

[This question paper contains 12 printed pages.]

Your Roll No..... 21033530039

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

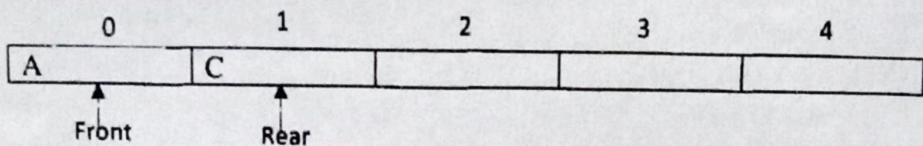
1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. 1 of 35 marks is compulsory. — |
3. Attempt any **Four** questions from Q. No. 2 to Q. No. 7.

→ 2, 3, 4, 6

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)

1 (a) Give Output.

(4)

2

(b) Consider the linked list:

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

Give the output of the below function fun1 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)

3

```

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);

}

}

```

4

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.

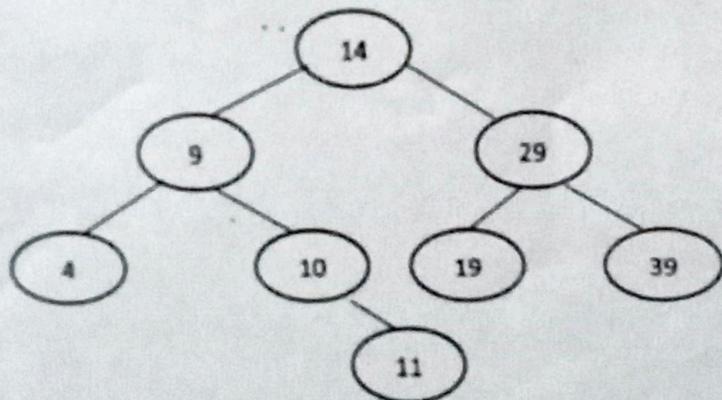
- (a) Create a balanced multiway search tree of order 5 using following integers

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)

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)

[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 1901

C

Roll No.1305827002

Unique Paper Code : 234201

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

Name of the Paper : Data Structure (CSHT-203)

Semester : II

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 1 is compulsory.
 3. Attempt any **four** questions out of the remaining Q2-Q7.
 4. Parts of a question must be answered together.
-
1. (a) Define a class to represent node of a doubly circular linked list.
Write a member function to display the content of doubly circular linked list. (5)
 - (b) Consider the following postfix expression :
8 7 3 - / 6 2 5 4 + * + -
The above expression is evaluated using stack. Show the content of stack after each step. (5)
 - (c) Draw binary trees with 3 nodes which when traversed in post-order gives the sequence A, B, C. (5)
 - (d) Consider following list S of alphabetic characters :
B, F, H, M, Q, S, U, V

An application requires to perform search operations on the above list. Which of the search technique is appropriate and why? Apply the technique suggested by you to search an element U on the list S and count the number of comparisons performed in searching U. (5)

- (e) Consider following list of 9 numbers :

66, 33, 44, 22, 55, 88, 11, 77, 99

Suppose the list is to be sorted. Use the quicksort algorithm to find final position of first number 66 in the sorted list. (5)

- (f) The Binomial Coefficient is defined recursively according to the following definition

$$C(n,k) = 1 \text{ if } k = 0 \text{ or } k = n$$

$$C(n,k) = C(n-1, k-1) + C(n-1, k) \quad \text{otherwise}$$

Find the value of $C(3,2)$ and $D(4,4)$. (5)

- (g) Write a function to delete an element x from an ordered linked list. (5)

2. (a) Consider the following class definition of singly linked list :

```
class SLList
{
    Node * start; //points to first node
public:
    SLList()
    { start = 0; }
    .....
    void change();
}
```

