

- (vii) The data structure needed to convert a recursion to an iterative procedure is
 (a) Queue (b) Graph (c) Stack (d) Tree.
- (viii) A Circular queue is empty if
 (a) front = rear - 1 (b) rear = front - 1
 (c) front = rear + 1 (d) rear = front.
- (ix) Hashing collision resolution techniques are
 (a) Chaining, Bucket addressing
 (b) Bucket addressing, Huffman coding
 (c) Huffman coding, linear hashing
 (d) Chaining, Huffman coding.
- (x) Inserting a node after a given node in a doubly linked list requires
 (a) one pointer changes (b) two pointer changes
 (c) four pointer changes (d) none.

Group - B

2. (a) Write a function to remove duplicates from an ordered array, without using any second array. For example, if the original content of the array is: a, a, c, d, q, q, r, s, u, w, w, w, w; then the final content of the array should be a, c, d, q, r, s, u, w.
 (b) Why '&' operator is not used with array names in scanf()?
 (c) What are the characteristics of an algorithm?
3. (a) What are the basic properties of algorithms? What is abstract data type (ADT)? Explain.
 (b) Show that the function $f(n)$ defined by:
 $f(1) = 1$
 $f(n) = f(n - 1) + \frac{1}{n}$ for $n > 1$
 has the complexity $O(\log n)$.
 (c) What is the addressing formula of a three-dimensional array (i.e., the addressing formula of any element of X [i, j, k]), assuming any base address? (subscript limits are, $-2 \leq i \leq 3$, $1 \leq j \leq 5$ and $-6 \leq k \leq 0$).

(3 + 2) + 4 + 3 = 12

Group - C

4. (a) Using stacks, write an algorithm to determine whether an infix expression has balanced parenthesis or not.
 (b) Write down the differences between recursion and iteration.
 (c) Explain how you can make a queue by using two stacks.

8 + 2 + 2 = 12

5. (a) Given a stack s and a queue q , show the contents of each after the indicated operations. The starting contents of s and q are shown. If an operation would result in an error, write "error" and assume the contents of s and q do not change. If there is no change otherwise, leave the cell blank.

Operation	Contents of stacks		Contents of queue q	
	Top	bottom	front	rear
Start	empty		2, 4	
s.pop()				
s.push(3)				
q.add(5)				
s.push(q.peek())				
q.add(s.peek())				
q.add(s.pop())				
s.push(s.pop())				
q.add(q.remove())				

where push(), pop() and peek() have their usual meaning with respect to stack and add(), remove() and peek() have their usual meaning with respect to queue.

- (b) Define queue, circular queue and dequeue.

8 + (1 + 1 + 2) = 12

Group - D

6. (a) Is it possible to draw a tree with 5 nodes whose inorder and postorder traversal sequences are the same? If yes, draw the tree.
 (b) Suppose that we have numbers between 1 and 1000 in a Binary Search Tree and want to search for the number 363. Some possible sequences are given below. Mention which of the following sequences could be correct sequence and which could not, with explanation.

(i) 2, 252, 401, 398, 330, 344, 397, 363

- (ii) 924, 220, 911, 244, 898, 258, 362, 363
- (iii) 925, 202, 911, 240, 912, 245, 363
- (iv) 2, 399, 387, 219, 266, 382, 381, 278, 363
- (v) 935, 278, 347, 621, 299, 392, 358, 363

2 + 10 = 12

7. (a) Prove that, the height of a binary tree that contains n elements, $n > 0$, is at most n and at least $\lceil \log (n + 1) \rceil$.
- (b) Insert the following keys into a B-Tree of order 3:
p, q, r, d, h, m, l, s, k, n.
- (c) Insert the following keys in the order given below to build them into an AVL tree (Clearly mention different rotations used and balance factor of each node).
g, h, s, l, e, m, t, u.

3 + 5 + 4 = 12

Group - E

8. (a) Write a recursive algorithm for binary search.
- (b) What is hashing? Why is it required? What is the time complexity of hashing? Explain linear probing, quadratic probing and double hashing with suitable example.
9. (a) What are the properties of a heap? Distinguish between a max heap and a min heap.
- (b) Transform the array 2, 8, 6, 1, 10, 15, 3, 12, 11 into a heap using any suitable method.

3 + (3 + 6) = 12

(2 + 2) + 8 = 12

**DATA STRUCTURE & BASIC ALGORITHMS
(CSEN 2001)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: 10 × 1 = 10
- (i) The postfix form of the infix notation $(A + B) * (C * D - E) * F$ is
 (a) $AB+CD * E - * F *$ (b) $AB+CDE - * F **$
 (c) $AB+CD - * EF **$ (d) $ABCDEF ** - * +$.
- (ii) The number of nodes in a complete binary tree of depth d (with root at depth 0) is
 (a) $2^{d-1} + 1$ (b) $2^{d+1} - 1$ (c) $2^{d-1} - 1$ (d) $2^{d+1} + 1$.
- (iii) Which sorting algorithm is the best if the list is already in order?
 (a) Insertion sort (b) Quick sort
 (b) (c) Merge sort (d) Bubble sort.
- (iv) The number of comparisons required to sort 5 numbers in ascending order using bubble sort is
 (a) 25 (b) 7 (c) 6 (d) 10.
- (v) If Array's upper bound is specified by 'U' and lower bound is specified by 'L' then the range of the array will be.
 (a) $U - L - 1$ (b) $L + U - 1$ (c) $U - L + 1$ (d) $L - U + 1$.
- (vi) Which of the following applications may use a stack?
 (a) A parentheses balancing program
 (b) Keeping track of local variables at run time
 (c) Syntax analyzer for a compiler
 (d) All of the above.