UNIVERSITY OF THE PUNJAB

Fourth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Data Structure and Algorithm   TIME ALLOWED: 2 hrs. & 30 mins.
Course Code: IT-207 / IT-22408   MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

Question # 2. Short Questions: (4 x 5 =20 marks)

a) Write down the in fix notation of the following expression:

$$9-3+2*(3*4-3)/4+2*1$$

b) What is the output of the following code

```cpp
#include <iostream>
using namespace std;
int fun1(int n)
{
if (n == 1)
        return 0;
else
        return 1 + fun1(n / 2);   // recurrsive call
}
int main()
{
cout << "answer is = " << fun1(32) << endl;
return 0;
}
```

c) For the following given data below draw the Max-Heap

Data is:

15 3 , 6 , 18 , 5 , 9 , 11 , 20 , 17 , 7 , 2 , 3 , 14

d) Write down the code for the Insertion Sort.
   void InsertionSort (int A[ ] , int size); // you have to define this function only

Question # 3. Long Questions   (30 marks)

a) Write down the code of the following function of Link List Class.

i)   void removeFromHead( ) // remove the first node at head
ii)   int countDuplicate (int key) // count the node having duplicate values.

b) Suppose you are given a sorted array A of n distinct numbers that has been rotated k steps, for some *unknown integer k* between *1 to n-1*. That is, A[1..k] is sorted in increasing order, and A[k+1...n] is also sorted in increasing order, and A[n] < A[1].
The following array A is an **example** of n=16 elements with k=10.
   A={9,13,16,18,19,23,28,31,37,42,0,1,2,5,7,8}
You have to design an O(log n) code to find the value of k.

   int FindK(int A[ ], int size) //you have to implement this function   P.T.O.

UNIVERSITY OF THE PUNJAB

Fourth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Data Structure and Algorithm   TIME ALLOWED: 30 mins.
Course Code: IT-207 / IT-22408   MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.

PART – I (OBJECTIVE)

Question#1. Multiple Choice Questions: **(2 x 5 =10 marks)**

1. Two main measures for the efficiency of an algorithm are
   a) Processor and memory
   b) Complexity and capacity
   c) Time and space
   d) Data and space

2. The memory address of the first element of an array is called
   a) floor address
   b) foundation address
   c) first address
   d) base address

3. A binary tree whose every node has either zero or two children is called
   a) Complete binary tree
   b) Binary search tree
   c) Extended binary tree
   d) None of above

4. In which notation operator is comes after operand?
   a) Infix
   b) Prefix
   c) Postfix
   d) None

5. Linear order linked list is provided through _____
   a) variables
   b) arrays
   c) Pointer
   d) Strings

UNIVERSITY OF THE PUNJAB

Fourth Semester - 2018

Examination: B.S. 4 Years Programme

PAPER: Data Structure and Algorithm
Course Code: IT-207 / IT-22408 Part – I (Compulsory)

TIME ALLOWED: 15 Mints.
MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.

Please encircle the correct option. Each MCQ carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.

Question#1. Multiple Choice Questions.   **(1x10=10)**

i. Stack is used for:
   a. CPU Resource Allocation   b. Breadth First Traversal
   c. Recursion   d. None of the above

ii. How many swaps are required to sort the given array using bubble sort – {2, 5, 1, 3, 4}:
   a. 4   b. 5
   c. 6   d. 7

iii. A binary tree whose every node has either zero or two children is called:
   a. Complete binary tree   b. Binary search tree
   c. Extended binary tree   d. None of the above

iv. What is the worst case time complexity of linear search algorithm?
   a. O(1)   b. O(n)
   c. O(log n)   d. $O(n^2)$

v. In the deletion operation of max heap, the root is replaced by:
   a. Next available value in the left sub-tree
   b. Next available value in the right sub-tree
   c. Any random value from the heap
   d. Last element of the last level

vi. Which of the below is not divide and conquer approach?
   a. Selection sort   b. Bubble Set
   c. Counting sort   d. Merge Sort

vii. In which notation operator is comes after operand?
   a. Infix   b. Prefix
   c. Postfix   d. None

viii. Two main measures for the efficiency of an algorithm are:
   a. Processor and memory   b. Complexity and capacity
   c. Time and space   d. Data and space

ix. The memory address of the first element of an array is called:
   a. Floor address   b. Foundation address
   c. First address   d. Base address

x. Linear order linked list is provided through:
   a. Variables   b. Arrays
   c. Pointer   d. Strings

UNIVERSITY OF THE PUNJAB

Fourth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Data Structure and Algorithm
Course Code: IT-207 / IT-22408   Part – II

