. If host generates 1000 identifier per second , then in 256 sec, it can generate 2^{18} identifiers.

7. In an IPv4 datagram, the M bit is 0, the value of HLEN is 10, the value of total length is 400 and the fragment offset Id 300. The position of datagram, the sequence numbers of the first and last bytes of the payload, respectively **[2013]**

(a) Last Fragment, 2400 and 2789
(b) First Fragment, 2400 and 2759
(c) Last Fragment, 2400 and 2759
(d) Middle Fragment, 300 and 689

Solution: (c)

For last fragment always M = 0. If header length is 40 bytes, therefore, total data in fragment is 400 – 40 = 360 bytes.

Since offset is 300 total bytes ahead of this fragment is $8 \times 300 = 2400$ bytes.

Therefore it is last fragment, starting byte is 2400 and ending byte is 2759 (as 2400 + 360 = 2760 bytes but byte number starts with zero, so it is from 2400 to 2759).

Hence, the correct option is (c)

8. Consider an instance of TCP's Additive Increase Multiplicative Decrease(AIMD) algorithm where the window size at the start phase is 2 MSS and threshold at the start of the first transmission is 8 MSS. Assume that a time out occur during the fifth transmission. Find the congestion window size at the end of ten transmission. **[2012]**

(a) 8 MSS (b) 14 MSS
(c) 7 MSS (d) 12 MSS

Solution: (d)

Transmission10	Window Size	
1	2 MSS	
2	4 MSS	
3	8 MSS	Meets required threshold
4	10 MSS	Linear growth
5	12 MSS	Timeout occurs, hence, congestion window set to 2 MSS and new threshold is 6 MSS
6	2 MSS	
7	4 MSS	
8	6 MSS	Meets threshold
9	8 MSS	Linear growt
10	10 MSS	
11	12 MSS	At the end of the 10th transmission, it is 12 MSS

Hence, the correct option is (d)

9. Suppose computer A and B have IP address 10.105.1.113 and 10.105.1.91, respectively. They both uses the same net mask *N*. What value of *N* should not be used if A and B should belong to the network? **[2010]**

(a) 255.255.255.0 (b) 255.255.255.128
(c) 255.255.255.192 (d) 255.255.255.224

Solution: (d)

If result of AND operation between given mask and IP address of A and B is same, then use mask else not.

Mask: 255.255.255.111 00000

AND

IP(A):10.105.1.011 10001

10.105.1.011 10001

Mask: 255.255.255. 11100000

IP(B): 10.105.1.01011011

10.105.1. 0100000

Hence, the correct option is (d)

10. While opening a TCP connection, the initial sequence number is to be derived using a Time-of-Day (ToD) clock that keeps running even when the host down. The low order 32-bits of the counter of the ToD clock is to be used for the initial sequence numbers. The clock counter increments once per milliseconds and maximum packet lifetime is given to be 64s. Which one of the following choice given below is the closest to minimum possible rate at which sequence numbers used for packets connection can increase? **[2009]**

(a) 0.015 /s (b) 0.064/s
(c) 0.135/s (d) 0.327/s

Solution: (b)

Wraparound time of sequence numbers should not be less than life period of the packet. If counter increments for every millisecond, then the rate at which sequence numbers can increase is 64/1000 = 0.064/s.

Hence, the correct option is (b)

11. In a slow start phase of the TCP congestion control algorithm, the size of the congestion window **[2008]**

(a) does not increase
(b) increases linearly
(c) increases quadratically
(d) increases exponentially

Solution: (d)

Congestion window increase exponentially in slow start phase.

