Your Roll No...............

Sr. No. of Question Paper : 48   I

Unique Paper Code   : 3234301

Name of the Paper   : Data Structures

Name of the Course   : B.Sc. (H) Computer Science

Semester   : III

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Section A is Compulsory.

3. Attempt any 4 questions out of 6 questions from Section B.

Section A

1. (a) Evaluate the following postfix expression using stack, showing stack after each step.

    12 7 3 − / 2 1 5 + * +   (4)

   (b) Consider the following list of numbers :

    12, 28, 45, 53, 62, 76, 90, 95, 100

P.T.O.

To search a given number in the above list, which of the searching technique (linear/binary) is better suited and why? (2)

(c) An array A of integers with size 2×3 is stored in memory in column-major order, base address of A is 100, and each integer takes 4 bytes of memory. Find the address of A[1,2]. (3)

(d) The elements of the following sequence are inserted in a binary search tree one by one.

40, 30, 42, 5, 7, 23, 9, 19

Show the binary search tree after every insertion. What is the height of the binary search tree you have constructed? (4)

(e) Give an example of a situation where an array will be preferred over linked list. (2)

(f) What is the maximum numbers of passes required to sort list of n numbers using bubble sort algorithm?

Give first two passes required to sort the following sequence: in ascending order using bubble sort.

45, 23, 10, 9, 1, 40, 100, 25, 65, 90 (4)

(g) Draw all possible binary search trees that can be generated with three nodes having key values A, B, and C.   (5)

(h) Find the post order traversal of the tree if its preorder and inorder traversals are given below:

Preorder traversal: 1,2,4,8, 5,10,3,6,11,7,12

Inorder traversal: 8,4,2,5,10,1,6,11,3,12,7   (6)

(i) If an upper triangular matrix M of n x n dimension is stored as a one dimensional array A, how many elements will the array A have? Also give formula to map A $[i,j]th$ element of M into array A.   (5)

Section B

2. (a) Write a recursive function to find and return the length of a linked list.   (4)

(b) A queue is represented in memory using a circular array of size 5 as given below:

QUEUE

Front: -1

Rear: -1

0   1   2   3   4
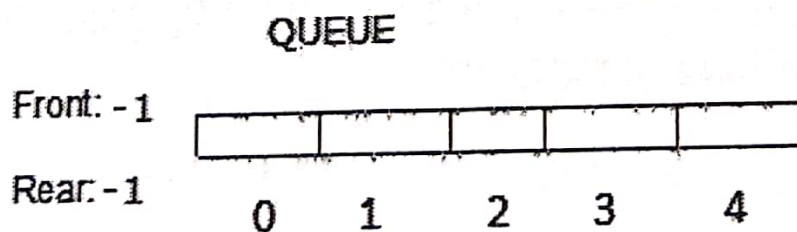
Represent Front and Rear in the queue after each step as given below:

(i) insert A, B and C in sequence

(ii) delete

(iii) insert D and E

(iv) a sequence of three deletions

(v) insert F

(vii) delete

(viii) insert H and K   (6)

3. (a) Write a program to merge two ordered singly linked list into a new ordered list. Give the necessary class definition with all required constructors.   (4+2)

(b) Write a non-recursive function for in-order traversal of a binary tree.   (4)

4. (a) Design a class for doubly linked list having integer data and write a function to delete all odd numbered nodes.   (6)

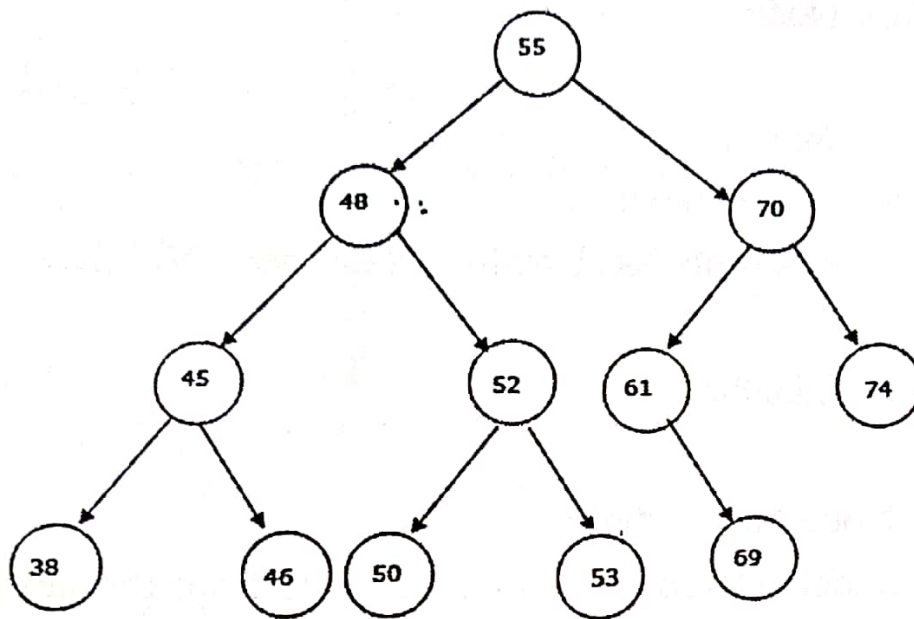(b) Name an in-place algorithm that can be used to sort the following numbers.

18, 14, 25, 21, 18, 9, 85, 40, 76

Make use of the algorithm that you mention to show first two iterations on the above data.   (4)

5. (a)   (4+2)

55

48   70

45   52   61   74

38   46   50   53   69

(i) List the nodes of the above tree in the order in which they will be traversed when each of the following algorithms is used.

- Breadth First

- Pre-order

- In-order

- Post- order

(ii) Delete node 48 using deletion by merging and show the resultant tree after deletion.

(b) Suppose the following class definitions of a singly linked list are given :

P.T.O.

```
class Node
{
    int info;
    Node *next;
    Node(int data) {info = data; next=NULL;}
}
class linkedlist
{
    Node *head, *tail;
    // delete()function deletes a node from the head
    delete()
    {
        Node *pTemp = head;
        delete pTemp;
        head = head->next;
    }
    // insert() function inserts a node at the beginning
    insert(int info)
    {
        Node *pNode = new Node(info);
        pNode->next = head;
    }
};
```

Spot the errors in the insert() and delete() function
given in the above code. Suggest the corrections.

(4)

6. (a) H is a recursive function defined as follows :

$H(n,m) = m+1$ if $n=0$;

$\quad = H(n-1,1)$ if $n > 0$, $m=0$

$\quad . = H(n-1, H(n,m-1))$ otherwise

Find the value of

(i) H (0,0)

(ii) H (1,1)   (4)

(b) Insert the keys: 15, 9, 30, 0, 17, and 28 into a hash table with open addressing of size 11 (in that order). Use the hash function k%9 and linear probing for collision resolution. Show the status of table after each insertion. If chaining is used for collision resolution, then show the status of table after each insertion. Write one advantage and one disadvantage of using linear probing over chaining for collision resolution?   (6)

7. (a) What are self-organizing lists? For a given linked list having E,F,G,H show the list after each step using i) Move to Front and ii) Transpose. Steps are :

     (i) Access G   (ii) Access E

     (iii) Access H   (iv) Access E

(v) Access F   (vi) Access H

(vii) Access G   (viii) Access E   (5)

(b) Construct a B+ tree by inserting the following keys:

19, 24, 3, 6, 4, 1, 7, 6, 5, 8

Maximum number of keys allowed in a node is four.

Show the B+ tree diagrammatically after each key insertion.

(5)