TIME ALLOWED: 2 Hrs. & 45 Mints.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

Question # 2. Short Questions: (4 x 5 =20 marks)

a) Write down the code for the Insertion Sort.
   void InsertionSort (int A[ ] , int size); // you have to define this function only

b) Write down the code of the following function of Link List Class.
   void remove(int key) // remove the node having value equal to key.

c) The following given function runs in time O(n), you have to write an equivalent function that runs in time O(1).

```
int fun( int size, int a[ ] )
{
    s=0;
    for( i = 1 to n )
        s=s+a[ i ] - a[ i -1 ]
    return s;
}
```

d) How many times "Hello" will be displayed on screen by running this code, also draw recursion tree for calculating your answer.

```cpp
#include <iostream>
using namespace std;
void f(int n)
{
    if (n == 1 || n == 0)
        return;
    else
    {
        cout << "Hello" << endl;
        f(n - 1);  // recurrsive call
        f(n - 2);  // recurrsive call
        cout << "Hello" << endl;
    }
}
int main()
{
    f(5);
    return 0;
}
```

Question # 3. Long Questions   (3x 10=30 marks)

a) Write a program to check whether a given string is of the form aⁿbⁿ where n = 0, 1, 2, 3... using appropriate data struture.
   Examples:
   aaabbb – is of the form aⁿbⁿ
   bbbaaa – is not a form of aⁿbⁿ
   ababab – is not a form of aⁿbⁿ

b) For the following given data below draw the following:
   i.   BST(Binary Search Tree)
   ii. Min Heap

   Data is:

   15 , 3 , 6 , 18 , 5 , 9 , 11 , 20 , 17 , 7 , 2 , 3 , 14

c) What is a circular queue? Write a program to implements a circular queue.

UNIVERSITY OF THE PUNJAB

Fourth Semester   2015
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Data Structure and Algorithm
Course Code: IT-207 /

TIME ALLOWED: 2 hrs. & 30 mins.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

Part-II (Short Questions)

QUESTION # 2   [4 x 5 = 20 marks]

1. Draw the **Binary Search Tree (BST)** obtained when the following values are inserted (in the given order) into an initially empty BST:

   14   10   8   9   15   13   16   14

   You only have to show the final BST which results after inserting all of the above values.

2. Compute the running time of the program fragment shown below.
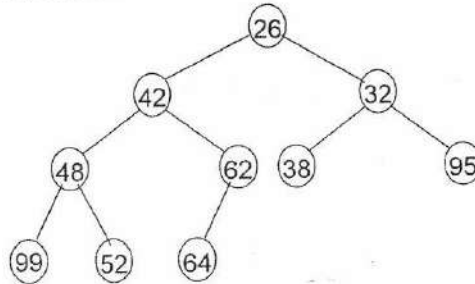
```
num = 0;
for(i=N; i>0; i--)
{
    if(i > j)
    {
        num = num + 1;
    }
    else
    {
        for(k=N; k > 0; k--)
        num = num - 1;
    }
}
```

3. Write a C++ function **leastDifference** that finds the least difference between any two elements of an array. For example:

   Array: 20   24   30   45   32   19
   Least Difference: 2 (between 30 and 32)

4. Perform deletion operation of minimum value only one time in the following min- heap and draw the resultant tree after deletion.

P.T.O.

Part-III (Subjective)

QUESTION # 3 [10 marks]

Convert following In-fix expression to Pre-fix expression. Evaluate both In-fix and Post-fix expression to compare results?

$$(12/(6*4)) + ((27/(3*3)+1)/8)$$

QUESTION # 4 [10 marks]

Write a C++ function that removes duplicates from a Linked List. Consider the following scenarios, just for examples, before and after applying your function:

```
Before:      23   24   23   45   39   45   78   45   90
After:       23   24   45   39   78   90

Before:      1    3    4    5
After:       1    3    4    5
```

QUESTION # 5 [10 marks]

Write a C++ function **leafCount** that counts the leaves of a binary tree.

Good Luck

UNIVERSITY OF THE PUNJAB

Roll No. ....

Fourth Semester   2015
Examination: B.S. 4 Years Programme

PAPER: Data Structure and Algorithm
Course Code: IT-207 / ....

TIME ALLOWED: 30 mins.
MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.

Part-I (Objective)

QUESTION # 1   [10 marks]

Select the best option for each of the following multiple choice questions (MCQs). Only one option is correct. Cutting and overwriting in this question will be considered wrong.