Member function `change()` removes the first element of the singly linked list and adds it to the end of the list without changing any value of `info`. Write the code of member function `change()`. Assume class `Node` is defined and have data members `info` for storing value of the node and `next` to store address of next node and constructor to initialize these members. (5)

- (b) What are self-organizing lists? For a given sequence BCADADACB, show the list after each step using (i) Move to Front (ii) Transpose method. (5)

3. (a) Consider the following queue `QUEUE` of characters, where queue `QUEUE` is a circular queue of size 6. `FRONT` is at 2 and `REAR` is at 4. And queue `Q` is :

0	1	2	3	4	5
		S	A	U	

Show the status of `QUEUE`, `FRONT` and `REAR` as the following operations take place in the sequence given below :

(i) Elements P, Y are added.

(ii) Elements C, N, B are added.

(iii) Two elements are deleted.

(iv) Three elements are deleted. (4)

- (b) In the part 3(a), which operation(s) will cause overflow or underflow? What is condition for overflow and underflow to occur in a circular queue? Write the functions to test for overflow and underflow conditions and to print an appropriate message in a circular queue. (6)

4. (a) Consider the following recursive function :

```
unsigned int Fib (unsigned int n){
    if (n < 2)
        return n;
    else
        return (Fib(n-2) + Fib(n-1)); }
```

This function produces Fibonacci sequence 0,1,1,2,3,5,8,13

Function `Fib(5)` is called to compute sixth number of Fibonacci sequence.

How many recursive calls and additions will be performed to compute `Fib(5)`. (5)

Draw the tree showing all the calls generated by `Fib(5)`.

- (b) What is hashing? Consider the following 4 digit numbers (keys) :

6514, 4331, 1825

- Find the 2-digit hash address of each key using Mid Square method. (5)

- (a) Consider a upper triangular matrix of $n \times n$ size. What will be total number of non zero entries in this upper triangular matrix. Give the mapping formula for storing and retrieving elements of upper triangular matrix in a one dimensional array. (6)

- (b) Consider the following Sparse Matrix :

0	0	0	0	0	5	0	2
8	0	0	0	3	0	0	0
0	9	0	0	0	0	4	0
0	6	1	0	0	0	0	0

Show how the elements will be stored in one dimensional array in row major order and column major order. (4)

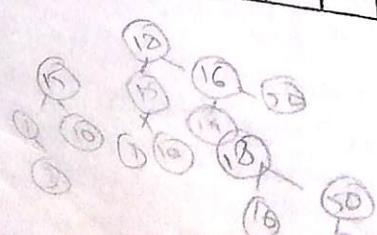
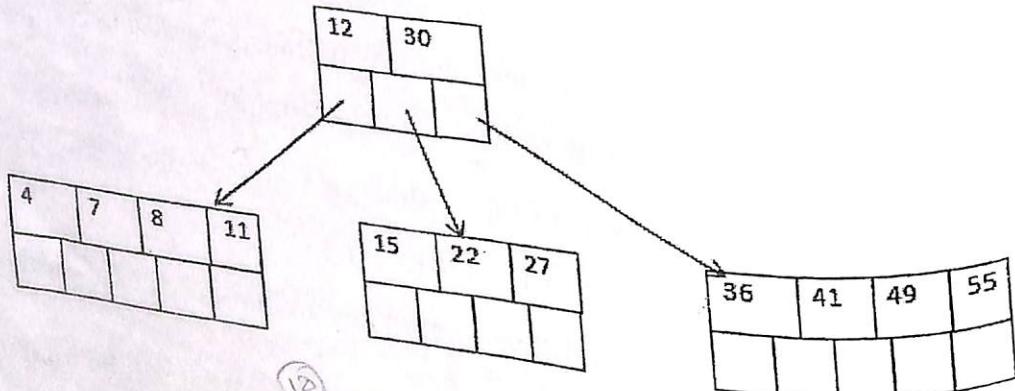
6. (a) Write a function to implement iterative preorder traversal on a Binary search tree. (5)
- (b) Create a Binary Search Tree using following data :

15, 7, 1, 18, 50, 19, 3, 10, 16

Then, perform deletion of node 7 using (i) deletion by copying and (ii) deletion by merging method. Show the tree structure for each deletion separately. (5)

7. (a) Write a function to count total number of left children in a Binary Search tree. (5)

- (b) Consider the following B-tree of order 5. Insert 13, 45, and 37 in the following B - tree. Show the status of B-tree after each insertion (5)



This question paper contains 4+2 printed pages]

Roll No.

