

**DATA STRUCTURES AND APPLICATIONS  
(CBS2101)**

**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) A linear list in which the last node points to the first node is
  - (a) Singly linked list
  - (b) Doubly linked list
  - (c) Circular Queue
  - (d) Circular linked list
- (ii) Which of the following can be done with Linked List?
  - (a) Stack
  - (b) Queue
  - (c) Binary Search Tree
  - (d) All of the above
- (iii) What is the result of the following sequence of operations on a stack: Push(1), Push(2), Pop(), Push(3), Pop()?
  - (a) 1
  - (b) 2
  - (c) 3
  - (d) Stack is empty
- (iv) In a circular queue, if front = rear + 1, the queue is:
  - (a) Empty
  - (b) Full
  - (c) Half full
  - (d) None of the above
- (v) A full binary tree with  $2n+1$  nodes contains
  - (a)  $n$  leaf nodes
  - (b)  $n$  non-leaf nodes
  - (c)  $n-1$  leaf nodes
  - (d)  $n-1$  non-leaf nodes
- (vi) What data structure is used for breadth-first traversal of a graph?
  - (a) queue
  - (b) stack
  - (c) linked list
  - (d) None of the mentioned
- (vii) Which of the following binary tree traversal methods processes the left subtree, then the root, and finally the right subtree?
  - (a) Pre-order
  - (b) In-order
  - (c) Post-order
  - (d) Level-order
- (viii) 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.

- (ix) Quick sort uses which of the following methods to implement sorting?  
 (a) partitioning (b) selection (c) exchanging (d) merging
- (x) In hashing, what is the purpose of a hash function?  
 (a) To determine the location of an element in a hash table  
 (b) To sort the elements  
 (c) To compare keys  
 (d) To handle collisions

*Fill in the blanks with the correct word*

- (xi) Using Bubble sort to sort 100 names, the maximum number of comparisons will be \_\_\_\_\_.
- (xii) The searching technique that takes  $O(1)$  time complexity for searching the data is \_\_\_\_\_.
- (xiii) \_\_\_\_\_ is the prefix form of  $A+B*C$ .
- (xiv) The height of a skewed binary tree having 'n' nodes is \_\_\_\_\_.
- (xv) The best case time complexity of Insertion sort is \_\_\_\_\_.

### Group - B

2. (a) Distinguish between linear and non-linear data structures. [[CO2](Understand/LOCQ)]  
 (b) Polynomials can be represented either by an array or a linked list. Compare and contrast these two types of representation. How can a polynomial such as  $4x^3 + 16x - 23$  can be represented by a linked list? [[CO2](Apply/IOCQ)]  
 (c) What is the disadvantage of a linear queue using arrays and how to overcome this disadvantage? [[CO2](Apply/IOCQ)]  
 **$3 + (2 + 3) + 4 = 12$**
3. (a) Define row major and column major representations of arrays and write the formulas to find the address of any elements of the array for both cases. [[CO1](Understand/LOCQ)]  
 (b) Write a function to represent the sparse matrices of two ordinary matrices. Use these sparse matrices to add two matrices and print the resultant sparse matrix. [[CO2](Apply/IOCQ)]  
 **$(3 + 3) + (3 + 3) = 12$**

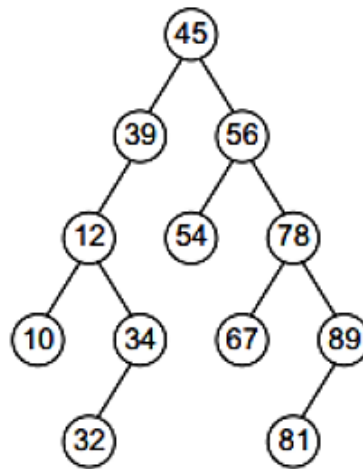
### Group - C

4. (a) Explain the tail recursive algorithm? What are the advantages of tail-recursive algorithms? [[CO3](Remember/LOCQ)]  
 (b) Describe the applications of recursion algorithms. [[CO3](Remember/LOCQ)]  
 (c) Explain the usage of the stack in recursive algorithm implementation. [[CO3](Analyze/IOCQ)]  
 **$(2 + 3) + 3 + 4 = 12$**

5. (a) Consider the following infix expression:  $4 * 5 + 9 / 5 - 2 + 3$ .  
 (i) Convert the above infix expression to postfix using a stack.  
 (ii) Evaluate a postfix expression using a stack. Show all the steps using a diagram. [[CO2](Apply/IOCQ)]
- (b) Consider a circular queue and write an algorithm or C function for the following operations.  
 (i) Delete the last element. (ii) Insert a node at a given position. [[CO3](Apply/IOCQ)]  
 **$(3 + 4) + 5 = 12$**

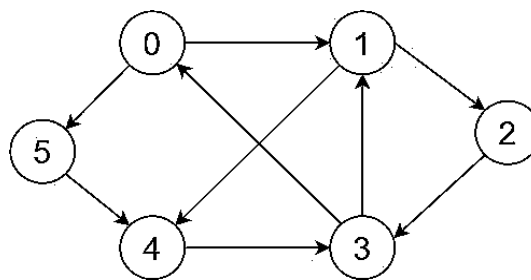
### Group - D

6. (a) Write a function to delete values from a binary search tree. [[CO5](Analyze/IOCQ)]  
 (b) Traverse the following tree using the in-order and pre-order tree traversal algorithms: [[CO4](Apply/IOCQ)]



**$6 + (3 + 3) = 12$**

7. (a) Consider the following directed graph.  
 Construct the adjacency list and adjacency matrix of the above graph.



[[CO5](Analyse/HOCQ)]

- (b) How to balance the height of an AVL tree in insertion and deletion operations? Explain with examples. [[CO5](Apply/IOCQ)]

**$(2 + 2) + (4 + 4) = 12$**

### Group - E

8. (a) What is the pivot, and how to select the pivot element in the quick sort? What are the advantages of quick sort? [[CO5](Analyze/IOCQ)]  
 (b) Write each intermediate step to construct a max-heap from the array 9, 4, 3, 8, 10, 2, 5. Write the time complexity of heap sort for all cases. [[CO6](Apply/IOCQ)]

**$(3 + 3) + 6 = 12$**

9. (a) Write the multiplication method and the mid-square method of the hash function. *[[CO6](Remember/LOCQ)]*
- (b) Explain in brief the various methods used to resolve collisions in hashing. *[[CO6](Remember/LOCQ)]*
- (3 + 3) + 6 = 12**
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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	30.20	65.62	4.19