1. Two main measures for the efficiency of an algorithm are
   A. Processor and memory
   B. Complexity and capacity
   C. Time and space
   D. Data and space

2. The Worst case occur in linear search algorithm when
   A. Item is somewhere in the middle of the array
   B. Item is not in the array at all
   C. Item is the last element in the array
   D. Item is the last element in the array or is not there at all

3. The complexity of the average case of an algorithm is
   A. Much more complicated to analyze than that of worst case
   B. Much more simpler to analyze than that of worst case
   C. Sometimes more complicated and some other times simpler than that of worst case
   D. None or above

4. The result of a postfix expression 8 2 3 ^ / 2 3 * + 5 1 * - with single digit operands is:
   A. 1
   B. 2
   C. 3
   D. 4

5. The complexity of Bubble sort algorithm is
   A. O(n)
   B. O(log n)
   C. O(n^2)
   D. O(n log n)

6. Which of the following data structure is not linear data structure?
   A. Arrays
   B. Linked lists
   C. Graphs
   D. None of above

7. Which of the following is not the required condition for binary search algorithm?
   A. The list must be sorted
   B. There should be the direct access to the middle element in any sublist
   C. There must be mechanism to delete and/or insert elements in list
   D. None of above

8. Suppose that you insert the following values (in the given order) into an empty binary search tree:

   8 4 7 6 2 9 5

   How many levels will be there in the resulting binary search tree?
   A. 4
   B. 5
   C. 6
   D. 7

9. When inorder traversing a tree resulted **E A C K F H D B G**; the preorder traversal would return
   A. FAEKCDBHG
   B. FAEKCDHGB
   C. EAFKHDCBG
   D. FEAKDCHBG

10. The time complexity to sort n elements by using merge sort technique, is always $\log_2(n)$
    A. True
    B. False

UNIVERSITY OF THE PUNJAB

Fourth Semester 2012
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Data Structure and Algorithm
Course Code: IT-207 / IT-22408

TIME ALLOWED: 2 hrs. & 30 mins.
MAX. MARKS: 50

Attempt This Paper on Separate Answer Sheet provided.

Part-II (Short Questions)

Question # 2

1. Draw the **Binary Search Tree(BST)** obtained when the following values are inserted(in the given order) into an initially empty BST:

   46   32   28   30   55   60   58

   You only have to show the final BST which results after inserting all of the above values.

2. Compute the running time of the program fragment shown below.

```
s= 0;
For (i=0; i<N; i++)
{
        If (i > j)
        {
               Sum = Sum + 1;
        }
        Else
        {
               For (k=0; k < N; k--)
               Sum = Sum - 1;
        }
}
```

3. Consider a circular queue of 100 elements. Find total number of elements in the circular queue against the following situations. Also write a formula to calculate the total number of elements in the circular queue.
   a) Front = 67; R = 92;
   b) Front = 76; R = 62;
   c) General Formula

4. How priority queue is different from simple queue?

5. Give the trace of bubble sort and insertion sort to sort the following list of element:

   12   5   18   7   21   14

Draw the following table on your answer sheet and fill the cells after each pass of the sorting algorithm.

Pass	Bubble Sort	Pass	Insertion Sort
Pass 1		Pass 2	
Pass 2		Pass 2	
Pass 3		Pass 3	
Pass 4		Pass 4	
Pass 5		Pass 5	

6. Write an algorithm to insert an element in a circular queue.

<center>Part-III (Subjective)</center>

Question # 3

Convert following in-fix expression to pre-fix expression. Evaluate both in-fix and post-fix expression to compare results?

$$(3 * (6/3)) + (8 / (6-4))$$

Question # 4

Write C++ function **bool isMaxHeap (int A [], int size)** to determine whether the array **A** is a Max Heap or not. This function should return true if the array **A** is a Max Heap and it should return false otherwise. You can assume that the indices of the array start at 1 (instead of 0).

Question # 5

Write a C++ function **Node * middleLinkedList (Node *head)** to find the middle of a linked list. This function receives the head of linked list as parameter and then after finding returns the address of middle node.

UNIVERSITY OF THE PUNJAB

Fourth Semester 2013
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Data Structure and Algorithm
Course Code: IT-207 / IT-22408

TIME ALLOWED: 2 hrs. & 30 mins.
MAX. MARKS: 50

Attempt This Paper on Separate Answer Sheet provided.

Part-II (Short Questions)

Question # 2

1. Draw the **Binary Search Tree(BST)** obtained when the following values are inserted(in the given order) into an initially empty BST:

    23   16   14   15   27   25   30   29

    You only have to show the final BST which results after inserting all of the above values.