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S. No. of Question Paper : 5037

Unique Paper Code : 234261

D

Name of the Paper : Data Structure [CSPT-202]

Name of the Course : B.Sc. Mathematical Sciences/B.Sc. Physical Sciences

Semester : II

Duration : 3 Hours

Maximum Marks : 75

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

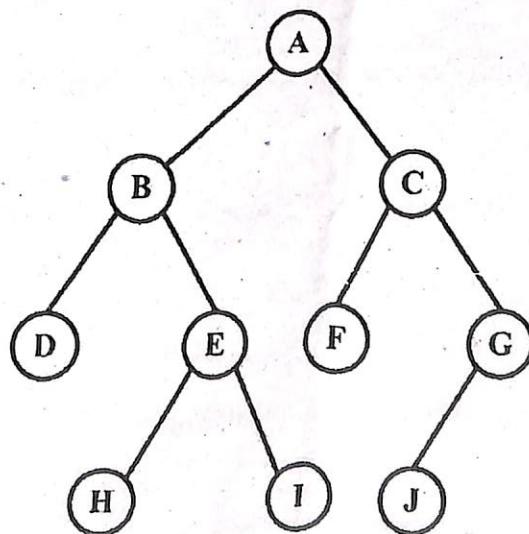
Question No. 1 is compulsory.

Attempt any Five of question No. 2 to 8.

2-8

Parts of a question must be answered together.

1. (a) Perform the preorder and Inorder traversal of the following binary tree : 4



(2)

98
X50

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Consider the following circular queue which is capable of accommodating maximum 6 elements.

Front = 2 Rear = 4

Queue: —, —, L,M,N, —

Describe the status of the queue as the following operations take place :

(i) Add O,P,Q

(ii) Delete Two elements

(iii) Add R

(iv) Delete one element.

(c) Convert the following infix expression to postfix expression. Show the status of the stack at each step :

 $A \wedge B * C / (D * E - F)$ $\text{A} \text{ } \wedge \text{ } \text{B} \text{ } \text{A}$
 $\text{C} \text{ } \text{D} \text{ } \text{E} \text{ } \text{F} \text{ } \text{-} \text{ } \text{1}$

(d) Apply selection sort algorithm on the following list of numbers. Show the outcome after each iteration :

82, 42, 49, 8, 25, 52, 36, 93, 59.

(3)

5037

(e) Mention whether True/False :

(i) Queue works on the principle of FIFO. T

(ii) Efficiency of Binary Search algorithm is $\log(n)$. T

(iii) Recurssion is a process in which a problem is defined in terms of itself. T

(iv) In a doubly linked list the two pointers in a node point to the first and last node of the linked list. F

(v) In a tree, nodes are arranged in hierarchical order and so there is only one way in which these nodes can be tranversed. F

(f) List two applications of stacks. Give reasons why stack would be preferable to array. 2

(a) Write a program in C++ to sort a list of numbers using Bubble sort. 5

(b) Compare the two implementations of stack i.e. the array implementation and linked implementation; giving advantages and disadvantages of linked lists. 5

