MADE EASY

India's Best Institute for IES, GATE & PSUs

Important Questions *for* GATE 2022

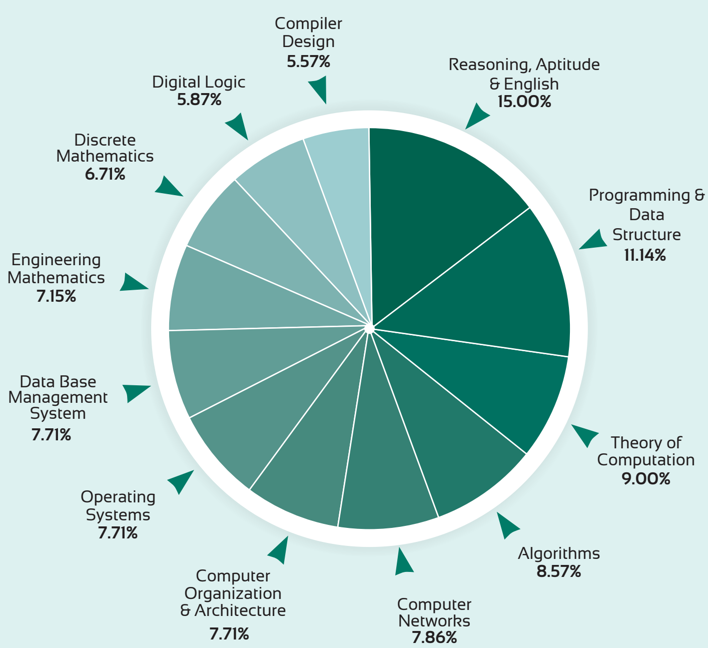
COMPUTER SCIENCE & IT

Day 4 of 8

Q.76 - Q.100 (Out of 200 Questions)

Computer Networks + Algorithms

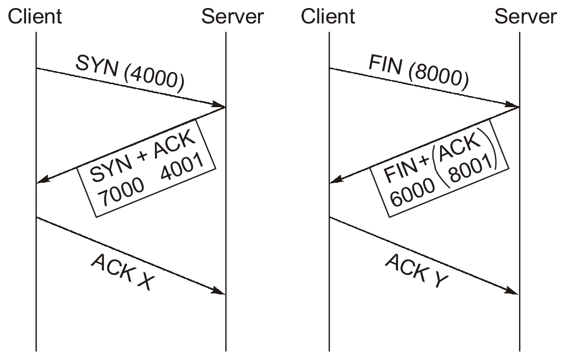
SUBJECT-WISE WEIGHTAGE ANALYSIS OF GATE SYLLABUS



Subject	Average % (last 5 yrs)
Reasoning, Aptitude & English	15.00%
Programming & Data Structure	11.14%
Theory of Computation	9.00%
Algorithms	8.57%
Computer Networks	7.86%
Operating Systems	7.71%
Computer Organization & Architecture	7.71%
Data Base Management System	7.71%
Engineering Mathematics	7.15%
Discrete Mathematics	6.71%
Digital Logic	5.87%
Compiler Design	5.57%
Total	**100%**

Computer Networks + Algorithms

Q.76 Consider the following TCP connection where only control segments are exchanged. The TCP follows the same 3-way handshaking procedure as in circuit switching. FIN and SYN have the usual meaning of TCP connections.
What are the possible values of X and Y respectively?



(a) 4002, 8002
(b) 4001, 8001
(c) 7000, 6000
(d) 7001, 6001

Q.77 Consider a 90 Kbps link. What are the respective maximum bandwidth (in Kbps) when pure aloha and slotted aloha is used?
(a) 33.12, 33.12
(b) 16.56, 16.56
(c) 16.56, 33.12
(d) 33.12, 16.56

Q.78 Match the following:

List-I (Packets)

A.

	Source IP	Destination IP
Data	250.255.255.255	40.40.40.40

B.

	Source IP	Destination IP
Data	22.21.23.24	255.255.255.255

C.