2. Compute the running time of the program fragment shown below.

    ```
    Sum = 0;
    For (i=N; i>0; i--)
    {
            If (i > j)
            {
                    Sum = Sum + 1;
            }
            Else
            {
                    For (k = N; k > 0; k--)
                    Sum = Sum -1;
            }
    }
    ```

3. Write a function swap (int a, int b) that exchange two node in list that is implemented using linked list. You have to add this function swap () as a member function of list class. The nodes are identified by number and are passed as parameters. For example to exchange node 5 and 8, you would call swap (5, 8). If the exchange is successful, the function should return true. If it encounters an error, such as an invalid node number then it should return false.

4. Consider a circular queue of 100 elements. Find total number of elements in the circular queue against the following situations. Also write a formula to calculate the total number of elements in the circular queue.
    a) Front = 45; R = 90;
    b) Front = 54; R = 71;
    c) General Formula

5.

6. Perform deletion operation of minimum value only one time in the following min-heap and draw the resultant tree after deletion.
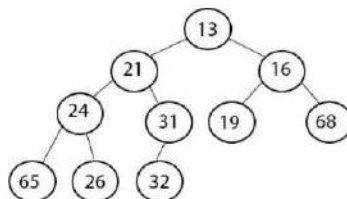
Question # 3

Convert following in-fix expression to pre-fix **expression**. Evaluate both in-fix and pre-fix expression to compare results?

$$(5 * (10 / 5)) + (12 / (10 - 7))$$

Question # 4

Write C++ function **bool isMinHeap (int A [], int size)** to determine whether the array **A** is a Min Heap or not. This function should return true if the array **A** is a Min Heap and it should return false otherwise. You can assume that the indices of the array start at 1 (instead of 0).

Question # 5

Write a C++ function **Node * middleLinkedList (Node *head)** to find the middle of a linked list. This function receives the head of linked list as parameter and then after finding returns the address of middle node.

UNIVERSITY OF THE PUNJAB

Fourth Semester   2014
Examination: B.S. 4 Years Programme

Roll No. _____

PAPER: Data Structure and Algorithm   TIME ALLOWED: 2 hrs. & 30 mins.
Course Code: IT-207 / IT-22408   MAX. MARKS: 50

Attempt This Paper on Separate Answer Sheet provided.

Part-II (Short Questions)

Question # 2

1. Draw the **Binary Search Tree(BST)** obtained when the following values are inserted(in the given order) into an initially empty BST:

   12 8 7 9 14 13 15 16

   You only have to show the final BST which results after inserting all of the above values.

2. Compute the running time of the program fragment shown below.

```
s= 0;
for (i=0; i>n; i++)
{
        If (i<n/2)
        {
                s= s+1;
        }
        else
        {
                for (j=n; j>n/2; j--)
                s= s-1;
        }
}
```

3. Write a function exchange (int a, int b) that exchanges two node in list that is implemented using linked list. You have to add this function exchange () as a member function of list class. The node are identified by number and are passed as parameters. For example to exchange node 5 and 8, you would call exchange (5, 8). If the exchange is successful, the function should return true. If it encounters an error, such as an invalid node number then it should return false.

4. Perform deletion operation of minimum value only one time in the following min-heap and draw the resultant tree after deletion.
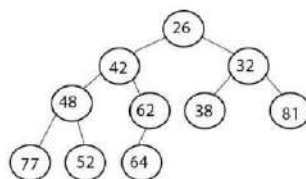
Part-III (Subjective)

Question # 3
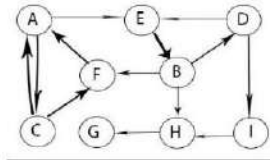
Convert following in-fix expression to pre-fix expression. Evaluate both in-fix and pre-fix expression to compare   results?

$$(4 * (8/4)) + (6/(8-5))$$

Question # 4

Given the following directed graph, write the sequence of vertices after performing:

a) **Depth-First Search (DFS)** starting from vertex **B**, and
b) **Breath-First Search (BFS)** starting from vertex **A**

If you have more than a single choice of vertices at a certain point, traverse them in alphabetical order.

Question # 5

Write a C++ function **bool isSorted (Node *head)** to find whether a linked list is sorted or not? This function receives the head of the linked list as parameter and then checks whether the linked list is sorted if yes then it return true and it return false otherwise.

PAPER: Data Structure and Algorithm
Course Code: IT-207 /

TIME ALLOWED: 30 mins.
MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.
Part-I (Objective)

QUESTION # 1

[10 marks]

Select the best option for each of the following multiple choice questions (MCQs). Only one option is correct. Cutting and overwriting in this question will be considered wrong.