Hence, the correct option is (d)

12. If a Class B network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet? **[2008]**

(a) 1022 (b) 1023
(c) 2046 (d) 2047

Solution: (c)

255.255.248.0, 5 bits are borrowed from 16-bit host ID for subnet IDs. Therefore, 11 bots are leftover for host ID, Hence no of hosts per subnets = $2^{11} - 2 = 2046$

Hence, the correct option is (c)

13. A Client process P needs to make a TCP connections to a server process S. Consider the following situations; the server process S executes a sockets(), a bind(), and a listen() system call in that order, following which it is preempted subsequently the client process P executes a sockets () system call followed by connect the server process S. The server process has not executed any accept() system call. Which one of the following events could take place? **[2008]**

(a) Connect() system call returns successfully
(b) Connect() system call blocks
(c) Connect() system call returns an error
(d) Connect() system call results in a core dump

Solution: (c)

Hence, the correct option is (c)

14. The address of a Class B host is to be split into subnets with a 6-bits number. What is the maximum number of subnets and the maximum number of hosts in each subnets? **[2007]**

(a) 62 subnets and 262142
(b) 64 subnets and 262142
(c) 62 subnets and 1022 hosts
(d) 64 subnets and 1024 hosts

Solution: (c)

Class B has 16-bits as host ID out of which you borrow 6-bits, then

Host ID bits = 10

So, total host per subnet $2^{10} - 2 = 1022$

Total subnets = $2^6 = 64$.

Hence, the correct option is (c)

15. Two computers C_1 & C_2 are configured as follows: C_1 has IP address 203.197.2.53 and net mask 255.255.128.0, C2 has IP address 203.197.75.201 and net mask 255.255.192.0. Which one of the following statements is TRUE? **[2006]**

(a) C_1 and C_2 both assume they are on the same network.
(b) C_2 assumes that C_1 is on the same network, but C_1 assumes C_2 is on a different network.
(c) C_1 assumes C_2 is on same network, but C_2 assumes C_1 is on a different network.
(d) C_1 and C_2 both assumes they are on different networks.

Solution: (c)

Both netmask, one subnet mask. In (255.255.128.0) 7-bits are borrowed from network, therefore 27 networks are aggregation, i.e., 128 networks.

C_1 was 203.197.2.53 if we consider this starting network then last network in the super net is 203.197.130. So, C_1 assumes (203.197.75.201) is within C_1, C_2 has netmask 255.255.192.0, 6-bits are borrowed from network, there $2^6 = 64$.

Networks are aggregated could be from 203.197.75……..203.197.139.

Therefore C_1 assumes C_2 is on the sub network, but C_2 assumes C_1 is on a different network.

Hence, the correct option is (c)

16. A TCP message consisting of 2100 bytes passed to IP for delivery across the network. First network can carry a maximum payload of 1200 bytes per frame. And the second network can carry a maximum payload of 400 bytes per frame. Neglect network overhead. Assume that IP overhead per packet is 20 bytes. What is the total overhead in the second network transmission? **[2004]**

(a) 40 bytes (b) 80 bytes
(c) 120 bytes (d) 160 bytes

Solution: (c)

Maximum payload in first network = 1200

Hence, possible fragments are
1. 1200 + 20
2. 900 + 20

Possible fragment in second network.

1200 + 20 fragment becomes 400 + 20, 400 + 20, 400 + 20.

900 + 20 fragment becomes 400 + 20, 400 + 20, 100 + 20.

Total fragments in second frame work = 6.

Hence, IP overload in second network = 120 bytes.

Hence, the correct option is (c)

Common Data for Questions 17 and 18

Consider three IP Network A, B and C. Host H_A in Network A sends messages each containing 180 bytes of application data to a host H_C in network C. The TCP layer prefixes a 20 bytes header to the message. This passage through an intermediate Network B. The maximum packet size, including 20 bytes IP header, in each network is

A: 1000 bytes

B: 100 bytes

C: 1000 bytes

The Network A and B are connected through a 1Mbps link, while B and C are connected by a 512 Kbps link (bps = bits per second).

Destination	Subnet Mask	Interace
128.75.43.0	255.255.255.0	Eth0
128.75.43.0	255.255.255.128	Eth1
192.12.17.5	255.255.255.255	Eth3
default		Eth2

[2004]

17. Assuming that the packets are correctly delivered, how many bytes, including headers, are delivered to IP layer at the destination for one application messages, in the best case? Consider only data packets.

(a) 200 (b) 220
(c) 240 (d) 260

Solution: (d)

Datagram size = 180 + 20 = 200.

(Msg + TCP header)

IP header = 20 bytes.

So, fragment in Network B are

20 + 80, 20 + 80, 20 + 40.

