

Instructions:-

- (i) The marks are indicated in the right-hand margin.
- (ii) There are NINE questions in this paper.
- (iii) Attempt FIVE questions in all.
- (iv) Question No. 1 is compulsory.

Q.1 Choose the correct answer of the following (Any seven question only): **[2 x 7 = 14]**

- (a) In a stack, if a user tries to remove an element from empty stack it is called:
 - (i) underflow
 - (ii) empty collection
 - (iii) garbage collection
 - (iv) overflow
- (b) Consider the binary max-heap implemented using an array. Which one of the following array represents the heap:
 - (i) 25, 12, 16, 13, 10, 8, 14
 - (ii) 25, 12, 16, 13, 10, 8, 14
 - (iii) 25, 14, 16, 13, 10, 8, 12
 - (iv) 25, 14, 12, 13, 10, 8, 16
- (c) A hash function h defined as $h(\text{key}) = \text{key} \bmod 7$, with linear probing used to insert keys 44, 45, 79, 55, 91, 18, 63 into a table indexed from 0 to 6. What will be the location of key 18.
 - (i) 3
 - (ii) 4
 - (iii) 5
 - (iv) 6
- (d) If the number of values to be sorted is already partially sorted, then _____ sorting can be efficient.
 - (i) merge
 - (ii) insertion
 - (iii) bubble
 - (iv) selection
- (e) The time complexity of merge sort is:
 - (i) $O(n)$
 - (ii) $O(\log n)$
 - (iii) $O(n \log n)$
 - (iv) $O(n^2)$
- (f) State true or false:
 - A : Binary search is used for searching in a sorted array.
 - B : The time complexity of binary search is $O(\log n)$
 - (i) True, False
 - (ii) False, True
 - (iii) False, False
 - (iv) True, True
- (g) In a circular linked list organization, insertion of a record involves modification of
 - (i) One pointer
 - (ii) Two pointers
 - (iii) More than two pointers
 - (iv) No pointer
- (h) Level order traversal of a rooted tree can be done by starting from the root and performing
 - (i) pre-order traversal
 - (ii) in-order traversal
 - (iii) depth first search
 - (iv) breadth first search
- (i) An Abstract Data Type (ADT) is
 - (i) same as an abstract class
 - (ii) a data type that cannot be instantiated
 - (iii) a data type for which only the operations defined on it can be used, but none else
 - (iv) all of the above
- (j) How many distinct BSTs can be constructed with 3 distinct keys?
 - (i) 4
 - (ii) 5
 - (iii) 6
 - (iv) 9

- Q.2** (a) Explain different asymptotic notations (O , Ω , θ) used for comparing the time complexity of an algorithm with neat figures. [7]
- (b) The run time of an algorithm is represented by the recurrence relation $T(n) = 2T(n/2) + n$; $n \geq 2$ and with boundary condition $T(1) = 0$. What is the time complexity (in terms of θ notation). [7]
- Q.3** (a) Discuss pre-order, in-order and post-order traversal techniques of binary tree. Write a C function for non-recursive pre-order traversal. [7]
- (b) The pre-order traversal sequence of a Binary Search Tree (BST) is 30, 20, 10, 15, 25, 23, 39, 35, 42. Write step by step process to derive the BST and find post-order traversal also. [7]
- Q.4** (a) Consider a circular queue of capacity n -elements implemented with an array. Write C functions for *insertion* and *deletion* operations. [7]
- (b) Convert the given Infix expression into postfix using stack : $A + B / C * (D + E) - F$. For each input symbol clearly mention the *action taken* and *status of the stack* during conversion. [7]
- Q.5** (a) Write a C function to delete last node from a singly linked list. [7]
- (b) Create a max-heap by inserting following keys in the given order. Show each insertion step with clear illustration: 25, 35, 18, 9, 46, 70, 48. [7]
- Q.6** (a) Write an algorithm for merge sort and discuss space and time complexity. [7]
- (b) Define collision in hashing. Explain briefly different methodologies to resolve collision. [7]
- Q.7** (a) Write algorithm to count leaf nodes in a binary tree. What is the complexity of your algorithm? [7]
- (b) Compare BFS and DFS traversal techniques for graph. Write an algorithm to perform BFS using queue. [7]
- Q.8** (a) Differentiate between system defined data types and abstract data types with suitable examples. [7]
- (b) What is doubly linked list? What are its applications? Explain how a node can be added as last node using appropriate pseudo code [7]
- Q.9** Write short notes on any two of the following: [7x2=14]
- AVL Rotations
 - Open Addressing & Chaining
 - B-Tree
 - Priority Queue