[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4343 **G**

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) An application requires frequent insertions and deletions to store and maintain its data items. Which data structure is appropriate: a linked list or an array? Justify the answer.

P.T.O.

However, the application's database become stable after some time and no further insertion and deletions are required. At this point, th application can change its choice of data structur Which data structure is appropriate now: a linke list or an array? Justify the answer.

(b) Convert the following function into its equivale recursive code :

```
int f (int a [], int p, int q)
{
    int x = a[p];
    for (int i = p+1; i<q; i++)
        if(x>a [i])
            x=a[i];
    return x;
}
```

(c) Consider a stack S implemented using a singl Linked List. Stack S implements Push() an Pop() operations using add_to_Tail() an remove_from_tail() methods.

(i) Give the running time of Push() and Pop operations for the above stack S.

(ii) Can the efficiency of these operations be improved using any alternate implementation strategy using a singly Linked List? Justify your answer by comparing running times.

(d) Create a Multiway Search Tree of order two and show all the steps involved :

50, 35, 40, 24, 65, 56

Write a function to find the inorder successor of the root node of the above tree. (5)

(e) Consider a scenario where every node of a doubly linked list stores a character with given head and tail pointers. Write a function that visits each node of the list exactly once to check whether the contents of the doubly linked list form a palindrome or not. The function should also report the number of characters in the list without using any further traversal.

A palindrome is a string that reads the same backward as forwards. For example, 'madam and 'ABBA' are palindromes. (5)

(f) Consider a circular queue created using an array of size 4. Perform the following operations in the given order and show the status of the queue after every operation :

P.T.O.

Enqueue(4), dequeue(), dequeue(), enqueue(5),
enqueue(6), enqueue(8), enqueue(10), enqueue(9),
dequeue (), enqueue(11)

If the above queue was linear, show the fina
contents of the queue after performing all th
above operations.

(g) A lottery game generates 10-digit ticket number
These tickets are to be stored in a square matri
(5X5) based on the ticket number. The summatio
of the first five digits of a ticket number (modul
the number of rows in the square matrix) is use
to identify the row number and the summation
the last five digits of the ticket number (modul
the number of columns in the square matrix)
used to identify the column number of the squa
matrix to store that ticket. Two tickets may ha
to the same location in the square matrix, in whi
case, the location becomes a bucket that can ho
multiple tickets. Demonstrate the working of t
above game on the following ticket numbers:

1234567890, 0123456789, 0234516789, 013452678
0124536789, 0123546789, 0123465789, 901234567

2. (a) Consider a scenario where the students are submitting their answer scripts one by one to a teacher. The teacher is maintaining the collected answer sheets in order always. Suggest the algorithm that can be used by the teacher. Use this algorithm to arrange the following 5 answer scripts that are numbered as follows and show all the steps :

23, 14, 56, 2, 10

Compute the number of comparisons that the teacher must have performed. (5)

(b) Find the preorder traversal of a Binary Search Tree (BST) if its postorder traversal is given below. Show all the steps performed.

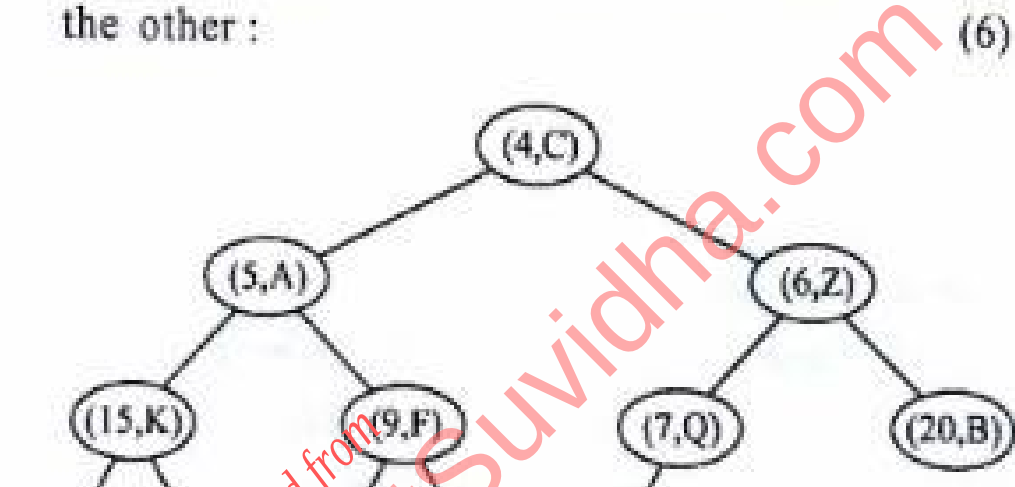
2 20 17 25 [illegible] 48 45 50 40 (5)

3. (a) An upper triangular integer matrix A with nXn dimension is to be stored as a one-dimensional array B in column-major order. If the base address of the array B is 200 and each integer takes 4 bytes of memory, find the address of A[1][2]. Also, give the formula to map the A[i][j] element of array A into array B. Assume that the indexing for array A starts with 1 and that of B from 0. (6)

P.T.O.

(b) Assuming a class is already defined for a singly linked list, write a member function to display the middle node of the list by traversing the list exactly once. (4)

4. (a) For the given Priority Queue implemented using Heap, illustrate the following operations one after the other : (6)



(i) insert new element (3, T)

(ii) removeMin()

(b) Insert the given keys one by one in a multiway search tree of order 5 such that the search time is always logarithmic. Show all the steps involved. Thereafter, delete the key 16 and show the resulting tree.

24, 30, 16, 43, 51, 65, 48, 75, 34 (4

5. (a) Give a class definition for an ordered singly linked list. Write a member function to insert a node in this linked list such that the list remains in order. (6)

(b) Write a recursive function to find the maximum key value in a Binary Search Tree. (4)

6. (a) Consider an array with the following elements:

102, 280, 405, 513, 632, 746, 910, 958, 1000

Which searching technique (linear/binary) is better suited and why? Will this technique be appropriate if the given data is stored using a linked list? Why/ Why not? (5)

(b) Discuss the minimum and maximum height of a Binary Search Tree having n nodes. State the advantage of using a height-balanced tree like an AVL Tree over a Binary Search Tree. (5)

7. Consider an electronic calculating device named FastCal. On receiving a mathematical expression, A, as input, FastCal converts that expression into a parenthesis-free notation and evaluates it using some suitable data structures. Answer the following :

P.T.O.

(i) Which data structures FastCal must use for the conversion and evaluation of the expression?

(ii) Give the complete algorithm for the above-mentioned functioning of FastCal. (10)