	Source IP	Destination IP
Data	24.23.22.21	24.22.23.24

List-II

1. Unicast packet within network
2. This packet never exists
3. Limited broadcasting

Codes:

	A	B	C
(a)	1	2	3
(b)	2	3	1
(c)	3	1	2
(d)	2	1	3

Q.79 Consider a network having 6 nodes A, B, C, D, E and F. The measured delay between A to B, A to D and A to C are 4, 5 and 6 respectively. Which of the following is routing table of A using distance vector routing? The vector tables of B, D, C are given as follows

	A	B	C	D	E	F
Vector table of B =	(2	0	4	4	3	2)
Vector table of C =	(5	4	0	2	7	4)
Vector table of D =	(5	1	3	0	3	6)

(a)

	A	B	C	D	E	F
	0	4	6	5	7	6
Via	–	B	C	D	B	B

(b)

	A	B	C	D	E	F
	0	6	6	4	5	7
Via	–	B	C	D	B	B

(c)

	A	B	C	D	E	F
	0	4	6	6	5	7
Via	–	B	C	D	B	B

(d) None of these

Q.80 The initial congestion window size over a TCP is 1. If slow start algorithm is used and the size of congestion window incremented by 1 whenever an ACK is received i.e. after first round trip time congestion window size is 2 segments. Assume connection never leaves slow start. Find the number of RTT in which we can send 3999 segments?

Q.81 Which of the following is true about SMTP protocol?

S_1 : It can send image files with the help of POP3.
S_2 : It can send image files with the help of IMAP4.
S_3 : IMAP4 is more secure than POP3 for retrieving information from server.

(a) Only S_1
(b) Only S_2
(c) S_2 and S_3 only
(d) S_3 Only

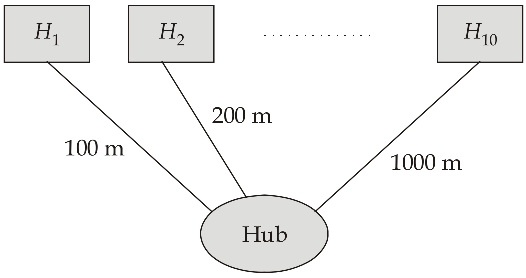
Q.82 Pick the true statements from the following.

(i) Circuit switching is a store and forward technique
(ii) Packet switching is faster as compared to circuit switching.
(iii) Packet switching wastes less resources as compared to circuit switching
(iv) Packet switching is not a store and forward technique.

(a) Only (*ii*)
(b) (*ii*) and (*iii*)
(c) Only (*i*) and (*iv*)
(d) All of these

Q.83 Station A needs to send a message consisting of 10 packets to station B using a sliding window of size 4. All packets are ready and can be transferred immediately. Selective repeat and GBN are used at 2 different times and every 5^{th} packet get lost for both protocols. (ACK's from B never gets lost). Let x and y be the number of transmissions that A has to make in selective repeat and GBN respectively to ensure safe delivery to B. Then $x + y$ = ?

Q.84 Consider the speed of propagation of a signal along a cable is 2×10^8 m/s and network has 10 Mbps CSMA/CD network interconnecting ten computers shown in below image. Each computer is connected to the hub with a cable of different length. Computer H_1 is connected via a 100 m cable, computer H_2 via a 200 m cable, computer H_3 via a 300 m cable and so on upto computer H_{10}, which is connected via a 1000 m cable (ignore the requirement of repeater due to signal degradation). Assume that the hub introduces a delay of 2.5 microseconds. What is the shortest packet length Lmin of this network in order to ensure that the CSMA/CD protocol functions properly?



(a) 340 bits
(b) 240 bits
(c) 520 bits
(d) 120 bits

Q.85 Consider a TCP message that contains 1024 bytes of data and 20 bytes of TCP header is passed to IP for delivery across two networks interconnected by a router (i.e., it travels from the source host to a router to the destination host). The first network has an MTU of 1024 bytes and the second has an MTU of 576 bytes. If all packets are correctly delivered, the number of bytes, including headers, are delivered to the IP layer at the destination for TCP message, in the best case is ________ bytes. (Assume all IP headers are 20 bytes)

Q.86 Consider two Hosts A and B are each connected to a router R via 10 Mbps links. The propagation delay on each link is 20 microseconds. R is a store and forward device i.e. transmission of the packet on the R-B link begin only if whole packet is received on the A-R link. Suppose R forwards a packet 35 microseconds (processing delay) after it has finished receiving it. The time saved when transmit 10000 bits from A to B as two 5000 bit packets sent one right after the other instead of as a single packet is ________ in µs.