So, overall bytes received at Network C = 260 bytes.

Hence, the correct option is (d)

18. What is the rate at which application data is transferred to Host H_C? Ignore errors, acknowledgement and other overheads.

(a) 325.5 Kpbs (b) 354.5 Kpbs
(c) 409.6 Kbps (d) 512 Kbps

Solution: (b)

Effective data transfer from network B to Network C = 180 bytes.

Hence, effective Efficiency = (180/260) × 512 Kbps

= 354.46 Kbps

Hence, the correct option is (b)

19. The routing table of a router is shown below:

Destination	Subnet Mask	Interface
128.75.43.0	255.255.255.0	Eth_0
128.75.43.0	255.255.255.128	Eth_1
192.12.17.5	255.255.255.255	Eth_3
Default		Eth_2

On which interfaces will the router forward packets addressed to destinations 128.75.43.16 and 192.12.17.10 respectively? **[2004]**

(a) Eth_1 and Eth_2 (b) Eth_0 and Eth_2
(c) Eth_0 and Eth_3 (d) Eth_1 and Eth3

Solution: (a)

General routing process is to perform AND operation between incoming IP address and subnet mask and compare result with destination. If there is a match, route the packet through that interface. If there is a match with multiple subnet masks, choose longest length.

128.75.43.16

AND

255.255.255.0

128.75.43.0

128.75.43.16

AND

255.255.255.128

128.75.43.0

Since it matches with both the entries, choose the longest length subnet mask, hence, this packet is forwarded through Eth_1.

192.12.17.10

does not match with any destination even after performing AND operations with subnet masks, hence, packet is forwarded through Eth_2.

Hence, the correct option is (a)

20. The subnet mask for a particular network 255.255.31.0. Which of the following pairs of IP addresses could belong to this network. **[2003]**

(a) 172.57.88.62 and 172.56.87.233
(b) 10.35.28.2 and 10.35.29.4
(c) 191.203.31.87 and 191.234.31.88
(d) 128.8.129.43 and 128.8.161.55

Solution: (d)

Given subnet mask is for class B network. IP address in option(d) belongs to same network and class B.

Hence, the correct option is (d)

21. Suppose that the maximum transmit window size for a TCP connection is 1200 bytes. Each packet consists of 2000 bytes. At some point of time, the connection is in slow start phase with a current transmit window of 4000 bytes. Subsequently, the transmitter receives two acknowledgements. Assume that no packets are lost and there are no time outs. What is the maximum possible value of the current transmit window? **[2004]**

(a) 4000 bytes (b) 8000 bytes
(c) 10000 bytes (d) 12000 bytes

Solution: (d)

Congestion window size increases exponentially in slow start phase. Current window size is 4000 bytes means it has two packets. It becomes 4 packets on getting first acknowledgement and 8 on getting second acknowledgement. Therefore, size of transmit window is $8 \times 2000 = 16000$ bytes.

But maximum transmit window is 1200 bytes. Hence, congestion cannot grow beyond transmit window.

Therefore, answer is 1200 bytes.

Hence, the correct option is (d)

22. In a packet switching network, packets are routed from source to destination along a single path having two intermediate nodes. If the message size is 24 bytes and each packets contains a header of 3 bytes, then the optimum packet size is:

(a) 4 (b) 6
(c) 7 (d) 9

Solution: (d)

If optimum packet size is 9, then data $9 - 3 = 6$ bytes, hence, we need only 4 packets carry 24 bytes. In option (a), (b), (c) number of packets transmitted would be more, and hence, network traffic is more.

Hence, the correct option is (d)

Chapter 4

Application Layer and Routing Algorithm

One-mark Questions

1. Consider the following three statements about link state and distance vector routing protocols, for a large network with network nodes and 4000 links. **[2014]**

[S_1] The computational overhead in link protocols is higher than in distance via protocol.

[S_2] A distance vector protocol (with horizon) avoids persistent routing but not link state protocol.

[S_3] After a topology change, a link protocol will converge faster the distance vector protocol.

Which one of the following is correct about S_1, S_2 and S_3?