1. Two main measures for the efficiency of an algorithm are
   A. Processor and memory
   B. Complexity and capacity
   C. Time and space
   D. Data and space
2. The Worst case occur in linear search algorithm when
   A. Item is somewhere in the middle of the array
   B. Item is not in the array at all
   C. Item is the last element in the array
   D. Item is the last element in the array or is not there at all
3. The complexity of the average case of an algorithm is
   A. Much more complicated to analyze than that of worst case
   B. Much more simpler to analyze than that of worst case
   C. Sometimes more complicated and some other times simpler than that of worst case
   D. None or above
4. The result of a postfix expression 8 2 3 ^ / 2 3 * + 5 1 * - with single digit operands is:
   A. 1
   B. 2
   C. 3
   D. 4
5. The complexity of Bubble sort algorithm is
   A. O(n)
   B. O(log n)
   C. O(n²)
   D. O(n log n)
6. Which of the following data structure is not linear data structure?
   A. Arrays
   B. Linked lists
   C. Graphs
   D. None of above
7. Which of the following is not the required condition for binary search algorithm?
   A. The list must be sorted
   B. There should be the direct access to the middle element in any sublist
   C. There must be mechanism to delete and/or insert elements in list

   D. None of above
8. Suppose that you insert the following values (in the given order) into an empty binary search tree:

       8 4 7 6 2 9 5

   How many levels will be there in the resulting binary search tree?

   A. 4
   B. 5
   C. 6
   D. 7
9. When inorder traversing a tree resulted E A C K F H D B G; the preorder traversal would return
   A. FAEKCDBHG
   B. FAEKCDHGB
   C. EAFKHDCHG
   D. FEAKDCHBG
10. The time complexity to sort n elements by using merge sort technique, is always log₂(n)
   A. True
   B. False

UNIVERSITY OF THE PUNJAB

Fourth Semester   2015
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Data Structure and Algorithm
Course Code: IT-207 /

TIME ALLOWED: 2 hrs. & 30 mins.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

Part-II (Short Questions)

QUESTION # 2   [4 x 5 = 20 marks]

1. Draw the **Binary Search Tree (BST)** obtained when the following values are inserted (in the given order) into an initially empty BST:

   14 10 8 9 15 13 16 14

   You only have to show the final BST which results after inserting all of the above values.

2. Compute the running time of the program fragment shown below.
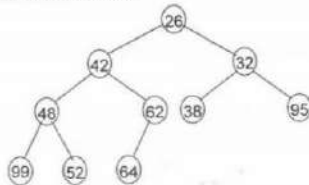
```
num = 0;
for(i=N; i>0; i--)
{
    if(i > j)
    {
        num = num + 1;
    }
    else
    {
        for(k=N; k > 0; k--)
        num = num - 1;
    }
}
```

3. Write a C++ function **leastDifference** that finds the least difference between any two elements of an array. For example:

   Array: 20   24   30   45   32   19
   Least Difference: 2 (between 30 and 32)

4. Perform deletion operation of minimum value only one time in the following min- heap and draw the resultant tree after deletion.

P.T.O.

Part-III (Subjective)

QUESTION # 3   [10 marks]

Convert following In-fix expression to Pre-fix expression. Evaluate both In-fix and Post-fix expression to compare results?

$$(12/(6*4)) + ((27/(3*3) + 1)/8)$$

QUESTION # 4   [10 marks]

Write a C++ function that removes duplicates from a Linked List. Consider the following scenarios, just for examples, before and after applying your function:

Before:	23	24	23	45	39	45	78	45	90
After:	23	24	45	39	78	90			

Before:	1	3	4	5
After:	1	3	4	5

QUESTION # 5   [10 marks]

Write a C++ function **leafCount** that counts the leaves of a binary tree.

Good Luck

UNIVERSITY OF THE PUNJAB

Fourth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Data Structure and Algorithm
Course Code: IT-207 / IT-22408

TIME ALLOWED: 30 mins.
MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.