Q.87 A trunk of 4000 km long operates at 1.5 Mbps is used to transmit 32 bytes frame and uses SR sliding window protocol, if propagation speed is 4 µsec/km, number of bits required for sequence number?

(a) 7
(b) 8
(c) 9
(d) 10

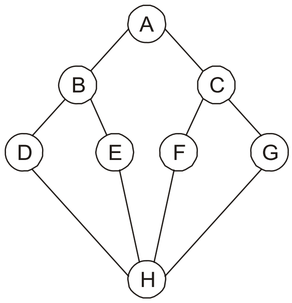
Q.88 A certain problem is having an algorithm with the following recurrence relation.

$$T(n) = 2.T\left(\sqrt{n}\right) + \log\left(\sqrt{n}\right)$$

How much time would the algorithm take to solve the problem?

(a) $\theta(\log_2 n \log_2 (\log_2 n)^2)$
(b) $\theta(\log_2 n (\log_2 n^2))$
(c) $\theta(\log_2 n \log_2 (\log_2 n))$
(d) $\theta(\log_2 n \log_2 \log_2 \log_2 n)$

Q.89 Consider the following graph:



Which of the following is NOT a depth first search traversal of the above graph?

(a) ACFHEBDG
(b) ACFHGEBD
(c) ABDHFCGE
(d) ABDEHFCG

Q.90 Suppose there are 4 sorted lists of $\frac{n}{4}$ elements each. If we merge these lists into a single sorted list of n elements, how many key comparisons in the worst case using an efficient algorithm?

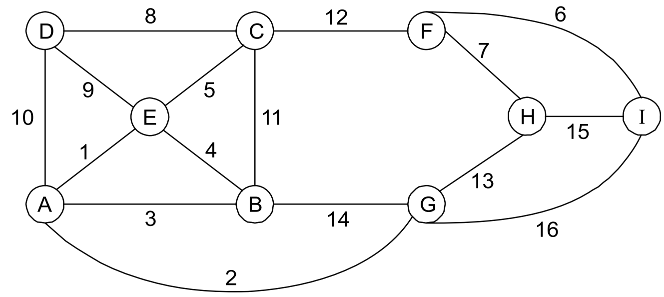
(a) $\frac{6}{4}n-3$
(b) $\frac{7}{4}n-3$
(c) $\frac{8}{4}n-3$
(d) $\frac{9}{4}n-3$

Q.91 Consider the following adjacency matrix that represents undirected graph:

	A	B	C	D
A	0	1	2	4
B	1	0	3	5
C	2	3	0	6
D	4	5	6	0

Find the minimum cost of the path whose destination is D where all vertices are covered exactly once in the path but it may start from any vertex other than D.

Q.92 Consider the weighted undirected graph below:



Assume that edge FG is added to the minimum spanning tree. For what maximum value of FG does this new edge belong to the minimum spanning tree?

Q.93 Consider the following strings x and y.

x = "csemadeeasy"

y = "gateexam"

How many longest common subsequences are possible from x and y?

Q.94 Consider the following statements:

S_1 : In a connected undirected graph $G = (V, E)$ with distinct edge costs, the cheapest edge belongs to every minimum spanning tree.

S_2 : In a connected undirected graph $G = (V, E)$ with distinct edge costs, the most expensive edge is excluded from every minimum spanning tree.

Which of the following is true?

(a) Only S_1
(b) Only S_2
(c) Both S_1 and S_2
(d) Neither S_1 nor S_2

Q.95 In a directed graph G (number of vertices = n), super-sink is a vertex whose indegree is $(n - 1)$ and outdegree is zero. What will be the optimal time complexity to determine if such a vertex exists in the graph or not if adjacency matrix representation of graph is used?

