MAULANA ABUL KALAM AZAD
UNIVERSITY OF TECHNOLOGY,
WEST BENGAL

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Paper Code : EC-504B

DATA STRUCTURE & C

Time Allotted: 3 Hours   *Full Marks*: 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words
as far as practicable.

Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternative for *any ten* of the following: 1×10=10

   (i) Insert a new node after given a node in a doubly linked list requires

   (a) four pointer exchanges.   (b) two pointer exchanges.

   (c) one pointer exchanges.   (d) no pointer exchanges.

   (ii) Maximum possible height of an AVL Tree with 7 nodes is

   (a) 3   (b) 4

   (c) 6   (d) None of these

   (iii) If a binary tree is threaded for inorder traversal, a right NULL link of any node is replaced by the address of its

   (a) Successor   (b) Predecessor

   (c) Root   (d) Own

   (iv) Total nodes in a 2-tree (Strictly binary tree) with 30 leaves will be

   (a) 60   (b) 58

   (c) 59   (d) 57

   (v) The initial configuration of queue is a, b, c, d ('a' is at the front). To get the configuration d, c, b, a one needs a minimum of

   (a) 2 deletions and 3 additions   (b) 3 deletions and 2 additions

   (c) 3 deletions and 3 additions   (d) 3 deletions and 4 additions

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Turn Over

(vi) Adjacency matrix of digraph is

    (a) identify matrix   (b) symmetric matrix

    (c) asymmetric matrix   (d) None of these

(vii) The Ackerman function, for all non-negative values of m and n is recursively defined as

$$A(m,n) = n+1 \qquad \text{if } m=0$$
$$= A(m-1, 1) \qquad \text{if } m!=0 \text{ but } n=0$$
$$= A(m-1, A(m, n-1)) \qquad \text{if } m!=0 \text{ but } n!=0$$

Therefore the value of $A(1, 2)$ is

    (a) 4   (b) 3

    (c) 5   (d) 2

(viii) Which of the following traversal techniques lists the elements of a binary search tree in ascending order?

    (a) Preorder   (b) Postorder

    (c) Inorder   (d) None of these

(ix) The method of linear probing for collision resolution can lead to

    (a) Clustering   (b) Efficient storage utilization

    (c) Overflow   (d) Underflow

(x) A complete Binary tree with n leaves contains

    (a) n nodes   (b) $2n$ nodes

    (c) $2n-1$ nodes   (d) 2^n nodes

(xi) The following sequence of operations performed on a stack:
push(1), push(2), pop, push(1), push(2), pop, pop, pop, push(2), pop.
The sequence of popped out values are

    (a) 2,2,1,1,2   (b) 2,2,1,2,2

    (c) 2,1,2,2,1   (d) 2,1,2,2,2

Group – B

(Short Answer Type Questions)

Answer *any three* of the following.   5×3=15

2. Write an algorithm to insert the nth node of a singly linked list. The Error conditions are to be handled properly.

3. Each element of an array arr [20][50] requires 4 bytes of storage. Base address of the array arr is 2000. What will be the address of arr [10][10] when the elements are stored in row-major and column-major order?

4. What is an Abstract data type? Define as ADT for a list.   2+3=5

5. Given below are the Pre-order and In-order traversals of a binary tree. Draw the actual tree and write its Post-order traversal:

Pre-order Traversal : A B D I E J C F G K

In-order Traversal : D I B E J A F C K G 4+1=5

6. Define sparse matrix. How is sparse matrix efficient for storing data elements? Explain diagrammatically.

Group – C

(Long Answer Type Questions)

Answer *any three* of the following. 15×3=45

7. (a) Let a and b denotes positive integers. Suppose a function Q defined as follows:

$$Q(a, b) = \begin{cases} 0 & \text{if } a < b \\ Q(a-b, b) + 1 & \text{if } b <= a \end{cases}$$

Find the value of Q (2, 3) and Q (14, 3).

(b) Why the Queue data structure is called FIFO?

(c) Construct the following Queue of characters where Queue is a circular array which is allocated six memory cells:

FRONT = 2 REAR = 4 QUEUE : –, A, C, D –, –

Describe the following operations take place:
   (i) 'F' is added to the Queue.
   (ii) Two letters are from the Queue.
   (iii) 'K', 'L', 'M' are added to the queue.
   (iv) Two letters are deleted from the queue.
   (v) R is added to the Queue.
   (vi) One letter is deleted from the queue.

(d) Write an algorithm to add two polynomials using link list. 3+2+6+4=15

8. (a) Show the stages in growth of an order –4 B-Tree when the following keys are inserted in the order given: https://www.makaut.com

74, 72, 19, 87, 51, 10, 35, 18, 39, 60, 76, 58, 19, 45

(b) How do AVL trees differ from binary search tree?

Build an AVL tree with node inserted in the following order:

8, 12, 9, 11, 7, 6, 62, 15, 3

Clearly mention different rotations used and balance factor of each node.

(c) Prove that, for any non-empty binary tree T, if n_0 is the number of leaves and n_2 be the number of nodes of degree 2, then $n_0 = n_2 + 1$. 5+(2+4)+4=15

9. (a) Convert the following infix expression to postfix notation by showing the operator stack and output string after reading each input taken:

A * B + C * (D –E) – F * G

(b) By applying the algorithm of postfix expression evaluation using stack find the result of the given following postfix expression:

12, 7, 3, –, /, 2, 1, 5, +, *, +

(c) Write a recursive function for the problem of 'Tower of Hanoi'.   5+5+5=15

10. (a) Define Hashing.

(b) Briefly explain the different commonly used hash functions.

(c) Explain with suitable example the collision resolution scheme using linear probing with open addressing.

(d) Write an algorithm to delete from a Binary Search Tree.   2+4+4+5=15

                                                                          5×3=15

11. Answer *any three* of the following:

(i) Prim's Algorithm

(ii) Threaded Binary Tree

(iii) BFS and DFS

(iv) Asymptotic notation

(v) Merge sort

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