

**DATA STRUCTURE AND BASIC ALGORITHMS
(CSE2004)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) What is a data structure?
(a) A programming language (b) A collection of algorithms
(c) A way to store and organize data (d) A type of computer hardware.
- (ii) What are the disadvantages of arrays?
(a) Index value of an array can be negative
(b) Elements are sequentially accessed
(c) Data structure like queue or stack cannot be implemented
(d) There are chances of wastage of memory space if elements inserted in an array are lesser than the allocated size.
- (iii) What does the following function do for a given Linked List with the first node as head?
void fun1(struct node* head)
{
 if(head == NULL)
 return;
 fun1(head→next);
 printf(“%d”, head→data);
}
(a) Print all nodes in the list
(b) Print all nodes in reverse order
(c) Prints alternate nodes of Linked List
(d) Prints alternate nodes in reverse order
- (iv) What is the time complexity of push and pop operations in a stack implemented using an array?
(a) O(1) (b) O(n) (c) O(log n) (d) O(n²)
- (v) In a queue, where is the new element inserted?
(a) Front (b) Rear (c) Middle (d) None of the above.

- (vi) What is the worst case time complexity of the Breadth First Search algorithm on a graph having V vertices & E edges?
 (a) $O(V+E)$ (b) $O(V^2)$ (c) $O(V*E)$ (d) $O(E^2)$.
- (vii) What is the worst case time complexity of searching a key in a binary search tree having 'n' nodes?
 (a) $O(n)$ (b) $O(\log_2 n)$ (c) $O(n^2)$ (d) $O(1)$.
- (viii) What is the time complexity of finding the maximum number in an unsorted array?
 (a) $O(n)$ (b) $O(\lg n)$ (c) $O(n^2)$ (d) $O(n*\lg n)$.
- (ix) What is the best time complexity of Linear search?
 (a) $O(1)$ (b) $O(n)$ (c) $O(\lg n)$ (d) $O(n^2)$.
- (x) Which of the following sorting algorithms is not based on the divide-and-conquer principle?
 (a) Quick Sort (b) Merge Sort (c) Heap Sort (d) Bubble Sort.

Fill in the blanks with the correct word

- (xi) Sparse matrix _____ format is used to save the memory space of sparse matrix.
- (xii) The _____ points to the first node in a linked list.
- (xiii) After creating a linked list's head pointer, you should make sure it points to _____ before using it in any operations.
- (xiv) The total number of comparisons performed in the best case of the Selection Sort algorithm on an array of 'n' elements is _____.
- (xv) The maximum number of nodes in a binary heap of height 'h' is _____.

Group - B

- 2. (a) What is Big-Oh notation? [[CO1](Remember/LOCQ)]
 - (b) Prove that the following function $f(n)$ is the $O(n^3)$. [[CO1](Analyse/IOCQ)]
 $f(n) = 7n^3 + 2n^2 + 5$
 - (c) What is Data structure? [[CO1](Remember/LOCQ)]
 - (d) What are the basic properties of an algorithm? [[CO1](Remember/LOCQ)]
- 3 + 3 + 3 + 3 = 12**
- 3. (a) Consider a List using an array. What is the time complexity of the following operations?
 (i) Insert a beginning (ii) Delete from beginning (iii) Append
 (iv) Delete from end (v) Insert a position (vi) Delete from position
[[CO2](Understand/IOCQ)]
 - (b) What are the demerits of implementing a List using an array? [[CO2](Understand/IOCQ)]
 - (c) Consider the following loop and calculate its time complexity.

```
for(i=1;i<=n; i++)
{
    printf("Hello world\n");
}
```

```

    for(j=1;j<=i; j++)
        printf("Hello world of C\n");
}

```

[[CO1](Evaluate/HOCQ)]

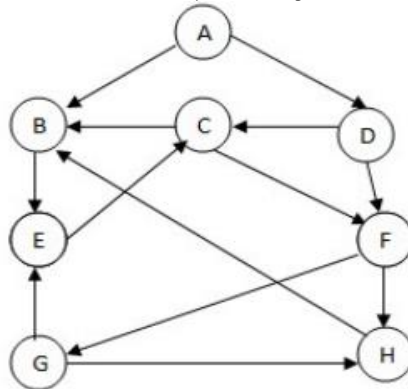
6 + 2 + 4 = 12

Group - C

4. (a) Write the pseudo code of stack operations (PUSH, POP, PEEK) using an array. [[CO2](Understand/LOCQ)]
 (b) How stack can be used to check the validity of parentheses in any algebraic expression? [[CO4](Analyse/HOCQ)]
 (c) How reversing a list can be done using stack? [[CO2](Understand/IOCQ)]
6 + 3 + 3 = 12
5. (a) Differentiate between iteration and recursion. [[CO2](Understand/LOCQ)]
 (b) Explain with code examples: direct, indirect, and tail recursion. [[CO2](Understand/IOCQ)]
3 + (3 + 3 + 3) = 12

Group - D

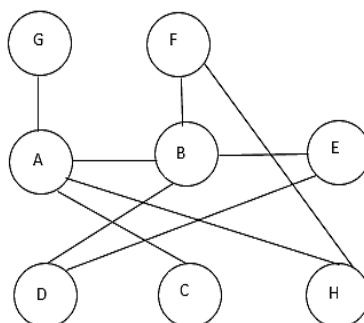
6. (a) Obtain the adjacency matrix & adjacency list of the following graph.



[[CO1](Apply/IOCQ)]

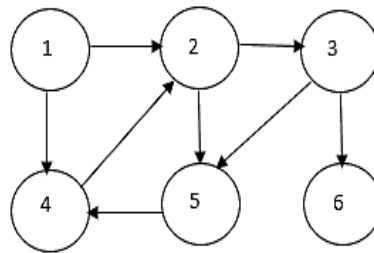
- (b) Create a binary search tree with the input:- 98, 2, 48, 12, 56, 32, 4, 67, 23, 87, 21, 55, 46. Thereafter, delete the values 23, 56 and 2. Show all steps. [[CO3](Apply/HOCQ)]
(3 + 3) + (3 + 3) = 12

7. (a) Write the pseudo-code for Breadth First Search traversal & show all steps of running your code on the given input graph taking G as the source node:-



[[CO1](Analyse/HOCQ)]

- (b) (i) Write the pseudo-code for Depth First Search traversal & mention the time complexity of the algorithm. [[CO3](Analyse/IOCQ)]
- (ii) Show the Depth First Search Traversal Sequence of the following graph starting from the source vertex numbered 1, along with the discovery & finishing time of each vertex of the graph. [[CO3](Apply/HOCQ)]



$$(3 + 3) + (3 + 3) = 12$$

Group - E

8. (a) Write a binary search function for an element in a sorted array. What is the time complexity of the Binary search function? [[CO4](Understand/LOCQ)]
- (b) Consider the following data sequence in the array.
10,100,85,65,95, 150,75,80.
Apply the Quick Sort algorithm to sort the array. Discuss all the passes with relevant figures. [[CO4](Apply/IOCQ)]
- $$(5 + 1) + 6 = 12$$
9. (a) Explain the methodology of Heap sort with examples. What is the time complexity of the Heap sort methodology? [[CO4](Apply/IOCQ)]
- (b) Explain the methodology of Merge sort with examples. What is the time complexity of the Merge sort algorithm? [[CO4](Apply/IOCQ)]
- $$(5 + 1) + (5 + 1) = 12$$

| Cognition Level | LOCQ | IOCQ | HOCQ |
|-------------------------|------|-------|-------|
| Percentage distribution | 25 | 52.08 | 22.92 |