(a) $O(n)$
(b) $O(\log n)$
(c) $O(n^2)$
(d) $O(\log\log n)$

Q.96 Consider the partial pseudocode given below used to calculate median of combination of 2 sorted arrays (arr1 and arr2) of equal size n.

```
int MEDIAN(int arr1[ ], int arr2[ ], int n) {
m1 = median(arr1)   /* calculates median of array elements, If n is even, median = (middle element + next element)/2, if n is odd, median = middle element */
m2 = median(arr2)
if (m1 == m2) return m1;
if (m1 < m2) {
    if (no of elements == even) return S1;
    return MEDIAN(arr1 + n/2, arr2, n - n/2);
}
if (m1 > m2) {
        if (no of elements == even)
            return MEDIAN(arr2 + n/2 - 1, arr1, n - n/2 + 1);
        return S2;
    }
}
```

The missing argument lists are respectively:

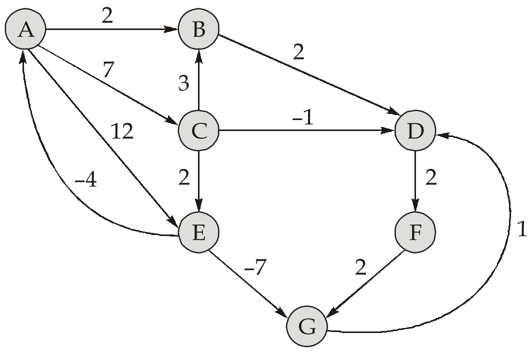
(a) MEDIAN(arr1 + $n/2$ – 1, arr2, n – $n/2$ + 1); MEDIAN(arr2 + $n/2$, arr1, n – $n/2$)
(b) MEDIAN(arr2 + $n/2$, arr1, n – $n/2$); MEDIAN(arr1 + $n/2$ – 1, arr2, n – $n/2$ + 1)
(c) MEDIAN(arr2 + $n/2$, arr1, n – $n/2$) ; MEDIAN(arr2 + $n/2$, arr1, n – $n/2$)
(d) MEDIAN(arr1 + $n/2$ – 1, arr2, n – $n/2$ + 1); MEDIAN(arr1 + $n/2$ – 1, arr2, n – $n/2$ + 1)

Q.97 Given two sequences A and B. Let $X(A, B)$ denote the number of times that A appears as subsequence of B i.e. sequence ab appears 4 times as a subsequence of aebabdb. Let A_i denotes the first i characters of string A and $A[i]$ denote the i^{th} character. Which of the following will computes the recurrence relation $C(A_i, B_j)$?

$$C(A_i, B_j) = \begin{cases} 1; & \text{if } (i = 0) \\ 0; & \text{if } (i > 0 \text{ and } j = 0) \\ ---- & -------------- \\ ---- & -------------- \end{cases}$$

(a) $C(A_i, B_{j-1})$; if $A[i] \neq B[j]$
$C(A_i, B_{j-1}) + C(A_{i-1}, B_{j-1})$; if $A[i] = B[j]$
(b) $C(A_{i-1}, B_j)$; if $A[i] = B[j]$
$C(A_i, B_{j-1}) + C(A_{i-1}, B_{j-1})$; if $A[i] = B[j]$
(c) $C(A_i, B_{j-1})$; if $A[i] = B[j]$
$C(A_i, B_{j-1}) + C(A_{i-1}, B_{j-1})$; if $A[i] \neq B[j]$
(d) None of the above

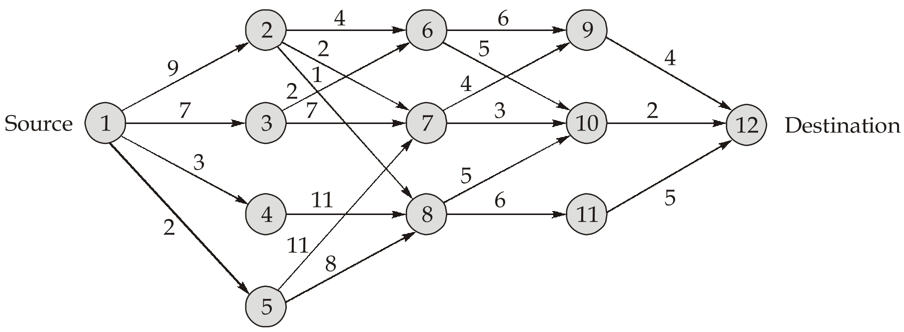
Q.98 While applying Dijkstra algorithm on given graph, it is already known that it is computing wrong path to some of the vertices. The number of wrong path computed are ________.



