

**A5-R5 : DATA STRUCTURE THROUGH OBJECT ORIENTED PROGRAMMING
LANGUAGE**

अवधि : 03 घंटे
DURATION : 03 Hours

अधिकतम अंक : 100
MAXIMUM MARKS : 100

ओएमआर शीट सं. :					
OMR Sheet No. :					

रोल नं. :
Roll No. :

उत्तर-पुस्तिका सं. :
Answer Sheet No. :

परीक्षार्थी का नाम : _____;Signature of Candidate : _____
Name of Candidate :

परीक्षार्थियों के लिए निर्देश :

Instructions for Candidate :

कृपया प्रश्न-पुस्तिका, ओएमआर शीट एवं उत्तर-पुस्तिका में दिये गए निर्देशों को ध्यानपूर्वक पढ़ें।	Carefully read the instructions given on Question Paper, OMR Sheet and Answer Sheet.
प्रश्न-पुस्तिका की भाषा अंग्रेजी है। परीक्षार्थी केवल अंग्रेजी भाषा में ही उत्तर दे सकता है।	Question Paper is in English language. Candidate can answer in English language only.
इस मॉड्यूल/पेपर के दो भाग हैं। भाग एक में चार प्रश्न और भाग दो में पाँच प्रश्न हैं।	There are TWO PARTS in this Module/Paper. PART ONE contains FOUR questions and PART TWO contains FIVE questions.
भाग एक "वैकल्पिक" प्रकार का है जिसके कुल अंक 40 हैं तथा भाग दो "व्यक्तिपरक" प्रकार का है और इसके कुल अंक 60 हैं।	PART ONE is Objective type and carries 40 Marks. PART TWO is Subjective type and carries 60 Marks.
भाग एक के उत्तर, ओएमआर उत्तर-पुस्तिका पर ही दिये जाने हैं। भाग दो की उत्तर-पुस्तिका में भाग एक के उत्तर नहीं दिये जाने चाहिए।	PART ONE is to be answered in the OMR ANSWER SHEET only. PART ONE is NOT to be answered in the answer book for PART TWO.
भाग एक के लिए अधिकतम समय सीमा एक घण्टा निर्धारित की गई है। भाग दो की उत्तर-पुस्तिका, भाग एक की उत्तर-पुस्तिका जमा कराने के पश्चात् दी जाएगी। तथापि, निर्धारित एक घंटे से पहले भाग एक पूरा करने वाले परीक्षार्थी भाग एक की उत्तर-पुस्तिका निरीक्षक को सौंपने के तुरंत बाद, भाग दो की उत्तर-पुस्तिका ले सकते हैं।	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.
परीक्षार्थी, उपस्थिति-पत्रिका पर हस्ताक्षर किए बिना और अपनी उत्तर-पुस्तिका, निरीक्षक को सौंपे बिना, परीक्षा हॉल/कमरा नहीं छोड़ सकते हैं। ऐसा नहीं करने पर, परीक्षार्थी को इस मॉड्यूल/पेपर में अयोग्य घोषित कर दिया जाएगा।	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.
प्रश्न-पुस्तिका को खोलने के निर्देश मिलने के पश्चात् एवं उत्तर लिखना आरम्भ करने से पहले उम्मीदवार जाँच कर यह सुनिश्चित कर लें कि प्रश्न-पुस्तिका प्रत्येक दृष्टि से संपूर्ण है।	After receiving the instruction to open the booklet and before starting to answer the questions, the candidate should ensure that the Question Booklet is complete in all respect.

**जब तक आपसे कहा न जाए, तब तक प्रश्न-पुस्तिका न खोलें।
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 Which concept allows you to reuse the written code ?

- (A) Encapsulation
- (B) Abstraction
- (C) Inheritance
- (D) Polymorphism

1.2 Out of the following, which is not a member of the class ?

- (A) Static function
- (B) Friend function
- (C) Constant function
- (D) Virtual function

1.3 How run-time polymorphisms are implemented in C++ ?

- (A) Using Inheritance
- (B) Using Virtual functions
- (C) Using Templates
- (D) Using Inheritance and Virtual functions

1.4 Which of the following asymptotic notation is the worst among all ?

- (A) $O(n+9378)$
- (B) $O(n^3)$
- (C) $n^{O(1)}$
- (D) $2^{O(n)}$

1.5 Which of the following is an example of in-place algorithm ?

- (A) Bubble Sort
- (B) Merge Sort
- (C) Insertion Sort
- (D) All of the above

1.6 How many stacks are needed to implement a queue ? Consider the situation where no other data structure like arrays, linked list is available to you.

