



**MAULANA ABUL KALAM AZAD UNIVERSITY OF
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Paper Code : PCC-CS-301

PUID : 03443 (To be mentioned in the main answer script)

DATA STRUCTURE & ALGORITHMS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following : $10 \times 1 = 10$

- i) The worst case complexity of binary search for a list having n elements is
- a) $\log 2^n$ b) $n \log 2^n$
c) n d) n^2 .

- ii) Which among the following are applications of queues ?
- Queues keep track of events waiting to be handled, like multiple button clicks
 - Queues are used for evaluation of arithmetic expressions
 - Queues are used in parsing
 - None of these.
- iii) A full binary tree with n non-leaf nodes contains
- $\log 2n$ nodes
 - $n + 1$ nodes
 - $2n$ nodes
 - $2n + 1$ nodes.
- iv) Consider that n elements are to be stored. What is the worst case time complexity of Bubble sort ?
- $O(1)$
 - $O(\log 2n)$
 - $O(n)$
 - $O(n^2)$.
- v) The pre-requisite condition of binary search is
- Unsorted array
 - Ascending order array
 - Descending order array
 - Sorted array.

- vi) The following sequence of operations are performed on a stack : push (1), push (2) , pop, push (1), push (2), pop, pop, pop, push (1) pop. The sequence of popped out values are
- a) 2, 2, 1, 1, 1
 - b) 2, 2, 1, 2, 2
 - c) 2, 1, 2, 2, 1
 - d) 2, 1, 2, 2, 2.
- vii) The postfix equivalent of the prefix expression $* +ab - cd$ is
- a) $ab + cd - *$
 - b) $abcd + - *$
 - c) $ab + cd * -$
 - d) $ab + - cd *$.
- viii) Linked list is a
- a) Linear data structure
 - b) Dynamic data structure
 - c) Self referential data structure
 - d) all of these.
- ix) One limitation of linked list is
- a) it requires huge memory space
 - b) it requires contiguous memory space
 - c) nodes can only be accessed sequentially
 - d) nodes can only be accessed randomly.
- x) What is the worst case performance of Selection sort algorithm ?
- a) $O(\log n)$
 - b) $O(n * n)$
 - c) $O(n)$
 - d) $O(n \log n)$.

- xi) A sort which relatively passes through a list to exchange the first element with any element less than it and then repeats with a new first element is called
- a) insertion sort
 - b) selection sort
 - c) heap sort
 - d) quick sort.
- xii) Recursion uses more memory space than iteration because
- a) it uses stack instead of queue
 - b) every recursive call has to be stored
 - c) both (a) and (b)
 - d) none of these.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$.

2. Write an algorithm for Binary Search with non-recursive function call.

3/ Write the algorithms for PUSH and POP for linked representation of stack. $2\frac{1}{2} + 2\frac{1}{2}$

4/ Explain with suitable example the collision resolution scheme using linear probing with open addressing.

5. Write an algorithm to delete a node having value NUM from a Doubly linked list.
6. Sort the following data using bubble sort algorithm (show the intermediate outputs) :
- 12, 32, 23, 15, 34, 11, 25.

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Explain Dijkstra's algorithm for finding the shortest distance between two given nodes. Consider a graph of your choice having at least five nodes and specific weight assigned to each edge.
- b) What is priority queue ?
- c) How can the polynomial $4x^6 + 7x^3 + 2$ be represented using a linked list and an array ? Also explain why arrays should not be used in this regard.
- d) What is the necessity of having circular queue ?

$7 + 2 + 4 + 2$

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- Q. a) How does AVL tree differ from binary search tree ?
b) Explain different rotation mechanisms in AVL tree.
c) Build an AVL tree with nodes inserted in the following order :

8, 12, 9, 11, 7, 6, 62, 15, 3

Clearly mention different rotations used and balance factor of each node.

- (d) Show that for a non-empty binary tree, if n_0 is the number of leaf nodes and n_2 is the number of nodes of degree 2 then $n_0 = n_2 + 1$. $3 + 3 + 4 + 5$

- Q. a) Create a binary search tree using the following data elements : <http://www.makaut.com>
54, 60, 69, 32, 46, 25, 81, 29, 75, 78

- b) Explain with example the process of deleting a node from a binary search tree.

- c) Write down the algorithm for deleting a node from a binary search tree considering all possible cases of number of children.

$4 + 5 + 6$

10. a) Explain linear and non-linear data structure with example.
- b) Explain different types of data structure operations.
- c) What is meant by algorithmic complexity ?
- d) What is time-space trade-off ? 4 + 4 + 4 + 3

11. a) Explain Selection Sort algorithm.

b). Write an algorithm for Selection Sort. L

c) Compare Selection Sort with Insertion Sort.

d)- Sort the following data using selection sort algorithm (show the intermediate outputs) :

23, 12, 21, 15, 14, 50, 13.

3 + 4 + 4 + 4

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