

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) Which of the following can be done with Linked List?
(a) Stack (b) Queue
(c) Binary Search tree (d) All of the above
- (ii) In general, the index of the first element in an array is _____
(a) 0 (b) -1 (c) 2 (d) 1
- (iii) What is the primary difference between a stack and a queue?
(a) Stack is FIFO, Queue is LIFO
(b) Stack is LIFO, Queue is FIFO
(c) Stack allows access from both ends, Queue does not
(d) Stack is linear, Queue is non-linear
- (iv) Input restricted deque allows:
(a) insertion at both ends (b) deletion at both ends
(c) insertion at one end only (d) deletion at one end only
- (v) What is the best 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) $O(1)$
- (vi) What is the degree of a vertex in an undirected graph?
(a) The number of edges incident to the vertex
(b) The number of edges leaving the vertex
(c) The number of adjacent vertices to the vertex
(d) The total number of vertices in the graph
- (vii) Postorder traversal order is:
(a) root, left, right (b) left, right, root
(c) right, left, root (d) root, right, left

- (viii) Quick sort uses which of the following methods to implement sorting?
 (a) partitioning (b) selection
 (c) exchanging (d) merging
- (ix) Which of the following is true about binary search?
 (a) It can be applied to any list, sorted or unsorted.
 (b) It has a worst-case time complexity of $O(n)$.
 (c) It requires the list to be sorted before the search is performed.
 (d) It works faster than linear search on all types of lists.
- (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) The _____ points to the first node in a linked list.
- (xii) A _____ queue allows the queue to wrap around when the rear end is reached.
- (xiii) The two ends of a deque are called _____ and _____.
- (xiv) The height of a skewed binary tree having 'n' nodes is _____.
- (xv) A circular linked list has no _____ pointer.

Group - B

2. (a) Consider a doubly linked list with head and tail pointer. Now write pseudo code/C function for the following operations.
 (i) Insert a node at a particular position.
 (ii) Delete the last element of the list. [[CO2](Implement/HOCQ)]
- (b) Calculate the time complexity of the following loop.

```
while(n!=1){
    n=n/2;
    printf("Data structure\n"); }
```

[[CO1](Apply/IOCQ)]
 $(5 + 4) + 3 = 12$
3. (a) Consider $M[][]$ as a two-dimensional array of integers starting at 1000. The number of rows and columns are 10 and 5. Now calculate the address of $M[6][3]$ using row-major and column-major-addressing policy. [[CO1](Remember/LOCQ)]
- (b) Consider a Circular linked list with the tail pointer. Now write pseudo code/C function for the following operations.
 (i) Delete the first element.
 (ii) Insert a node at the first position. [[CO2](Implement/HOCQ)]
 $(2 + 2) + (4 + 4) = 12$

Group - C

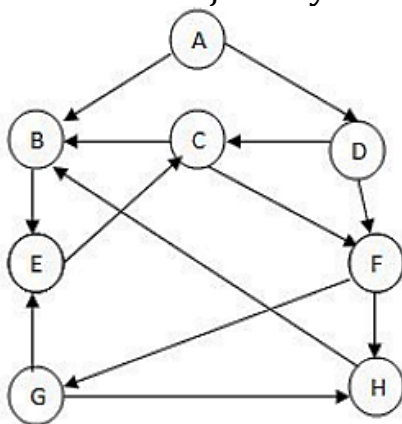
4. (a) Differentiate between iteration and recursion. [[CO1](Remember/LOCQ)]

- (b) Write the algorithm for evaluation of postfix expression. [[CO2](Apply/IOCQ)]
 (c) Evaluate the following:
 $a b c * + d e f ^ / -$ where $a=2, b=3, c=4, d=16, e=2, f=3$. [[CO2](Apply/IOCQ)]
 $3 + 5 + 4 = 12$

5. (a) Write the algorithm for implementing a circular queue using an array. [[CO2](Apply/IOCQ)]
 (b) Discuss the benefits of using a circular queue over a simple queue. [[CO2](Remember/LOCQ)]
 (c) How reversing a list can be done using stack. [[CO2](Develop/HOCQ)]
 $5 + 3 + 4 = 12$

Group - D

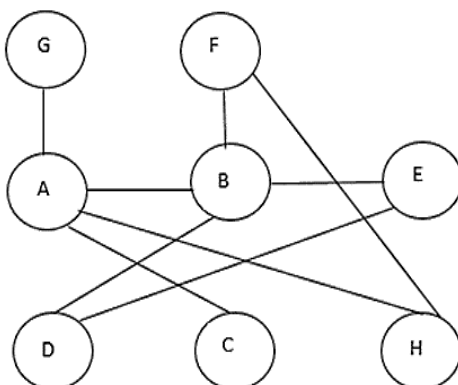
6. (a) Obtain the adjacency matrix & adjacency list of the following graph.



[[CO3](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/IOCQ)]
 $6 + 6 = 12$

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:-



[[CO3](Analyse/HOCQ)]

- (b) What are the possible values of the balance factor of an AVL tree? Compare with proper justification between a binary search tree and an AVL tree on the basis of the worst case time complexities of the following operations:-
 (i) Insertion of a node (ii) Searching of a node value
 (iii) Deletion of a node

[[CO3](Remember/LOCQ)]

$5 + (1 + 2 \times 3) = 12$

Group - E

8. (a) Given a hash table of 100 locations (0 to 99), calculate the hash value using the folding method for keys 500098, 351899, and 777709. [[CO4](Apply/IOCQ)]
(b) Explain why double hashing is preferred over linear probing and quadratic probing with multiple examples. [[CO4](Apply/IOCQ)]
6 + 6 = 12
9. (a) Describe Bubble Sort with algorithm. How we can modify the algorithm to minimize best case time complexity? Write the function to describe the changes. [[CO4](Develop/IOCQ)]
(b) What are the different ways to define pivot element in Quick Sort. Explain with a comparative analysis. [[CO4](Analyze/IOCQ)]
(c) Write a short note on Hashing. [[CO4](Remember/LOCQ)]
6 + 4 + 2 = 12
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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	20	53	27