Q.99 A multistage graph is a directed graph in which the nodes can be divided into a set of stages such that all edges are from a stage to next stage only. There is no edge between vertices of same stage and from a vertex of current stage to previous stage. The recurrence relation for finding the shortest path distance between two vertices (i, j) is given below:

$$\text{MSG}[i] = \min_{\forall j>i}\begin{Bmatrix} 0 & \text{if } j \in F \\ e(i,j)+\text{MSG}[j] & \text{if } j \notin F \end{Bmatrix}$$

where $e(i, j)$ = weight of edge connecting i and j. F is the final stage.
The shortest path value between source and destination in the following graph is ________.



Multiple Select Question (MSQ)

Q.100 Which of the following is/are true about Subnetting?
(a) It can be applied only for single network.
(b) It is used to improve security.
(c) Here, bits are borrowed from network ID portion.
(d) Here, bits are borrowed from host ID portion.

■■■■

Detailed Explanations

76. **(d)**

The respective values are 7001, 6001.

As these are only control segments, no data is shared. Only 1 sequence number is consumed. Hence 7001, 6001 is correct answer.

77. **(c)**

For pure aloha maximum throughput is 18.4%

For slotted aloha maximum throughput is 36.8%

$$\therefore \quad \text{Pure aloha} = \frac{18.4}{100} \times 90 = 16.56 \text{ Kbps}$$

$$\therefore \quad \text{For slotted Aloha} = \frac{36.8}{100} \times 90 = 33.12 \text{ Kbps}$$

78. **(b)**

Packet A: The source IP contain direct broad cast address and we never use direct broadcast address in source IP. It is always used in destination IP. Hence packet A never exists.

Packet B: If destination IP address contain all 1's then it broadcasts within same network (Limited Broadcasting).

Packet C: It is a unicast packet within the same network as network ID 24.0.0.0 is same for both source and destination IP.

79. **(a)**

	A	B	C	D	E	F
Vector table of A via B =	(0	4	8	8	7	6)
Vector table of A via C =	(0	10	6	8	13	17)
Vector table of A via D =	(0	6	8	5	8	11)

