DATA STRUCTURE
(CSEN 2005)

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 sorting method runs fastest for file which is already sorted?
(a) Selection Sort (b) Insertion Sort
(c) Quick Sort (d) Merge Sort.

(ii) Which data structure is used for the breadth first traversal of a graph?
(a) Stack (b) Tree
(c) Queue (d) Linked List.

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

(iv) 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**– *+

(v) The number of comparisons required to sort 5 numbers in ascending order using bubble sort is
(a) 25 (b) 7 (c) 6 (d) 10

(vi) A binary search tree is generated by inserting the following integers: 50, 15, 62, 5, 20, 58, 91, 3, 8, 37, 60, and 24. The number of nodes in the left subtree and right subtree of the root respectively is
(a) (4, 7) (b) (7, 4)
(c) (8, 3) (d) (3, 8)

(vii) Which types of traversal of Binary search tree outputs the value in sorted order?
(a) Pre-order (b) In-order
(c) Post-order (d) None

(viii) The result of evaluating the following postfix expression is
5 7 9 * + 4 9 3 / + -
(a) 55 (b) 65 (c) 61 (d) 66

(ix) The data structure used to execute a recursion is
(a) Queue (b) Graph
(c) Stack (d) Tree

(x) Collision resolution techniques in hashing are?
(a) Chaining and Bucket addressing
(b) Bucket addressing and Huffman coding
(c) Huffman coding and linear hashing
(d) Chaining and Huffman coding.

Fill in the blanks with the correct word

(xi) _____ tree is an example of height balanced tree.

(xii) The open addressing technique is free from clustering problems is_____.

(xiii) The number of nodes in a complete binary tree of depth *d* (depth of root is 0) is _____.

(xiv) The postorder traversal of a tree is D, F, H, G, E, B, C, A, then the root node is_____.

(xv) The worst case time complexity of quick sort is _____.

Group - B

2. (a) Consider M[][] as a two-dimensional array of integers with starting address 1000. The number of rows and columns are 10 and 5. Now calculate the address of M[6][3] using row-major and column-major manner. *[(CO1)(Evaluate/LOCQ)]*

(b) Consider a Circular linked list with tail pointer. Now write a pseudo code/ C functions for the following operations.
(i) Delete first element.
(ii) Insert a node at first position. *[(CO2)(Apply/IOCQ)]*

4 + (4 + 4) = 12

3. (a) A two dimensional integer array A [6] [8] is stored with address of A[2] [2] is 351. What is the address of A [5] [6] in both row-major and column-major order? *[(CO2)(Understand/LOCQ)]*

(b) Write pseudo code or algorithm to check whether the elements stored in a singly linked list form a palindrome or not. *[(CO4)(Analyze/IOCQ)]*

(3 + 3) + 6 = 12

Group - C

4. (a) Using stacks, how to determine whether an infix expression has balanced parenthesis or not? *[(CO2)(Analyse/IOCQ)]*

(c) Convert the following infix expression into postfix using stack:
M * N + (O ^ P) * W / U / V * T. *[(CO2)(Apply/LOCQ)]*

6 + 6 = 12

5. (a) Consider the following infix expression
4 * 5 + 9 / 5 – 2 + 3.
(i) Convert the above infix expression to postfix using stack.
(ii) Evaluate postfix expression using stack. Show all the steps using a diagram.
[(CO2)(Apply/IOCQ)]

(b) Write a recursive function fib(.....) where function fib(.....) will return n^{th} Fibonacci number. Ensure that the time complexity of that fib (.....) function will be O(n). *[(CO2)(Remember/LOCQ)]*

(4 + 4) + 4 = 12

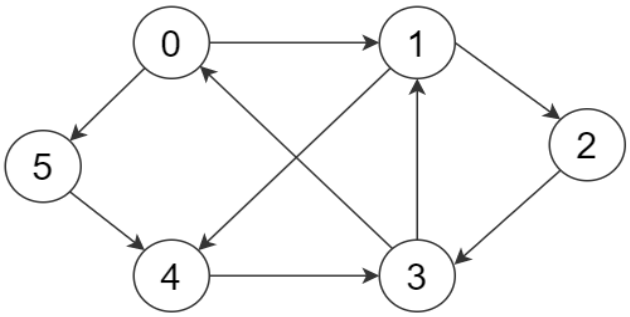
Group - D

6. (a) 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. *[(CO3)(Analyse/HOCQ)]*

(b) Name all possible rotations in AVL tree. *[(CO3)(Remember/LOCQ)]*

10 + 2 = 12

7. (a) Consider the following directed graph –



Construct adjacency list and adjacency matrix of the above graph.
[(CO3)(Understand/LOCQ)]

(b) Apply the Depth First Search (DFS) algorithm to the above mentioned graph and show the visited node sequence in the results. Assume '2' as the start node. What is the time complexity of the DFS algorithm? *[(CO3,CO6)(Apply/HOCQ)]*

5 + 7 = 12

Group - E

8. (a) Explain in brief the various methods used to resolve collision in hashing.
[(CO4)(Remember/LOCQ)]

(b) Write the binary search algorithm. *[(CO5)(Remember/LOCQ)]*

(c) Differentiate binary search and linear search. *[(CO5)(Remember/LOCQ)]*

6 + 4 + 2 = 12

9. (a) Construct max-heap from array 2, 8, 6, 1, 10, 15, 3, 12, 11. Show each intermediate step. *[(CO6)(Understand/IOCQ)]*

(b) Apply heap sort to sort the above array. *[(CO6)(Understand/IOCQ)]*

8 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	40.63	41.67	17.71

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.*