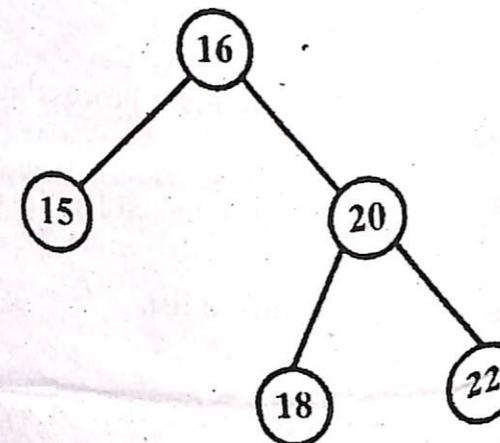
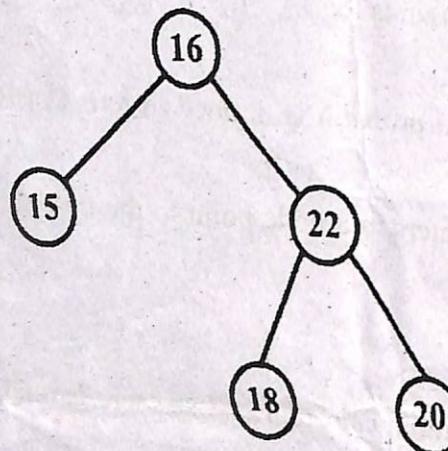
(a) What is a queue ? How do you represent it ? 2

(b) Write a function to insert a node after a node 'P' in a singly linked list. 4

P.T.O.

(4)

- (c) (i) Which one of the trees given below is a valid Binary search tree and why ?
one is not.



- (ii) Compare an iterative process with a recursive process.

(iii) is a data structure which represents hierarchical relationship among its elements.

4. (a) Define the following terms :

(i) Tree

(ii) Stack

(iii) Data structure.

(5)

5037
7

- (b) Write a program to accomplish the following stack operations :

(i) PUSH

(ii) POP

(iii) Is.empty

(iv) Is full.

5. (a) Show the states of the stack at each step while evaluating the given post fix expression :

$7532 \wedge * 922 \wedge - / + 64 * +$.

- (b) Write a program to find the desired element in an array using binary search. Is it efficient than sequential search ?

6. (a) What is a priority queue ? Which data structure is more efficient for doing insertion and deletion in this queue ?

- (b) Construct a binary search tree from the given inorder and preorder traversals :

Preorder : A B D G H E I C F J K

Inorder : G D H B E I A C J F K

What is the postorder traversal of the tree ?

5+2

P.T.O.

(6)

- 503
7. (a) Write a function QUEDEL () in C++ to display and delete an element from a dynamically allocated queue containing nodes of the following given structure :

Struct NODE

```
{ int itemno;  
    Char itemname[10];  
    NODE * next;  
};
```

- (b) Consider the following code :

Fun1 (x)

{

If($x < 5$)

 return ($3 * x$)

Else

 return ($2 * \text{fun1}(x - 5) + 7$)

- What would be returned if fun 1 is called as fun 1(10) ?
8. (a) Write a function for deleting the node from a single linked list which has a value
(b) Write the algorithm to evaluate a postfix expression using a stack.

[This question paper contains 6 printed pages.]

Your Roll No.....16058570033

Sr. No. of Question Paper : 6504

HC

Unique Paper Code : 32341301

Name of the Paper : Data Structures

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

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. Attempt any **four** questions out of the remaining Q.2-Q.7.
 3. Parts of a question must be answered together.
- .
- (a) Write enqueue and dequeue functions for a queue to be implemented through a circular singly linked list. (5)
- (b) Given the following code. Write its recursive function. (5)

2

6504

```

Void f(int n)
{
    For (i=1;i<=n;i++)
    {
        If(i%2==0)
            Cout<<i*i*i;
    }
}

```

- (c) Evaluate the following postfix expression using stack:

$$4 \ 10 \ 5 \ + \ * \ 15 \ 3 \ / \ -$$

- Show the contents of the stack after every step. (5)
- (d) Sort the following set of elements using selection sort.

Show the content of array after every pass.