Final vector table of A

	A	B	C	D	E	F
	0	4	6	5	7	6
Via	–	B	C	D	B	B

80. **(12)**

Window size [WS = 1] initially

⇒ After 1 RTT, window size = 2 and 1 segment is sent

⇒ After 2 RTT, window size = 4 and 3 segment sent in total

⇒ After 3 RTT, window size = 8 and 7 segment sent in total

⋮

⇒ After 'X' RTTS, window size = 2^x and $2^x - 1$ segment are sent

Now,

$$2^x - 1 = 3999$$

$$2^x = 4000$$

$$x = \log_2 (4000)$$

$$\boxed{x = 12 \text{ RTT's}}$$

81. **(d)**

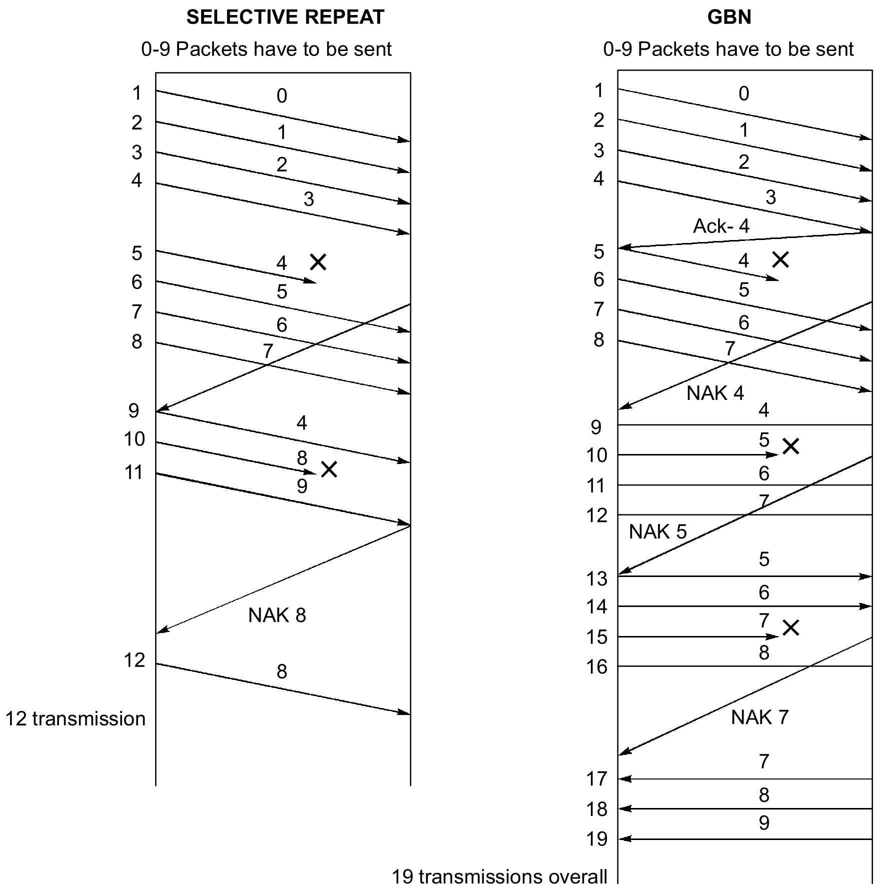
- SMTP is text based protocol and MIME extension helps in sending graphics and multimedia. POP3 and IMAP4 are used for retrieving information from server, they does not help SMTP to send multimedia. (S_1 and S_2 are false)
- IMAP4 is more secure than POP3 because it will scan for viruses before the file gets downloaded. This facility not available in POP3. (S_3 is true)

82. **(b)**

- Circuit switching is not a store and forward technique and path is predefined and router need not apply any routing algorithm until which packet would have to be stored at router. But packet switching is a store and forward technique.
- Packet switching is faster because it has only 1 phase (data transfer), where as circuit switching is slower because it is having 3 phases (connection establishment, data transfer and connection release).

83. **(31)**

In R.T.T time only 4 (window size) frames can be transmitted in sliding window protocol.



$x = 12, y = 19 \Rightarrow x + y = 31$

84. (b)

The maximum end-to-end propagation delay is = $\frac{(1000\,\text{m} + 900\,\text{m})}{(2 \times 10^8\,\text{m/s})}$ = 9.5 μsec

The hub introduces an additional 2.5 microseconds delay.

The time taken to transmit $L_{min} \geq 2 \times (9.5\ \mu\text{sec} + 2.5\ \mu\text{sec}) \geq 24\ \mu\text{sec}$

Hence, L_{min} = 24 μsec × 10 Mbps
= 240 bits

85. (1104)

First network: An MTU of 1024 means that is the largest IP datagram that can be carried, so a datagram has room for 1024 – 20 = 1004 bytes of IP-level data, because 1004 is not a multiple of 8, each fragment can contain at most $8 \times \left\lfloor \frac{1004}{8} \right\rfloor$ = 1000 bytes.

We need to transfer 1024 + 20 = 1044 bytes of data (TCP header is included).

This would be fragmented into fragments of size 1000 bytes, and 44 bytes.

Second network: The 44 byte packet would be unfragmented but the 1000-data-byte packet would be fragmented as follows. The 576 byte MTU allows for up to 576 – 20 = 556 bytes of payload.

So rounding down to a multiple of 8 again allows = 552 bytes in the first fragment.

And remaining 448 bytes in the second fragment.

