A5-R5 : Data Structure Through Object Oriented Programming Language

DURATION : 03 Hours   **MAXIMUM MARKS : 100**

OMR Sheet No. : ⬚⬚⬚⬚⬚

Roll No. : ⬚⬚⬚⬚⬚⬚   **Answer Sheet No. :** ⬚⬚⬚⬚⬚⬚

Name of Candidate : _____ ; **Signature of Candidate :** _____

INSTRUCTIONS FOR CANDIDATES :

- Carefully read the instructions given on Question Paper, OMR Sheet and Answer Sheet.

- Question Paper is in English language. Candidate has to answer in English language only.

- There are **TWO PARTS** in this Module/Paper. **PART ONE** contains **FOUR** questions and **PART TWO** contains **FIVE** questions.

- **PART ONE** is Objective type and carries **40** Marks. **PART TWO** is Subjective type and carries **60** Marks.

- **PART ONE** is to be answered in the **OMR ANSWER SHEET** only, supplied with the question paper, as per the instructions contained therein. **PART ONE** is **NOT** to be answered in the answer book for **PART TWO**.

- Maximum time allotted for **PART ONE** is **ONE HOUR**. Answer book for **PART TWO** will be supplied at the table when the Answer Sheet for **PART ONE** is returned. However, Candidates who complete **PART ONE** earlier than one hour, can collect the answer book for **PART TWO** immediately after handing over the Answer Sheet for **PART ONE** to the Invigilator.

- **Candidate cannot leave the examination hall/room without signing on the attendance sheet and handing over his/her Answer Sheet to the invigilator. Failing in doing so, will amount to disqualification of Candidate in this Module/Paper.**

- After receiving the instruction to open the booklet and before answering the questions, the candidate should ensure that the Question Booklet is complete in all respects.

DO NOT OPEN THE QUESTION BOOKLET UNTIL YOU ARE TOLD TO DO SO.

PART - ONE

(Answer all the questions; each question carries ONE mark)

1. **Each question below gives a multiple choice of answers. Choose the most appropriate one and enter in the "OMR" answer sheet supplied with the question paper, following instructions therein.** **(1x10)**

1.1 In C++, a member function can always access the data in _____.
   - (A) the class of which it is a member
   - (B) the object of which it is a member
   - (C) the public part of its class
   - (D) the private part of its class

1.2 Which of the following is/are automatically added to every class if we do not write our own ?
   - (A) Copy Constructor
   - (B) Assignment Operator
   - (C) A constructor without any parameter
   - (D) All of the above

1.3 What is the output of the following program ?
   ```
   #include<iostream>
   using namespace std;
   class Point {
       Point() {cout << "Constructor called";}
   };
   int main()
   {
   Point t1;
   return 0;
   }
   ```
   - (A) Compiler Error
   - (B) Runtime Error
   - (C) Constructor called
   - (D) Constructor called Constructor called

1.4 What is time complexity of fun() ?
   ```
   int fun(int n)
   {
   int count = 0;
   for (int i = n; i > 0; i /= 2)
      for (int j = 0; j < i; j++)
      count += 1;
   return count;
   }
   ```
   - (A) O(n^2)
   - (B) O(nLogn)
   - (C) O(n)
   - (D) O(nLognLogn)

1.5 The average number of key comparisons done in a successful sequential search in a list of length it is _____.
   - (A) log n
   - (B) $(n-1)/2$
   - (C) n/2
   - (D) (n+1)/2

1.6 The recurrence relation that arises in relation with the complexity of binary search is :
   - (A) $T(n) = 2T(n/2) + k$, where k is constant
   - (B) $T(n) = T(n/2) + k$, where k is constant
   - (C) $T(n) = T(n/2) + \log n$
   - (D) $T(n) = T(n/2) + n$

1.7 What is the worst-case time complexity of Quicksort ?

(A) $O(n^2)$

(B) $O(nLogn)$

(C) $O(n)$

(D) $O(nLognLogn)$

1.8 The level of a node is the distance from the root to that node. For example, the level of the root is 1, and the level of the left and right children of the root are 2. The maximum number of nodes on level i of a binary tree is :

(A) $2^{(i)} - 1$

(B) 2^i

(C) $2^{(i+1)}$

(D) $2^{[(i+1)/2]}$

1.9 The inorder and preorder traversal of a binary tree are d b e a f c g and a b d e c f g, respectively. The postorder traversal of the binary tree is :

