DATA STRUCTURE
(CSEN 2005)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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)   Which data structure is used for the breadth first traversal of a graph?
    (a) Stack   (b) Tree
    (c) Queue   (d) Linked List.

    (ii)   Maximum possible height of an AVL Tree with 7 nodes is
    (a) 3   (b) 4
    (c) 5   (d) 6.

    (iii)   The best-case time complexity of Insertion Sort is
    (a) $O(n^2)$ (b) $O(n \log n)$
    (c) $O(n)$ (d) $O(\log n)$.

    (iv)   Given an empty stack, after performing push (1), push (2), pop, push (3), push(4), pop, pop,push (5), pop, what is the value at the top of the stack?
    (a) 4   (b) 3
    (c) 2   (d) 1.

    (v)   Linked lists are not a suitable data structure for which of the following problems?
    (a) Insertion sort   (b) Radix sort
    (c) Binary Search   (d) Bubble sort.

    (vi)   The prefix form of A*B+C/D is
    (a) +*AB/CD   (b) +AB*CD/
    (c) +A*BC/D   (d) +/*ABCD

    (vii)   The postfix equivalent of the prefix expression * + a b – c d is
    (a) a b + c d - *   (b) a b c d + - *
    (c) a b + c d * -   (d) a b + - c d *

(viii) The searching technique that takes O (1) time to find a data is
(a) Linear Search (b) Binary Search
(c) Hashing (d) Tree Search.

(ix) If a user tries to remove an element from an empty stack, then it is called _____
(a) Underflow (b) Empty collection
(c) Overflow (d) Garbage Collection.

(x) Any binary tree can be accurately reconstructed from its
(a) Preorder & Postorder sequences (b) Inorder sequence only
(c) Inorder & Postorder sequences (d) None of the above are true.

Group- B

2. (a) Consider the array int arr[100][300]. The base address of the array is 2000. Calculate the memory address of the element arr[55][25] considering the following storage of array in main memory :
(i) row major order (ii) column major order. *[(CO1)(CO2)(Understand/LOCQ)]*
(b) Write an algorithm to evaluate postfix expression by using stack data structure.
[(CO1)(CO2)(Apply/IOCQ)]
(3 + 3) + 6 = 12

3. (a) Write a pseudo-code/C program to reverse a doubly linked list.
[(CO2,CO3)(Apply/IOCQ)]
(b) Implement an algorithm to perform "delete at front" in a circular linked list. Can you modify your algorithm such that the time complexity will be O(1)? Justify your answer with proper reasoning. *[(CO2)(Understand,Analyze/HOCQ)]*
6 + 6 = 12

Group - C

4. (a) What will be the postfix expression for the following infix expression?
a + b * c – d ^ e ^ f *[(CO2)(Apply/IOCQ)]*
(b) Compare two functions n^2 and $2^{n/4}$ for various values of n. Determine when the second becomes larger than the first. *[(CO5)(Evaluate/HOCQ)]*
(c) Write a pseudo-code to reverse the contents of a queue using stack.
[(CO2)(Remember/LOCQ)]
3 + 5 + 4 = 12

5. (a) Compare between linear queue and circular queue.
[(CO1)CO2)(Understand/LOCQ)]
(b) Write a pseudo code to insert an element in an array-based circular queue.
[(CO1,CO2)(Apply/IOCQ)]
(c) Write a pseudo code of a recursive function to calculate the nth fibonacci number. *[(CO1,CO2)(Analyze/IOCQ)]*
2 + 5 + 5 = 12

Group - D

6. (a) Explain with an example the various methods that can be used to represent a graph in the computer's memory. *[(CO3)(Understand/LOCQ)]*

(b) The in-order traversal and the pre-order traversal of a binary tree are given below:
preorder: D H B E A F C I G J Inorder : A B D H E C F G I J.
What would be the post-order traversal for the same binary tree?
[(CO3)(Analyze/IOCQ)]

(c) What will be resultant Max-Heap when the elements: 52, 25, 30, 41, 12, 35, 20 are inserted one by one? *[(CO3)(Understand/LOCQ)]*
3 + 4 + 5 = 12

7. (a) Discuss about AVL tree with a suitable example.
[(CO1,CO3,CO4,CO6)(Remember/IOCQ)]

(b) Insert the following keys in the following order to build an AVL tree. Clearly show the various rotations when required. 16, 31, 100, 12, 40, 54, 99, 7, 18, 131, 11, 1. *[(CO1)(CO3)(CO4)(CO6)(Analyze/HOCQ)]*
3 + 9 = 12

Group - E

8. (a) Compare between binary search and linear search technique.
[(CO4)(CO5)(Remember/LOCQ)]

(b) What is hashing? Discuss any one hash function with a suitable example.
[(CO2)(CO4)(Understand/LOCQ)]

(c) Consider the list of numbers :- 87, 86, 62, 96, 4, 0, 6, 3, 29, 59, 71, 80, 19, 31, 6,78. Take them in increasing order. Assume your target is 80 and the start index (lo) is 0 and the end index (hi) is 14 at the beginning. Apply binary search algorithm to find it.
(i) What will be the values of hi and lo when you find your target?
[N.B. Show all steps for calculation]
(ii) What will be the exact number of key comparisons to find your target?
[N.B. Show all steps for calculation].
[(CO4,CO5)/Analyse/IOCQ)]
2 + 4 + (3 + 3) = 12

9. (a) Write a pseudo code/function to merge two sorted arrays into one sorted array.
[(CO4)(Analyze/IOCQ)]

(b) State the best case and the worst case time complexities of the following algorithms:
(i) Bubble Sort (ii) Merge Sort (iii) Binary Search. *[(CO5)(Understand/LOCQ)]*

(c) What do you understand by the term 'Hashing'? What is a 'Hash Function' and 'Hash Table'? State and explain with example the various types of collision resolution techniques used in Hashing. *[(CO4) (Remember/LOCQ)]*
4 + 3 + 5 = 12

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	35.42	43.75	20.83

Course Outcome (CO):

After the completion of the course students will be able to

CSEN2005:1. Identify and select appropriate data structures as applied to specified problem definition.

CSEN2005:2. Implement operations like searching, insertion, deletion, traversal etc. on linear data structures like array, stack and queue.

CSEN2005:3. Implement operations like searching, insertion, deletion, traversal etc. on nonlinear data structures like tree and graph.

CSEN2005:4. Apply appropriate sorting/searching technique for given problem.

CSEN2005:5. Analyze and compare the different sorting algorithms.

CSEN2005:6. Design advanced data structure using Nonlinear data structures.

LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question