- (e) A hash table of length 10 uses open addressing with hash function $h(k)=k \bmod 10$, and linear probing. After inserting 6 values into an empty hash table, the table is as shown below. (2+3=5)

0	
1	11
2	32
3	63
4	71
5	85
6	52
7	
8	
9	

Which one of the following choices gives a possible order in which the key values could have been inserted in the table? Justify your answer.

- (i) 85, 11, 63, 71, 32, 52 ✗
- (ii) 63, 11, 32, 71, 52, 85 ✗
- (iii) 85, 63, 11, 32, 71, 52
- (iv) 11, 85, 52, 32, 63, 71 ✗

- (f) Some search operations are to be performed on a sorted data stored in an array. However, it is known that the keys to be searched are all present in the initial few positions. Which search technique would you use? Justify your answer. (2+3=5)

P.T.O.

```

this->val = obj.val;
} };

```

0	
1	11
2	32
3	63
4	71
5	85
6	52
7	
8	
9	

4

6504

- (g) Construct a binary tree whose following traversals are given : (5)

Inorder: x y z a p q r

Preorder: a y x z q p r

2. (a) Write a recursive function to display a single linked list of integers in reverse order. (4)

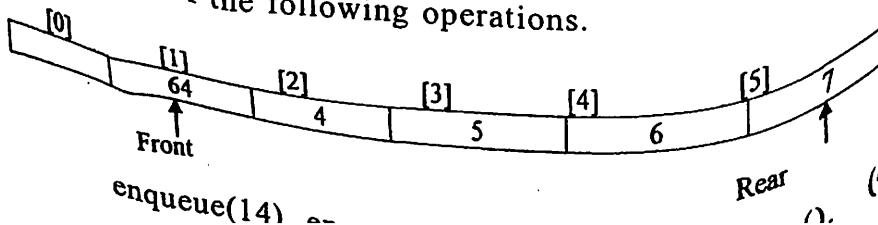
- (b) Write a member function to delete the element at i^{th} position in a doubly linked list. The position i is passed as a parameter to this function. (6)

3. (a) Write a function to reverse the order of elements in stack using two additional stacks. (4)

- (b) Compare and contrast the behavior of bubble and insertion sort on the following set of values. (4)

1, 2, 3, 4, 5, 6.

4. (a) Given a queue implemented using array of size 6. Show the queue and the front & rear values after performing each of the following operations. (5)



- (b) What is hashing? Explain any two hashing functions. Explain linear probing method of collision resolution with an example. (2+2+2=6)

5. (a) What are Self organizing lists? Compare the following two methods used to self organize lists. (4)

(i) Move to Front

(ii) Transpose

(2+3=5)

- (b) Give the formula and calculate the address of the element $A[3][2]$ of the 2D array defined as $A[5][5]$, if the elements are stored in

(i) Row major order.

(ii) Column major order.

The beginning address of array is 400. Every element requires 4 bytes of storage. (4)

- (a) Create a binary search tree using the following values. 12, 45, 13, 67, 10, 34.

Using the above tree perform the following operations

(i) Delete 12 using delete by merging.

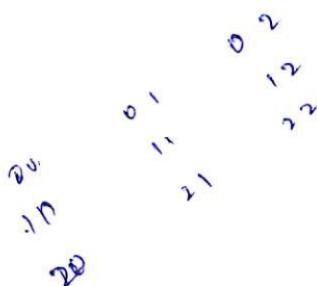
(ii) Delete 45 using delete by copying. (6)

(b) Write a function to calculate the number of leaves in a binary tree. (4)

7. (a) Insert the following values in B tree of order 5.

45, 12, 34, 78, 90, 22, 88, 96, 40, 82, 55, 100. (6)

(b) Define a class to implement a Lower Triangular matrix as a 1D array. Write a member function to store and retrieve its elements. (4)



[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 2046 GC-3 Your Roll No.....