(a) S_1, S_2 and S_3 are all true
(b) S_1, S_2 and S_3 are all false
(c) S_1, S_2 are true, but S_3 is false
(d) S_1, S_3 are true, but S_2 is false

Solution: (d)

Distance vector is a slower convergence as it sends periodic update every 30 to 60 seconds.

Ex-RIP, IGRE, BGP

In link state, update are not periodic so it has fast convergence.

Ex- OSPF

Hence, the correct option is (d)

2. Which one of the following is TRUE about Interior Gateway Routing Protocol (IGRP)-Routing Information Protocol (RIP) and Open Shortest Path First (OSPF) **[2014]**

(a) RIP uses distance vector routing protocol ; OSPF uses link state routing.
(b) OSPF uses distance vector routing ; RIP uses link state routing.
(c) Both RIP and OSPF uses link state routing.
(d) Both RIP and OSPF use distance vector routing

Solution: (a)

RIP is based on hop count so it uses distance vetor, OSPF is based on cost, hence uses link state.

Hence, the correct option is (a)

3. Assume that source S and destination D are connected through two intermediate routers labeled R. Determine how many times each packet has to visit the network layer and the data link layer during a transmission from S to D

S---R-----R---S **[2013]**

(a) Network layer-4 times and Data Link layer-4 times
(b) Network layer-4 times and Data Link layer-3 times
(c) Network layer-4 times and Data Link layer-6 times
(d) Network layer-2 times and Data Link layer-6 times

Solution: (c)

Hence, the correct option is (c)

4. Consider different activities related to email:

m_1: Send an email from a mail client to a mail server.

m_2: Download an email from mailbox server to a mail client.

m_3: Checking email in a web browser.

What is the application level protocol used in each activity? **[2011]**

(a) m_1: HTTP m_2: SMTP m_3: POP
(b) m_1: SMTP m_2: FTP m_3: HTTP
(c) m_1: SMTP m_2: POP m_3: HTTP
(d) m_1: POP m_2: SMTP m_3: IMAP

Solution: (c)

For transferring mail SMTP is used, and POP/IMAP is used to display mail we use HTTP.

Hence, the correct option is (c)

5. Which of the following uses UDP as the transport protocol? **[2007]**

(a) HTTP (b) Telnet
(c) DNS (d) SMTP

Solution: (c)

Hence, the correct option is (c)

6. In the following pairs of OSI protocol layer/sub layer and its functionality, the incorrect pair is **[2007]**

(a) Network layer and routing
(b) Data link layer and bit-wise synchronization
(c) Transport layer and end-to-end protocol communication
(d) Medium access control sub-layer and channel sharing

Solution: (b)

Data link layer has error, flow, access control, framing as functionalities. Bit synchronization is part of physical layer.

Hence, the correct option is (b)

Two-marks Questions

1. A graphical HTML browser resident at a network client machine *Q* accesses a static HTML webpage from a page has exactly one static embedded image which is also at *S*. Assuming no caching, which one of the following is correct about the HTML webpage loading(including the embedded image)? **[2014]**

(a) *Q* needs to send at least 2 HTTP requests to *S*, each necessarily in a separate TCP connection to server *S*.
(b) *Q* needs to send at least 2 HTTP requests to *S* but a single TCP connection to server *S* is sufficient.
(c) A single HTTP request from *Q* to S is sufficient and a single TCP connection between *Q* and *S* is necessary for this.
(d) A single HTTP request from *Q* to *S* is sufficient and this is possible without any TCP connection between *Q* and *S*.

Solution: (b)

Embedded image in HTML page need require a separate TCP connection but require as there is no caching.