So total bytes = 552 + 20 + 448 + 20 + 44 + 20
= 1104 bytes

86. (500)

Transmit delay of one link = 10^4 bits/10^7 (bits/sec) = 1000 μs

Transmission time for sending as single packet = 2 × 1000 + 2 × 20 + 35 = 2075 μs

When sending as 2 packets,

We have a total of one switch delay and two link delays;

Transmit delay = 5000 bits/10^7 (bits/sec) =500 μs

Transmission time for sending as multiple packets = 3 × 500 + 2 × 20 + 1 × 35 = 1575 μs

Time saved = (2075 – 1575)μs = 500 μs

87. (c)

Propagation speed is 4 μsec/km

$$\text{Round trip time} = 2 \times 4000 \times 4\ \mu\text{sec} = 32\ \text{ms}$$

In 1 sec → 1.5×10^6 bits

In 32 msec → $32 \times 10^{-3} \times 1.5 \times 10^6$

$$= 48000 \text{ bits are covered}$$

In SR sliding window protocol

$$\text{Sender window size} = \text{Receiver window size} = 2^{K-1}$$

Where K is number of bits for sequence number.

$$\text{Number of frames can send in 1 RTT } (2^{K-1}) = \frac{48000 \text{ bit}}{32 \times 8 \text{ bit}} = 187.5$$

$$2^{K-1} = 187.5$$

$$K - 1 = \log(187.5) \cong 8$$

$$K = 9$$

88. (c)

Here Master's theorem is not applicable directly.

$$T(n) = 2.T\left(\sqrt{n}\right) + \log\left(\sqrt{n}\right)$$

Put $n = 2^k$

$$T(2^k) = 2.T\left(2^{\frac{k}{2}}\right) + \log_2\left(2^{\frac{k}{2}}\right)$$

$$T(2^k) = 2.T\left(2^{\frac{k}{2}}\right) + \frac{k}{2}$$

put $S(k) = T(2^k)$

$$S(k) = 2.S\left(\frac{k}{2}\right) + \frac{k}{2}$$

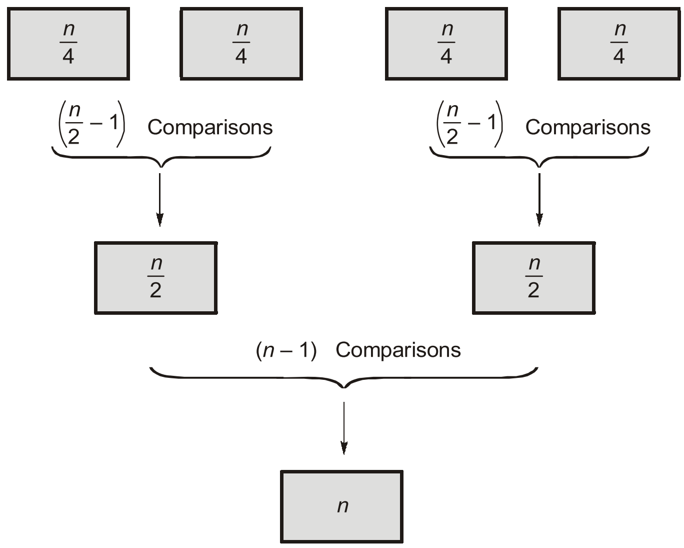
Now apply Master's theorem: $S(k) = \theta(k \log k)$

$$\boxed{T(2^k) = \theta(\log n . \log \log_2 n)}$$

89. (d)

ABDEHFGH is not DFS traversal.

90. **(c)**



$$\text{Total comparisons} = \left(\frac{n}{2}-1\right)+\left(\frac{n}{2}-1\right)+(n-1) = 2n - 3$$

$$= \frac{8}{4}n-3$$

91. **(8)**

$\{A, B, C\} \to$ D (destination is D). There are 6 possible paths which reaches to *D*

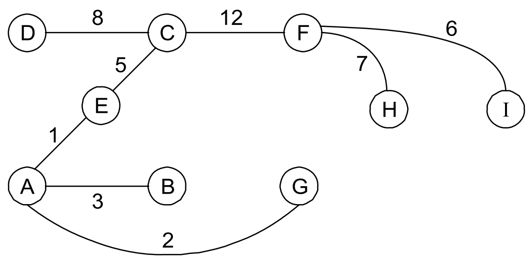
A – B – C – D
A – C – B – D
B – C – A – D
B – A – C – D
C – A – B – D
C – B – A – D

(1) A – B – C – D = 1 + 3 + 6 = 10
(2) A – C – B – D = 2 + 4 + 5 = 11
(3) B – C – A – D = 3 + 2 + 4 = 9
(4) B – A – C – D = 1 + 2 + 6 = 9
(5) C – A – B – D = 2 + 1 + 5 = 8
(6) C – B – A – D = 3 + 1 + 4 = 8

There are two paths produces minimum cost 8.