PART - I (OBJECTIVE)

Question#1. Multiple Choice Questions: _____ **(2 x 5 =10 marks)**

1. Two main measures for the efficiency of an algorithm are
   a) Processor and memory
   b) Complexity and capacity
   c) Time and space
   d) Data and space

2. The memory address of the first element of an array is called
   a) floor address
   b) foundation address
   c) first address
   d) base address

3. A binary tree whose every node has either zero or two children is called
   a) Complete binary tree
   b) Binary search tree
   c) Extended binary tree
   d) None of above

4. In which notation operator is comes after operand?
   a) Infix
   b) Prefix
   c) Postfix
   d) None

5. Linear order linked list is provided through _____
   a) variables
   b) arrays
   c) Pointer
   d) Strings

UNIVERSITY OF THE PUNJAB

Fourth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Data Structure and Algorithm
Course Code: IT-207 / IT-22408

TIME ALLOWED: 2 hrs. & 30 mins.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

PART-II (SHORT NOTES)

Question # 2. Short Questions: (4 x 5 =20 marks)

a) Write down the in fix notation of the following expression:

9-3+2*(3*4-3) /4+2*1

b) What is the output of the following code

```
#include <iostream>
using namespace std;
int fun1(int n)
{
if (n == 1)
    return 0;
else
    return 1 + fun1(n / 2);   // recurrsive call
}
int main()
{
cout << "answer is = " << fun1(32) << endl;
return 0;
}
```

c) For the following given data below draw the Max-Heap

Data is:

15 3 , 6 , 18 , 5 , 9 , 11 , 20 , 17 , 7 , 2 , 3 , 14

d) Write down the code for the Insertion Sort.
void InsertionSort (int A[ ] , int size); // you have to define this function only

Question # 3. Long Questions (30 marks)

a) Write down the code of the following function of Link List Class.

i) void removeFromHead( ) // remove the first node at head
ii) int countDuplicate (int key) // count the node having duplicate values.

b) Suppose you are given a sorted array A of n distinct numbers that has been rotated k steps, for some *unknown integer k* between 1 to n-1. That is, $A[1..k]$ is sorted in increasing order, and $A[k+1...n]$ is also sorted in increasing order, and $A[n] < A[1]$.
The following array A is an **example** of $n=16$ elements with $k=10$.
A={9,13,16,18,19,23,26,31,37,42,0,1,2,5,7,8}
You have to design an $O(\log n)$ code to find the value of k.

int FindK(int A[ ], int size) //you have to implement this function   **P.T.O.**

c) In which order the given tree will Travers when we use the following:
   i.   Post order Traversal
   ii. Write down the code for the Post Order Traversal of any tree.

   void PostOrderTraversal (Node * root); // it is the prototype of the
   function which   you have to define.
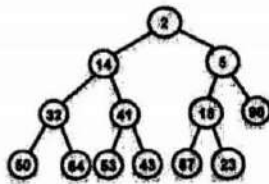
UNIVERSITY OF THE PUNJAB

Fourth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Data Structure and Algorithm	TIME ALLOWED: 15 Mints.
Course Code: IT-207 / IT-22408 Part – I (Compulsory)	MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.

Please encircle the correct option. Each MCQ carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.

Question#1. Multiple Choice Questions.   (1x10=10)

i.   Stack is used for:
   a.   CPU Resource Allocation   b.   Breadth First Traversal
   c.   Recursion   d.   None of the above

ii.   How many swaps are required to sort the given array using bubble sort – {2, 5, 1, 3, 4}:
   a.   4   b.   5
   c.   6   d.   7

iii.   A binary tree whose every node has either zero or two children is called:
   a.   Complete binary tree   b.   Binary search tree
   c.   Extended binary tree   d.   None of the above

iv.   What is the worst case time complexity of linear search algorithm?
   a. $O(1)$ b. $O(n)$
   c. $O(\log n)$ d. $O(n^2)$

v.   In the deletion operation of max heap, the root is replaced by:
   a.   Next available value in the left sub-tree
   b.   Next available value in the right sub-tree
   c.   Any random value from the heap
   d.   Last element of the last level

vi.   Which of the below is not divide and conquer approach?
   a.   Selection sort   b.   Bubble Set
   c.   Counting sort   d.   Merge Sort

vii.   In which notation operator is comes after operand?
   a.   Infix   b.   Prefix
   c.   Postfix   d.   None

viii. Two main measures for the efficiency of an algorithm are:
   a.   Processor and memory   b.   Complexity and capacity
   c.   Time and space   d.   Data and space

ix.   The memory address of the first element of an array is called:
   a.   Floor address   b.   Foundation address
   c.   First address   d.   Base address

x.   Linear order linked list is provided through:
   a.   Variables   b.   Arrays
   c.   Pointer   d.   Strings

UNIVERSITY OF THE PUNJAB
Fourth Semester - 2018
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Data Structure and Algorithm
Course Code: IT-207 / IT-22408 Part – II

TIME ALLOWED: 2 Hrs. & 45 Mints.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