- (A) 2
- (B) 1
- (C) 3
- (D) 4

- 1.7 In a circular linked list :
- (A) Components are all linked together in some sequential manner.
 - (B) There is no beginning and no end.
 - (C) Components are arranged hierarchically.
 - (D) Forward and backward traversal within the list is permitted.
- 1.8 What is a full binary tree ?
- (A) Each node has exactly zero or two children
 - (B) Each node has exactly two children
 - (C) All the leaves are at the same level
 - (D) Each node has exactly one or two children
- 1.9 In a full binary tree if there are L leaves, then total number of nodes N are :
- (A) $N = 2 * L$
 - (B) $N = L + 1$
 - (C) $N = L - 1$
 - (D) $N = 2 * L - 1$
- 1.10 For a given graph G having v vertices and e edges which is connected and has no cycles, which of the following statements is true ?
- (A) $v = e$
 - (B) $v = e + 1$
 - (C) $v + 1 = e$
 - (D) $v = e - 1$
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 Linked lists, stacks, queues and binary trees are examples of dynamic data structures.
 - 2.2 It is not possible to achieve inheritance in structures in C++.
 - 2.3 A stack is a linked-list that can be accessed from either end.
 - 2.4 A node with no children is called ancestor node.
 - 2.5 Binary trees facilitate high-speed searching and sorting of data, efficient elimination of duplicate data items, compilation of expressions into machine language and many other interesting applications.
 - 2.6 The size of lists, stacks, queues and trees must be determined in advance of using these data structures to ensure that the proper amount of memory is allocated for their elements.
 - 2.7 Compilers use stacks to evaluate arithmetic expressions and generate machine language code to process the expressions.
 - 2.8 In a Binary Tree, a node may have a degree greater than 2.
 - 2.9 Searching is more efficient in B-trees than in Binary Search Trees.
 - 2.10 In DFS, all the nodes adjacent to the current node are visited first while performing traversal.

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
3.1	In a binary tree, for every node the difference between the number of nodes in the left and right sub trees is at most 2. If the height of the tree is $h > 0$, then the minimum number of nodes in the tree is	A.	$O(\log n)$
3.2	A method used to remove the elements from a Stack is called as	B.	Queue
3.3	The time complexity of merge sort algorithm is	C.	$2^{h-1} + 1$
3.4	The time complexity of binary search algorithm is	D.	$O(n \log n)$
3.5	In Binary trees nodes with no successor are called	E.	pop()
3.6	To represent hierarchical relationship between elements, Which data structure is suitable ?	F.	Heap
3.7	Data structure best suited for efficient implementation of priority queue is	G.	Inheritance
3.8	Reusability is possible through	H.	Stack
3.9	Data structure that works on the principle of FIFO	I.	Tree
3.10	Data structure that works on the principle of LIFO	J.	Terminal nodes
		K.	Doubly linked list
		L.	Constructor
		M.	Multipointer

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.	Insertion Sort	B.	Terminal node	C.	Space complexity
D.	Sorted	E.	Private	F.	Post-order
G.	Two	H.	Multi-way	I.	Deleted
J.	Root of the heap	K.	Public	L.	Unsorted
M.	Time complexity				

- 4.1 Binary Search is the fastest searching methods for _____ records.
- 4.2 In a heap data structure, the largest element is placed in _____.
- 4.3 _____ method is optimal because the sorted array is developed without using any extra storage space.
- 4.4 The vertex is _____ from the queue when it is visited.
- 4.5 The B-tree is derived from _____ search trees.
- 4.6 If a node is a terminal node, then its left child and right child field are filled with _____.
- 4.7 _____ pointers are used to traverse a doubly linked list.
- 4.8 In _____ traversal, the root node is visited last.
- 4.9 _____ refers to the amount of storage the algorithm consumes.
- 4.10 The _____ member of a class cannot be accessed from outside the class.

PART TWO

(Answer any FOUR questions)

5. (a) What is a linked list ? What are the various operations performed on a single linked list ? Write an algorithm to insert a node after a given node in a single linked list.
- (b) Explain different type of inheritance. Take example of a University System and differentiate between multiple and multilevel inheritance. **(8+7)**
6. (a) Explain bubble sort technique along with its algorithm. Use bubble sort algorithm to sort the following list of numbers :
5, 1, 12, -5, 16
- (b) A square matrix is called symmetric if for all value of i and j are $a[i][j] = a[j][i]$. Write a program in C++ to test a given 5*5 matrix is symmetric or not.
- (c) Convert the following infix notation to postfix notation.
 $A + (B * C - (D / E - F) * G) * H$ **(5+5+5)**
7. (a) Define time and space complexity of an algorithm. List 3 parameters on which algorithms can be compared.
- (b) Distinguish between B tree and B+ Tree. Create a B tree of order 5 by inserting the following elements :
1, 12, 8, 2, 25, 6, 14, 28, 17, 7, 52, 16, 48, 68, 3, 26, 29, 53, 55, 45 and 67 **(5+10)**

8. (a) Explain Polymorphism, Data abstraction and encapsulation in detail.
- (b) Write a program in C++ to find whether a number is prime or not.
- (c) Define the graphs. Explain the adjacency matrix and adjacency linked list representation of a graph. **(6+5+4)**
9. (a) Differentiate between function overloading and operator overloading. Write a code to perform overloading of operator '+' to add integer, float, character input.
- (b) What is meant by binary search tree ? Consider a list of 10 elements as (A=10, 2, 3, 4, 6, 9, 10, 11, 0, 13). Explain the implementations of binary search tree using this list. **(8+7)**

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SPACE FOR ROUGH WORK

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