



**NATIONAL INSTITUTE OF TECHNICAL TEACHERS
TRAINING AND RESEARCH**
(DEEMED TO BE UNIVERSITY UNDER DISTINCT CATEGORY)
CHANDIGARH

Ph.D. Entrance Examination 2024

Subject / Branch / Department :	COMPUTER SCIENCE & ENGINEERING
Roll No. :	
Candidate Name :	
Date of Examination :	

Maximum Marks: 25 (There is no negative marking)

- Notes:** (a) Only one option to be tick-marked out of the four options given as answer
 (b) The Candidate must put his/her signature with date at the bottom of each page
 (c) For any rough work, please use ONLY back-sides of pages which are left blank

Q1. Consider the following sample of numbers: 9, 18, 11, 14, 15, 17, 10, 69, 11, 13.

The median of the sample is

- (A) 13.5
 (B) 14
 (C) 11
 (D) 18.7

Q2. In a B+ tree the requirement of at least half full (50%) node occupancy is relaxed for which are of the following case?

- (a) All leaf node (b) Only the root node
 (c) All internal nodes (d) Only the left most leaf node

Q3. For the code given in the box on the right-hand side, which one of the following statements is correct?

- (a) The program gets stuck in an infinite loop.
 (b) The program prints 9 as output.
 (c) The program Output is 10.
 (d) The program Output is 6.

```
#include <stdio.h>
int main()
{
    int a = 6;
    int b = 0;
    while (a < 10)
    {
        a = a/12 + 1;
        a+ = b;
    }
    printf("%d", a);
    return 0;
}
```

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Q4. Which of the following statements about relation R in 1NF is/are True?

- (a) R cannot have a foreign key
- (b) R can have a multi-attribute key
- (c) R cannot have more than one candidate key
- (d) R cannot have a composite key

Q5. Consider a system that uses 5 bits for representing signal integers in 2's complement format. In this system two integer A and B are represented as $A = 01010$ and $B = 11010$. Which one of the following operation will result in either an arithmetic overflow or an arithmetic underflow.

- (a) $A - B$
- (b) $B - A$
- (c) $A + B$
- (d) $2 \times B$

Q6. An array [82, 101, 90, 11, 111, 75, 33, 131, 44, 93] is heapified. Which one of the following options represents the first three element in the heapified array?

- (a) 131, 11, 93
- (b) 131, 111, 90
- (c) 82, 11, 93
- (d) 82, 90, 101

Q7. Consider a binary min-heap containing 105 distinct elements. Let K be the index (in the underlying array) of the maximum element stored in the heap. The number of possible values of k is .

- (a) 52
- (b) 27
- (c) 1
- (d) 53

Q8. About thread is/are true

- (a) Thread belonging to a process are by default not protected each other.
- (b) Each thread has it's file descriptive table for operfiles.
- (c) Threads can only be implement in kernal sapce
- (d) All the thread belonging to a process store a common stack.

Q9. In an engineering college of 10,000 students, 1,500 like neither their core branches nor other branches. The number of students who like their core branches is $\frac{1}{4}$ th of the number of students who like other branches. The number of students who like both their core and other branches is 500.

The number of students who like their core branches is

- (A) 1,800
- (B) 3,500
- (C) 1,600
- (D) 1,500

Q10. Consider the number $(10.625)_{10}$, the binary equivalent is

- a) 1010
- b) 1010.10
- c) 1010.101
- d) None of these

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Q11. Which of the following bit patterns give best performance using booth's algorithm ?

- a) 11001100 b) 00110011
c) 01010101 d) 11111111

Q12. The number of instructions which may possibly be executed by a computer depends upon the size of

- a) Opcode b) PC
c) MAR d) Word

Q13. RISC processor employs

- a) Branch prediction
b) Delay branch strategy
c) Loop buffer
d) None of these

Q14. Which of the following are displacement addressing modes?

- a) Relative b) Index
c) Base d) All of these

Q15. The number of memory references required for CPU to execute direct mode address reference is

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

Q16. How many 128 X 8 RAM chips are needed to provide a memory capacity of 2048 byte?

- b) 8 b) 16
c) 24 d) 32

Q17. Which of the following is true about linked list implementation of stack?

- a) In push operation, if new nodes are inserted at the beginning of linked list, then in pop operation, nodes must be removed from end.
b) In push operation, if new nodes are inserted at the end, then in pop operation, nodes must be removed from the beginning.
c) Both of the above
d) None of the above

Q 18. Let $G(V, E)$ an undirected graph with positive edge weights. Dijkstra's single-source shortest path algorithm can be implemented using the binary heap data structure with time complexity:

- a) $O(|V|^2)$ b) $O((|E| + |V|) \log |V|)$
c) $O(|V| \log |V|)$ d) $O(|E| + |V| \log |V|)$

Q 19. What is recurrence for worst case of QuickSort and what is the time complexity in Worst case?