Question # 2. Short Questions: (4 x 5 =20 marks)

a) Write down the code for the Insertion Sort.
    void InsertionSort (int A[ ] , int size); // you have to define this function only
b) Write down the code of the following function of Link List Class.
    void remove(int key) // remove the node having value equal to key

c) The following given function runs in time O(n), you have to write an equivalent function
    that runs in time O(1).

```
int fun( int size, int a[ ] )
{
    s=0;
    for( i = 1 to n )
        s=s+a[ i ] - a[ i -1 ]
    return s;
}
```

d) How many times "Hello" will be displayed on screen by running this code, also draw
    recursion tree for calculating your answer.

```
#include <iostream>
using namespace std;
void f(int n)
{
    if (n == 1 || n == 0)
        return;
    else
    {
        cout << "Hello" << endl;
        f(n - 1);  // recurrsive call
        f(n - 2);  // recurrsive call
        cout << "Hello" << endl;
    }
}
int main()
{
    f(5);
    return 0;
}
```

Question # 3. Long Questions   (3x 10=30 marks)

a) Write a program to check whether a given string is of the form aⁿbⁿ where n = 0, 1, 2, 3...
    using appropriate data struture.
    Examples:
    aaabbb -- is of the form aⁿbⁿ
    bbbaaa -- is not a form of aⁿbⁿ
    ababab -- is not a form of aⁿbⁿ

b) For the following given data below draw the following:
    i.   BST(Binary Search Tree)
    ii.   Min Heap

    Data is:

    15 , 3 , 6 , 18 , 5 , 9 , 11 , 20 , 17 , 7 , 2 , 3 , 14

c) What is a circular queue? Write a program to implements a circular queue.

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

Question # 2. Short Questions: **(4 x 5 =20 marks)**

a) Write down the in fix notation of the following expression:

$$9-3+2*(3*4-3)/4+2*1$$

b) What is the output of the following code

```cpp
#include <iostream>
using namespace std;
int fun1(int n)
{
    if (n == 1)
        return 0;
    else
        return 1 + fun1(n / 2);  // recurrsive call
}
int main()
{
    cout << "answer is = " << fun1(32) << endl;
    return 0;
}
```

c) For the following given data below draw the Max-Heap

Data is:

15 3, 6, 18, 5, 9, 11, 20, 17, 7, 2, 3, 14

d) Write down the code for the Insertion Sort.
void InsertionSort (int A[ ], int size); // you have to define this function only

Question # 3. Long Questions   **(30 marks)**

a) Write down the code of the following function of Link List Class.
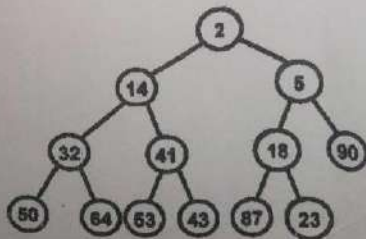
i)   void removeFromHead( ) // remove the first node at head
ii) int countDuplicate (int key) // count the node having duplicate values.

b) Suppose you are given a sorted array A of n distinct numbers that has been rotated k steps, for some *unknown integer k* between 1 to n-1. That is, A[1..k] is sorted in increasing order, and A[k+1...n] is also sorted in increasing order, and A[n] < A[1].
The following array A is an example of n=16 elements with k=10.
A={9,13,16,18,19,23,26,31,37,42,0,1,2,5,7,8}
You have to design an O(log n) code to find the value of k.

int FindK(int A[ ], int size) //you have to implement this function

c) In which order the given tree will Travers when we use the following:
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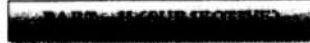
UNIVERSITY OF THE PUNJAB

Fourth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Data Structure and Algorithm
Course Code: IT-207 / IT-22408

TIME ALLOWED: 2 hrs. & 30 min
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

Question # 2. Short Questions: (4 x 5 =20 marks)

