[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1374 **C**

Unique Paper Code : 32341301

Name of the Paper : Data Structures

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

Semester : III

Duration : 3 Hours Maximum Marks : 75

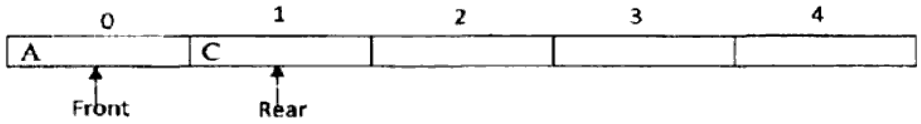
Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. **1** of **35** marks is compulsory.
3. Attempt any **Four** questions from Q. No. **2** to Q. No. **7**.

1. (a) Give necessary class definitions to create a circular linked list. Write a member function to remove a node following the cursor node in the circular linked list. (5)

P.T.O.

(b) Consider the following array-based queue of size 5 :



Show the contents of the queue with position of Front and Rear after each of the following operations done in sequence.

(i) Insert X

(ii) Remove two letters

(iii) Insert Y and Z

(iv) Insert W

(v) Remove one letter (5)

(c) Consider an electronic mathematical calculating device that is used to evaluate any mathematical expression but does not recognize parenthesis. The device is given the following mathematical

expression as input. ($ represents exponent operator): ((A* (B–C) +D) $F+E)

The calculating device upon receiving the expression start converting it into a parenthesis free notation step by step using some algorithm before evaluating it. Which data structure the calculating device would use in the algorithm. Show the steps of the algorithm used by the calculating device and give the parenthesis free notation that the calculating device would have generated. (5)

(d) A dictionary of following word's is to be maintained in memory such that searching is quick :

eye,ice,ant,cat,bat,dog,log,fog,leg,zip,yogart,wolf, top,unknown,xor

Answer the following :

(i) Which hierarchical data structure would you suggest for this dictionary?

(ii) Show diagrammatically, the dictionary created using your suggested data structure.

(iii) Give the number of comparisons that would be done to search the word xor in the above dictionary. (5)

(e) Define the following member functions for a vector V using an array A:

(i) insert (i, e) to insert a new element e into vector V at index i.

(ii) erase (i) to remove the element at index i from vector V. (5)

(f) A magician showed a trick to store some numbers in the range [1000, 9999] in a crate of size 20. The 20 positions in crate are numbered from 0 to 19. The magician decides where to put the number based on the two middle digits of the number. If the position in the crate is already occupied, magician puts the number in the next available free position of the crate in linear order. When

asked to pick up any number, the magician is able to pick up number without much searching. Devise the trick used by magician and find out the locations where the following numbers would have been stored 1226, 7242, 6867, 8220, 1161, 4444, 6221, 5288, 7465 and 8280. (5)

(g) Differentiate between max-heap and min-heap. Build a min-heap H using following data :

60, 33, 50, 22, 55, 40, 11, 22, 65, 30.

Show heap after each insertion. (5)

2. (a) Consider some data stored in a 2D array A of size 4×4. Each element requires 2 bytes of memory storage. Base address of data is 2005. Write mapping functions, determine the index value and memory location of A [2] [3] when array is stored in :

(i) Row major

(ii) Column major (5)

(b) Consider some students, seated randomly in a class. The students are required to perform on stage in increasing order of their heights, such that every time a student is called on stage, the teacher calls the shortest student out of all the remaining students to go on stage. Show the steps of the algorithm the teacher follows if the heights (in cms) of the students seated on the first 10 chairs in the class are given as :

Chair no.	1	2	3	4	5	6	7	8	9	10
Height in cms.	160	157	152	149	150	159	162	145	155	140

How many students the teacher has to examine at the end to determine the correct sequence in which the students are called to perform on stage? (5)

3. (a) Give Output. (4)

(i) Consider the linked list:

6->4->3->1->2->7->NULL

Give the output of the below function fund if 'func1' is invoked as func1 (p) where p is a node pointer pointing to node 6 in the above linked list.

```
Void fun1(node *p)
  {
     if(p==NULL)
        return;
     fun1(p->next->next);
     cout<< p->data+1;
  }
```

(ii) Consider the linked list :

1->2->3->4->5->6-> NULL

Give the output of the below function func2 if 'func2' is invoked as func2 (s) where s is a node pointer pointing to node 2 in above linked list.


```
Void fun2(node *s)
  {
     if(s==NULL)
        return;
     cout<< s->data;
     if(s->next!=NULL)
        fun2(s->next->next)
     cout<< s->data;
  }
```

(b) Write functions for the following :

(i) Remove an element x from a doubly linked list of integers.

(ii) Merge two singly linked lists of integers into one list. (6)

4. (a) Consider the following recursive function : (5)

```
Double calc(int x, int n)
  {
     if(n=0)
         return 1;
     else
         return x*calc(x,n–1);
  }
```

(i) What will be the output if function is invoked as calc (5, 4)?

(ii) How many recursive calls will be performed to compute calc(5, 4)?

(iii) Write the iterative version of the above function.

(b) Consider the following recursive function of tree traversal : (5)

```
traverse(node *p)
{
   if(p ! = 0)
     {
```



```
         traverse(p–>left);
         traverse(p–>right);
         visit(p);
       }
}
```

Write non-recursive / iterative tree traversal function of the given recursive function.

5. (a) Write a function to find in-order predecessor of a node in a binary search tree. (5)

(b) Consider implementing double ended queue (deque) in three different ways using Array, singly linked list, and doubly linked list. Give running time complexity of all the below operations for all the three implementations. (5)

(i) insertFront(e)

(ii) insertBack(e)

(iii) deleteFront()

(iv) deleteRear()

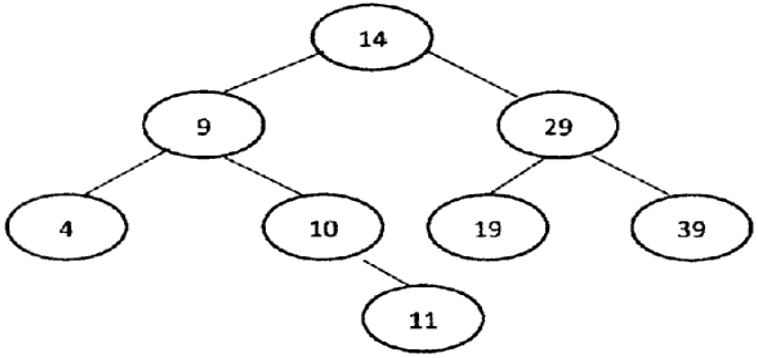
Which of the above three implementation ways is the most efficient? Justify.

6. (a) Create a balanced multiway search tree of order 5 using following integers

6, 4, 22, 10, 2, 14, 3, 8, 11, 13, 5, 9, 15, 18, 21, 1

Show the content of tree after each insertion. Delete element 11 and show the tree after deletion. (6)

(b) Consider the following binary search tree (BST):



Apply two approaches 'deletion by merging' and 'deletion by copying' to delete the root node. Compare both the trees after deletion in terms of height. (4)

P.T.O.

7. (a) Consider the following keys to be inserted in an AVL tree in given order :

H, I, J, B, A, E. Show each step. What will be the height of the created AVL tree? (6)

(b) Write a function to reverse the contents of a stack using additional queue. Assume that classes for stack and queue are defined. (4)