(A) e d b g f c a

(B) d e b f g c a

(C) e d b f g c a

(D) d e f g b c a

1.10 Given an undirected graph G with V vertices and E edges, the sum of the degrees of all vertices is :

(A) E

(B) 2E

(C) V

(D) 2V

2. **Each statement below is either TRUE or FALSE. Choose the most appropriate one and enter your choice in the "OMR" answer sheet supplied with the question paper, following instructions therein.** **(1x10)**

2.1 Members of a class are private by default.

2.2 Every class containing an abstract method must be declared abstract.

2.3 A class in C++ takes up space in memory and has an associated address.

2.4 Destructors can be virtual in C++.

2.5 A copy constructor may be called when an object is constructed based on another object of the same class.

2.6 In a linked list implementation of stack, if new nodes are inserted at the beginning of the linked list, then nodes must be removed from the end.

2.7 In a linked list implementation of a queue, if new nodes are inserted at the end, then nodes must be removed from the beginning.

2.8 A full binary tree is one in which every node other than the leaves has two children.

2.9 Random access is allowed in a typical implementation of Linked Lists.

2.10 A graph is a linear data structure with vertices and edges.

3. Match words and phrases in column X with the closest related meaning / word(s) / phrase(s) in column Y. Enter your selection in the "OMR" answer sheet supplied with the question paper, following instructions therein. (1x10)

	X			Y	
	X			**Y**	
3.1	Reusability		**A**	Divide and Conquer	
3.2	Operator Overloading		**B**	Queue	
3.3	Quick Sort		**C**	Stack	
3.4	Breadth First Search		**D**	Inheritance	
3.5	Depth First Search		**E**	Dynamic data structure	
3.6	Self balancing search tree		**F**	Polymorphism	
3.7	Linked List		**G**	Non linear data structure	
3.8	Graph		**H**	B Tree	
3.9	Binary Search		**I**	$O(n^2)$	
3.10	Selection sort		**J**	$O(\log n)$	
			K	C	
			L	::	
			M	Static Data Structure	

4. **Each statement below has a blank space to fit one of the word(s) or phrase(s) in the list below. Choose the most appropriate option, enter your choice in the "OMR" answer sheet supplied with the question paper, following instructions therein.** (1x10)

A.	O(V^2)	**B.**	B Tree	**C.**	Asymptotic analysis	**D.**	Class
E.	Encapsulation	**F.**	O(n^2)	**G.**	?: (conditional)	**H.**	Object
I.	O(n log n)	**J.**	O(n)	**K.**	Stack	**L.**	Queue
M.	Out-Degree						

4.1 A _____ is a user-defined data type that has data members and member functions.

4.2 _____ is an identifiable entity with some characteristics and behaviour.

4.3 _____ is defined as wrapping up of data and information under a single unit.

4.4 For a sparse graph G(V, E), adjacency matrix consumes _____ space.

4.5 _____ is a self-balancing tree data structure that maintains sorted data and allows searches, sequential access, insertions, and deletions in logarithmic time.

4.6 _____ operator can't be overloaded in C++.

4.7 _____ of an algorithm refers to defining the mathematical boundation/framing of its run-time performance.

4.8 Best-case time complexity of Bubble sort algorithm is _____.

4.9 Worst-case time complexity of Mergesort algorithm is _____.

4.10 _____ data structure is used to evaluate postfix expressions.

PART - TWO

(Answer any FOUR questions)

5. (a) Write the pseudo codes/algorithms of stack basic operations like push and pop.

(b) Apply bubble sort on the following input string. Show all the intermediate steps. Input string: 50, 10, 40, 20, 80

(6+9)

6. (a) Make the binary search tree of integers from the following inputs received in order. Input string: 5, 1, 2, 7, 3, 9, 6

(b) What are multiple inheritances? Explain with a suitable example.

(9+6)

7. (a) We are traversing a graph using Stack. What kind of traversal is it ? BFS or DFS ? Explain the working of the traversal algorithm.

(b) Develop a code in C++ to make a linked list of integers {3, 1, 7, 2, 9}. Use the given definition of a node.

(6+9)

8. (a) What is an abstract class, and why is it used ?

(b) Write a code in C++ for the addition of two 2-D matrices of size 3×3 of integers.

(6+9)

9. (a) Write a recursive code for the preorder traversal of a binary tree.

(b) What is the run time complexity of multiplication of two 2-D matrices ? Explain. Assume both matrices are implemented using 2D arrays.

(7+8)

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SPACE FOR ROUGH WORK