Hence, the correct option is (b)

2. Consider a source computer (S) transmitting file of size 106 bits to destination computer (D) over a network of two routers (R_1 and R_2) and three links (L_1, L_2, L_3). L_1 connects to R_1; L_2 connects to R1 to R_2; L_3 connects to D. Let each link be of length 100 meter. Assume signals travel over each link at a speed of 108 meters per second. Assume the link bandwidth on each link is 1Mbps. The file is broken down into 1000 packets each of size 1000-bits. Find the total sum of transmission and propagation delays in transmitting the file from S to D? **[2012]**

(a) 1005 ms (b) 1010 ms
(c) 3000 ms (d) 3003 ms

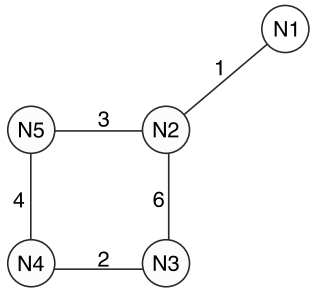
Solution: (a)

At source(S), it takes 1 sec(L/B) to transfer all 1000 packets. At 1.001 sec (D/V = 100 KM/108) last packet will be arriving at router 1(R_1), at R_1 transmission delay for this at last packet is 0.001 sec (L/B = 1000bits/1Mbps), propagation from R_1 to R_2 is 0.001 sec, transmission delay at R_2 is 0.001 sec propagation from R_2 to destination D is 0.001 sec hence it takes 1.005 sec or 1005 msec.

Hence, the correct option is (a)

Common Data for Questions 3 and 4

Consider a network with five nodes, N_1 to N_5 as shown below.



The network uses a distance vector routing protocol. Once the router have stabilized, distance vector at different nodes are following:

N1: (0, 1, 7, 8, 4)

N2: (1, 0, 6, 7, 3)

N3: (7, 6, 0, 2, 6)

N4: (8, 7, 2, 0, 4)

N5: (4, 3, 6, 4, 0)

Each distance vector is distance of the known path at that instance to nodes, N1 to N5, where the distance to itself is 0. Also links are symmetric and cost is identical in both directions. In each round all number exchange their distance vectors with the respective neighbors. Then all nodes update their distance vector. In between two routes, any change in cost of a link will cause the incident nodes to change only that entry their distance vectors. **[2011]**

3. The cost of link N2-N3 reduces to 2(in both directions). After the next round of update, what will be new distance vector of node N3?

(a) (3, 2, 0, 2, 5) (b) (3, 2, 0, 2, 6)
(c) (7, 2, 0, 2, 5) (d) (7, 2, 0, 2, 6)

Solution: (a)

N3→N1→3,N3→N2→2,N3→N3→0,N3→N4→2, N3 → N5 → 5 (Via N2)

Hence, the correct option is (a)

4. After the update in previous question, link N1-N2 goes down. N2 will reflect change immediately in its distance vector cost, ∞. After the NEXT ROUND of update, what will be the cost to N1 in the distance vector of N3?

(a) 3 (b) 9
(c) 10 (d) ∞

Solution: (c)

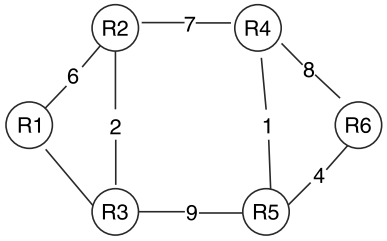
Alternative route is N3 → N4 → N5 → N2 → N1, so its value is 2 + 4 + 3 + 1 = 10.

NEXT ROUND' of update means '∞' at N2 will be received ball N5 but not ball N3. Hence, N3 still assume N3 → N4 → N5 → N2 is all alternative route to N1.

Hence, the correct option is (c)

Common Data for Questions 5 and 6

Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the following diagram:



[2010]

5. All the routers use the distance vector-based routing algorithm to update their routing table initialized to contain an entry for each neighbor with the weight of the respective connecting link. After all the routing tables stabilizes, how many links in the network will never be used for carrying any data?

(a) 4 (b) 3
(c) 2 (d) 1

Solution: (c)

R1--- → R2(6) will never be used as we have R1-- → R3(3) and R3- → R2(2).

Similarly, R4----- → R6 will never be used as we have R4-- → R5(1) and R5- → R6(3)

OR, R1-- → R5(2) and R4-- → R6(2).

Hence, the correct option is (c)

6. Suppose the weights of all unused links in the previous question are changed to 2 and the distance vector algorithm is used again until all routing tables stabilize. How many links will now remain unused?

(a) 0 (b) 1
(c) 2 (d) 3

Solution: (a)

The number of links that will remain unused will be 0 because when we make changes to R1 to R2 and R4 to R6, we will use all the links.