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{
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        return 0;
else
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}
int main()
{
cout << "answer is = " << fun1(32) << endl;
return 0;
}
```

c) For the following given data below draw the Max-Heap

Data is:

15 3 , 6 , 18 , 5 , 9 , 11 , 20 , 17 , 7 , 2 , 3 , 14

d) Write down the code for the Insertion Sort.
   void InsertionSort (int A[ ] , int size); // you have to define this function only

Question # 3. Long Questions   (30 marks)

a) Write down the code of the following function of Link List Class.

i)   void removeFromHead( ) // remove the first node at head
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b) Suppose you are given a sorted array A of n distinct numbers that has been rotated k steps, for some *unknown integer k* between *1 to n-1*. That is, A[1..k] is sorted in increasing order, and A[k+1...n] is also sorted in increasing order, and A[n] < A[1].
The following array A is an **example** of n=16 elements with k=10.
    A={9,13,16,18,19,23,28,31,37,42,0,1,2,5,7,8}
You have to design an *O(log n)* code to find the value of k.

   int FindK(int A[ ], int size) //you have to implement this function   **P.T.O.**

UNIVERSITY OF THE PUNJAB
Fourth Semester - 2018
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Data Structure and Algorithm
Course Code: IT-207 / IT-22408   Part – II

TIME ALLOWED: 2 Hrs. & 45 Mi
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

Question # 2. Short Questions: (4 x 5 =20 marks)

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c) The following given function runs in time O(n), you have to write an equivalent function that runs in time O(1).

```
int fun( int size, int a[ ] )
{
    s=0;
    for( i = 1 to n )
        s=s+a[ i ] - a[ i -1 ]
    return s;
}
```

d) How many times "Hello" will be displayed on screen by running this code, also draw recursion tree for calculating your answer.

```
#include <iostream>
using namespace std;
void f(int n)
{
    if (n == 1 || n == 0)
        return;
    else
    {
        cout << "Hello" << endl;
        f(n - 1);  // recurrsive call
        f(n - 2);  // recurrsive call
        cout << "Hello" << endl;
    }
}
int main()
{
    f(5);
    return 0;
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```

Question # 3. Long Questions   (3x 10=30 marks)

a) Write a program to check whether a given string is of the form $a^n b^n$ where n = 0, 1, 2, 3... using appropriate data struture.
   Examples:
   aaabbb -- is of the form $a^n b^n$
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b) For the following given data below draw the following:
i.   BST(Binary Search Tree)
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   Data is:

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c) What is a circular queue? Write a program to implements a circular queue.

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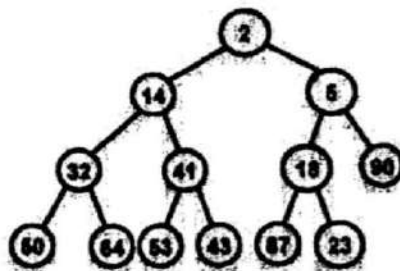
UNIVERSITY OF THE PUNJAB

B.S. 4 Years Program / Fourth Semester – 2019

Roll No. ....

Paper: Data Structure and Algorithm
Course Code: IT-207 / IT-22408 Part – II

Time: 2 Hrs. 45 Min. Marks: 50

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

Question # 2. Short Questions: **(4 x 5 =20 marks)**

a) What are the time complexities of each of the following code segments? Write your answers in Big Oh notation only.

```
for(int i = 1; i <= n; i++)
{
      for(int j = 0; j <= 10000; j++)
      {
            temp++;
      }
}
```

b) Apply the **Quick sort** algorithm on this array and show the contents after <u>one iteration</u> (partitioning this array once). Use the first number (12) as the pivot.

12	2	15	11	25	3	5	18	8	6

c) Write down the post-fix forms of the following infix expressions (keeping in mind the operator precedence rules of C++):

A + C + B / D – E * F / G

d) Write brief answers to the following two questions:
   o Name one advantage of a linked list over an array.
   o Name one advantage of an array over a linked list.

Question # 3. Long Questions   **(2 x 15 = 30 marks)**

a) Given the following declaration of a **Circular-Doubly-Linked-List** (with a dummy header node) which stores integers in unsorted order:

class DNode	class CDLinkedList
{ friend class CDLinkedList;	{
private:	private:
int data;	DNode head;
DNode* next;	public:
DNode* prev;	void insertAtEnd (int val);
};	};

You are required to implement the following member function **void insertAtEnd(int val)** of the CDLinkedList class. This function inserts "val" at the end of the linked list. The time complexity of this function should be constant i.e. $O(1)$.

b) Write a recursive C++ function to count all occurrences of a given number **k** in a given array of integers. The prototype of your function should be:

```
int count (int* arr, int start, int end, int k)
```

In the above prototype, **arr** is the array, **start** and **end** are starting and ending indices of the array, and **k** is the number whose occurrences are to be counted.

For example, if the array **arr** contains these 10 integers {2,1,7,5,7,2,6,7,8,7} and we call **count(arr,0,9,7)** then this function should return 4 (because the number 7 occurs 4 times in the above array).

Note: Do NOT change the function prototype. Do NOT use any global/static variables. The implementation must be recursive. No Marks for iterative implementation.