- a) Recurrence is $T(n) = T(n-1) + O(n)$ and time complexity is $O(n^2)$
- b) Recurrence is $T(n) = T(n-2) + O(n)$ and time complexity is $O(n^2)$
- c) Recurrence is $T(n) = 2T(n/2) + O(n)$ and time complexity is $O(n \log n)$
- d) Recurrence is $T(n) = T(n/10) + T(9n/10) + O(n)$ and time complexity is $O(n \log n)$

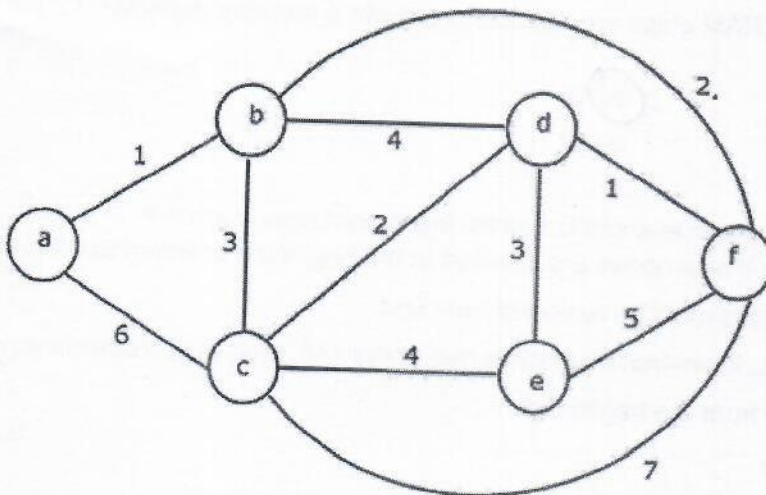
Q 20. Given a directed graph where weight of every edge is same, we can efficiently find shortest path from a given source to destination using?

- a) Breadth First Traversal
- b) Dijkstra's Shortest Path Algorithm
- c) Neither Breadth First Traversal nor Dijkstra's Algorithm
- d) Depth First Search

Q 21. Which of the following is not true about comparison based sorting algorithms?

- a) The minimum possible time complexity of a comparison based sorting algorithm is $O(n \log n)$ for a random input array $O(|E| + |V| \log |V|)$
- b) Any comparison based sorting algorithm can be made stable by using position as a criteria when two elements are compared
- c) Counting sort is not a comparison based sorting algorithm
- d) Heap sort is not a comparison based sorting algorithm

Q 22. Consider the following graph:

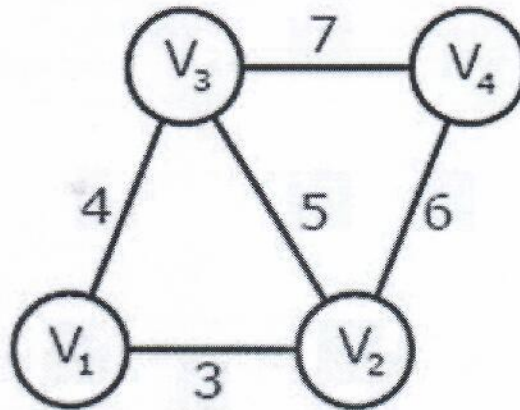


Which one of the following cannot be the sequence of edges added, in that order, to a minimum spanning tree using Kruskal's algorithm?

- a) $(a-b), (d-f), (b-f), (d-c), (d-e)$
- b) $(a-b), (d-f), (d-c), (b-f), (d-e)$
- c) $(d-f), (a-b), (d-c), (b-f), (d-e)$
- d) $(d-f), (a-b), (b-f), (d-e), (d-c)$

Ph.D. Entrance Exam – 2024, NITTTR Chandigarh

Q 23. An undirected graph $G(V, E)$ contains n ($n > 2$) nodes named v_1, v_2, \dots, v_n . Two nodes v_i, v_j are connected if and only if $0 < |i - j| \leq 2$. Each edge (v_i, v_j) is assigned a weight $i + j$. A sample graph with $n = 4$ is shown below. What will be the cost of the minimum spanning tree (MST) of such a graph with n nodes?



- a) $\frac{1}{12}(11n^2 - 5n)$
- b) $n^2 - n + 1$
- c) $6n - 11$
- d) $2n + 1$

Q 24. An undirected graph G has n nodes. Its adjacency matrix is given by an $n \times n$ square matrix whose (i) diagonal elements are 0's and (ii) non-diagonal elements are 1's. which one of the following is TRUE?

- a) Graph G has no minimum spanning tree (MST)
- b) Graph G has a unique MST of cost $n-1$
- c) Graph G has multiple distinct MSTs, each of cost $n-1$
- d) Graph G has multiple spanning trees of different costs

Q 25. Maximum Subarray Sum problem is to find the subarray with maximum sum. For example, given an array $\{12, -13, -5, 25, -20, 30, 10\}$, the maximum subarray sum is 45. The naive solution for this problem is to calculate sum of all subarrays starting with every element and return the maximum of all. We can solve this using Divide and Conquer, what will be the worst case time complexity using Divide and Conquer.

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

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