Hence, the correct option is (a)

7. A computer on a 10 Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 2Mbps. It is initially filled to capacity with 16 megabits. What is the maximum duration for which the computer can transmit at the full 10Mbps? **[2008]**

(a) 1.6 seconds (b) 2 seconds
(c) 5 seconds (d) 8 seconds

Solution: (b)

$S = C/M - \rho$ where $C = 16$Mbits

$M = 10$Mbps, $\rho = 2$Mbps

$S = 16/10 - 2 = 16/8 = 2$ sec.

Hence, the correct option is (b)

8. Match the following : **[2007]**

P. SMTP	1. Application Layer
Q. BGP	2.Transport Layer
R. TCP	3. Data Link Layer
S. PPP	4. Network Layer
	5. Physical Layer

(a) P-2, Q-1, R-3, S-5
(b) P-1, Q-4, R-2, S-3
(c) P-1, Q-4, R-2, S-5
(d) P-2, Q-4, R-1, S-5

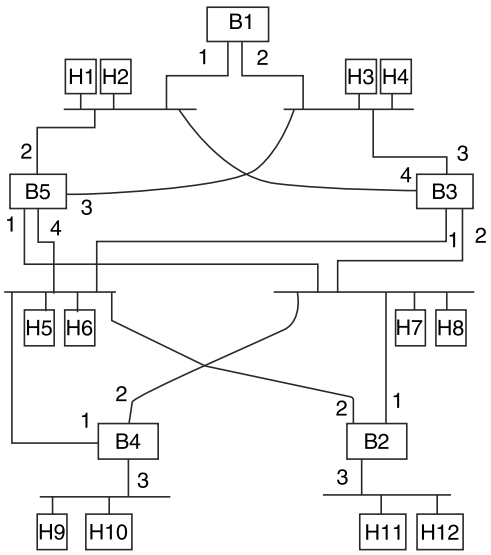
Solution: (b)

Hence, the correct option is (b)

Comman Data for Questions 09 and 010:

Consider the diagram shown below where a number of LANs are connected by (transparent) bridges. In order to avoid packets looping through circuits in the graph, the bridge organize themselves in a spanning tree. First, the root bridge is identified as the bridge with the least serial number. Next the roots sends out (one or more) data units to enable the setting up of the spanning tree of the shortest paths from the root bridge to each bridge.

Each bridge identifies a port (the root port) through which it will forward frames to the root bridge. Port conflicts are always reSolutionved in favour of the port with the lower index value. Where there is a possibility of multiple bridge forwarding to the same LAN (but not through the root port), ties are broken as follows: bridges closest to the root gets preference and between such bridges, the one with the lowest serial number is preferred.



[2006]

9. For the given connections of LANs by bridges, which one of the following choices represents the depth first traversal of the spanning tree of bridges?

(a) B1, B5, B3, B4, B2
(b) B1, B3, B5, B2, B4
(c) B1, B5, B2, B3, B4
(d) B1, B3, B4, B5, B2

Solution: (c)

In spanning tree, every bridge lies in the tree but no cycles or loops are formed. Hence, answer is B1, B5, B2, B3, B4.

Hence, the correct option is (c)

10. Consider the correct spanning tree for the previous question. Let host H1 sends out a broadcast ping packet. Which of the following options represents the correct forwarding table on B3?

(a)

Hosts	Port
H1, H2, H3, H4	3
H5, H6, H9, H10	2
H7, H8, H11, H12	2

(b)

Hosts	Port
H1, H2	4
H3, H4,	3
H5, H6,	1
H9, H10, H7, H8, H11, H12	2

(c)

Hosts	Port
H3, H4	3
H5, H6, H9, H10	1
H1, H2	4
H7, H8, H11, H12	2

(d)

Hosts	Port
H1, H2, H3, H4	3
H5, H7, H9, H10	1
H7, H8, H11, H12	4

Solution: (a)

Forwarding packets to H1, H2 through port 4 and H3, H4 through port 3 forms loop. Hence H1, H2.

H3, H4 it should be 3, H5, H6, H9, H10; it should be 1, H7, H8, H11, H12; it should be 2.

Hence, the correct option is (a)