92. **(12)**

Minimum spanning tree:



If FG edge is added to the MST we can throw away largest edge in the loop (AECFGA).

$$FG_{max} = 12$$

93. **(1)**

$$x = \text{csemadeeasy}$$
$$y = \text{gateexam}$$
$$\text{LCS}(x, y) = \text{aeea}$$

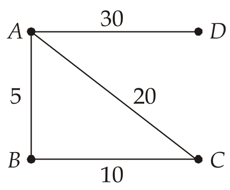
Only "aeea" is longest common subsequence.

94. **(a)**

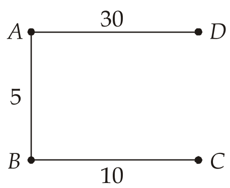
Since edges costs are distinct, so cheapest edge must be present in every minimum spanning tree while expensive edge is may not excluded from every minimum spanning tree.

Statement S_2 is false

Example:



MST will be:



So, most expensive edge is not excluded.

95. (a)

A vertex is super sink if and only if $M[i, j] = 0\ \forall\ j$ and $M[j, i] = 1\ \forall\ j \neq i$.

Traverse over the matrix and check the above condition,

Using below program we can find super-sink in directed graph:

```
i = 0;
do
{
    j = i + 1;
    while ((j < n) && !A[i][j]) j++;
    if (j < n) i = j;
} while (i < n);
flag = 1;
for (j = 0; j < n; j++)
    if ((j! = i) && (A[i][j] || !A[j][i])) flag = 0;
        if (flag) printf("Sink exists");
        else printf ("Sink does not exist");
```

96. (a)

If m1 is greater than m2, then median is present in between first element of arr1 to m1 or from m2 to last element of arr2.

If m2 is greater than m1, then median is present in between m1 to last element of arr1 or from first element of arr2 to m2.

97. (a)

$$C(A_i, B_j) = \begin{cases} 1; & \text{if } (i = 0) \\ 0; & \text{if } (i > 0 \text{ and } j = 0) \\ C(A_i, B_{j-1}); & \text{if } (A[i] \neq B[i]) \textbf{ when elements are not matched.} \\ C(A_i, B_{j-1}) + C(A_{i-1}, B_{j-1}); & \text{if } (A[i] = B[i]) \textbf{ when elements are matched.} \end{cases}$$

98. (3)

	Using Dijkstra algorithm		Actual Shortest path	
A → B	2	AB	2	AB
C	7	AC	7	AC
D	4	ABD	3	ACEGD
E	9	ACE	9	ACE
F	6	ABDF	5	ACEGDF
G	8	ABDFG	2	ACEG

So, there are 3 wrong path calculated to D, F and G vertices.

99. **(16)**

$$\text{MSG}(12) = 0 \text{ since } 12 \in F$$
$$\text{MSG}(11) = e(11, 12) + \text{MSG}(12) = 5 + 0 = 5$$
$$\text{MSG}(10) = 2$$
$$\text{MSG}(9) = 4$$
$$\text{MSG}(8) = \min(e(8, 10) + \text{MSG}(10), e(8, 11) + \text{MSG}(11))$$
$$= \min(5 + 2, 6 + 5) = 7$$

and so on ....

Finally,

1	2	3	4	5	6	7	8	9	10	11	12
16	7	9	18	15	7	5	7	4	2	5	0

So, the shortest path value between source and destination is 16.

[**Trick:** If the graph given is multistage graph, than greedy approach can be used from backwards for choosing the minimum weight, edge until reach source.]

100. **(a, b, d)**

In Subnetting bits are borrowed from host ID portion.

■■■■