

**DATA STRUCTURE AND BASIC ALGORITHMS
(CSEN 2004)**

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 notation provides a strict upper bound for $f(n)$?
(a) Omega notation (b) Big O notation
(c) Small o notation (d) Theta Notation.
- (ii) Given an integer array `arr[]`; the i th element can be accessed by writing
(a) `*(arr+i)` (b) `*(i+arr)` (c) `arr[i]` (d) All of these.
- (iii) Which type of linked list contains a pointer to the next as well as the previous node in the sequence?
(a) Singly linked list (b) Circular linked list
(c) Doubly linked list (d) All of these.
- (iv) How much time does an AVL tree take to perform search, insert, and delete operations in the average case as well as the worst case?
(a) $O(n)$ (b) $O(\log n)$ (c) $O(n^2)$ (d) $O(n \log n)$.
- (v) The total number of edges containing the node u is called
(a) In-degree (b) Out-degree (c) Degree (d) None of these.
- (vi) The circular queue will be full only when
(a) `FRONT = MAX - 1` and `REAR = Max - 1` (b) `FRONT = 0` and `REAR = Max - 1`
(c) `FRONT = MAX - 1` and `REAR = 0` (d) `FRONT = 0` and `REAR = 0`.
- (vii) A binary tree of height h has at least h nodes and at most _____ nodes.
(a) $2h$ (b) 2^h (c) 2^{h+1} (d) $2^h - 1$
- (viii) Which rotation is done when the new node is inserted in the right sub-tree of the right sub-tree of the critical node?
(a) LL (b) LR (c) RL (d) RR.
- (ix) Which of the following techniques deals with sorting the data stored in the computer's memory?
(a) Insertion sort (b) Internal sort
(c) External sort (d) Radix sort.

- (x) In which sorting, consecutive adjacent pairs of elements in the array are compared with each other?
 (a) Bubble sort (b) Selection sort
 (c) Merge sort (d) Radix sort.

Fill in the blanks with the correct word

- (xi) Name of the array acts as a _____.
 (xii) The complexity to insert a node at the beginning of the linked list is _____.
 (xiii) _____ is used in a non-recursive implementation of a recursive algorithm.
 (xiv) Adjacency matrix is also known as a _____.
 (xv) The worst case complexity is _____ when compared with the average case complexity of a binary search algorithm.

Group - B

2. (a) Discuss the significance and limitations of the Big O notation. *[[CO3](Understand/LOCQ)]*
 (b) Consider a two-dimensional array Marks[10][5] having its base address as 2000 and the number of bytes per element of the array is 2. Now, compute the address of the element, Marks[8][5], assuming that the elements are stored in row major order. *[[CO3](Understand/LOCQ)]*
 (c) Write a program to count the total number of nonzero elements in a two-dimensional array. *[[CO4](Apply/HOCQ)]*
 $4 + 4 + 4 = 12$
3. (a) Give the linked representation of the following polynomial:
 $7x^3y^2 - 8x^2y + 3xy + 11x - 4$. *[[CO3](Analyse/IOCQ)]*
 (b) Write a program to print the total number of occurrences of a given item in the linked list. *[[CO4](Apply/HOCQ)]*
 (c) Write a program to concatenate two doubly linked lists. *[[CO6](Apply/HOCQ)]*
 $3 + 4 + 5 = 12$

Group - C

4. (a) What do you understand by stack overflow and underflow? *[[CO1](Understand/LOCQ)]*
 (b) Convert the expression given below into its corresponding postfix expression and then evaluate it. Also write a program to evaluate a postfix expression.
 $10 + ((7 - 5) + 10)/2$ *[[CO5](Analyse/IOCQ)]*
 $3 + (2 + 2 + 5) = 12$
5. (a) Consider the queue given below which has FRONT= 1 and REAR = 5.

| | | | | | | | | | |
|--|---|---|---|---|---|--|--|--|--|
| | A | B | C | D | E | | | | |
|--|---|---|---|---|---|--|--|--|--|

 Now perform the following operations on the queue and show status of the queue after each operations:
 (i) Add F (ii) Delete two letters (iii) Add G (iv) Add H
 (v) Delete four letters (vi) Add I *[[CO3](Analyse/IOCQ)]*

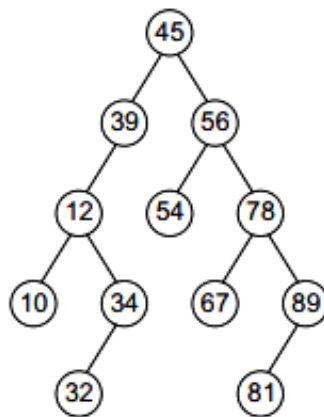
- (b) Explain following types of recursion with example.
 (i) Direct Recursion (ii) Indirect Recursion (iii) Tail Recursion.

[[CO3](Remember/LOCQ)]
 $6 + (2 \times 3) = 12$

Group - D

6. (a) What are the two ways of representing binary trees in the memory? Which one do you prefer and why?
 (b) What is the maximum height of a tree with 32 nodes?
 (c) Consider the binary search tree given below.
 Now do the following operations:
 (i) Find the result of in-order, pre-order, and post-order traversals.
 (ii) Show the deletion of the root node.
 (iii) Insert 11, 22, 33, 44, 55, 66, and 77 in the tree.

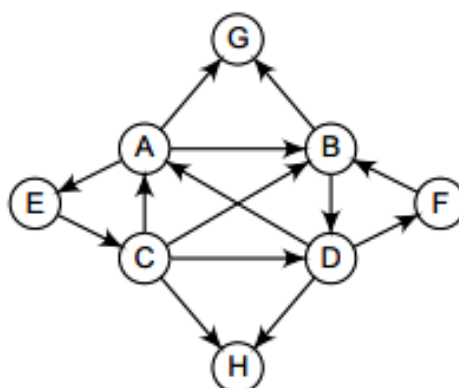
[[CO1](Understand/LOCQ)]
 [[CO3](Analyse/IOCQ)]



[[CO6](Analyse/IOCQ)]
 $(2 + 2) + 2 + 6 = 12$

7. (a) Write a program to delete values from a binary search tree.
 (b) How are graphs represented inside a computer's memory? Which method do you prefer and why?
 (c) Consider the graph given below.
 (i) Write the adjacency matrix of the graph.
 (ii) Write the path matrix of the graph.
 (iii) Is the graph biconnected?
 (iv) Is the graph complete?

[[CO5](Apply/HOCQ)]
 [[CO2](Remember/LOCQ)]



[[CO2](Analyse/IOCQ)]
 $4 + (2 + 2) + 4 = 12$