Unique Paper Code : 32341301

Name of the Paper : Data Structures

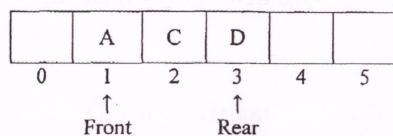
Name of the Course : **B.Sc. (H) Computer Sc. CBCS**

Semester : III

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on the receipt of this question paper.
 2. Question 1 is compulsory.
 3. Attempt any **four** questions out of the remaining **Q2-Q7**.
 4. Parts of a question must be answered together.
-
1. (a) Give template class definition for a doubly linked list of integers. Write a member function to insert a node at the end of this linked list. (5)
 - (b) Consider the following Queue of characters of size 6 : (5)



This Queue is implemented as a circular array. Show the contents of the Queue with the positions of Front and Rear after each of the following operations :

- (i) F is added to the Queue

P.T.O.

- (ii) Two letters are deleted
(iii) K, L and M are added
(iv) Three letters are deleted
(v) S is added
- (c) Write a recursive function for Linear Search on an array of integers. The function should return the index of the element if it is found else it should return -1. (5)
- (d) Evaluating the following postfix expression :- (5)
BA + CD - × CB - AD - + / where, B=5, A=9, C=8, D=4
Show the contents of the stack at every step.
- (e) Construct a binary search tree for the following keys in the given order :
75 70 44 48 98 108 91 145
Show :
(i) Inorder Traversal
(ii) Postorder Traversal
(iii) The tree after deleting key 98. Use deletion by merging.
(2+1+1+1=5)
- (f) Define a class to implement a Diagonal matrix as a 1-D array. Write the member functions to store and retrieve its elements. (5)
- (g) What is a hashing function ? Explain the Division Method.
Insert the keys 28, 37, 55, 72, 63, 89 into a hash table of size m=7 using linear probing with hash function as the Division Method. (1+1+3=5)

2. (a) Give the formula and calculate the address of the element A[2][4] of the 2D array defined as :

int A [6] [6], if the elements are stored in :

(i) row major order

(ii) column major order

The beginning address of the array is 100. Every element requires 4 bytes of storage. (4)

- (b) Let a and b be positive integers. Suppose a function F is defined recursively as follows :

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

Find the value of :

(i) F(2,3)

(ii) F(14,3)

(iii) F(5861,7)

(2+2+2=6)

3. Write member functions to perform the following operations on a Binary Search Tree :-

(i) Creation

(ii) Traversing Preorder (Iterative)

(iii) Calculating height

(4+3+3=10)

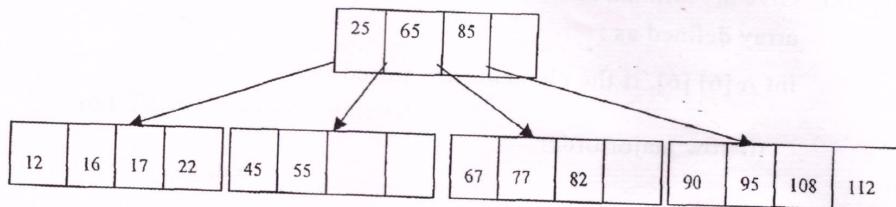
4. (a) Write a function to perform Merge Sort on an array of integers. (4)

- (b) Insert the given keys one by one in the following B tree of order 5 :

58, 78, 40, 42, 99, 64

Show the status of the tree after each insertion. (6)

P.T.O.



5. (a) Explain Priority Queue. (2)

(b) Write a C++ program to add two large integers using a stack. (8)

6. Write functions for the following : (4+4+2=10)

(i) Creating an ordered linked list of integers.

(ii) Merging two ordered singly linked lists of integers into one ordered list.

(iii) Displaying the linked list.

7. (a) Explain any two methods used to self-organize lists. (2+2=4)

(b) Apply Bubble Sort on the following array of integers :

26, 45, 13, 23, 12, 7, 38, 42

Show the contents of the array after every pass. (6)

(800)