B2.1-R4: DATA STRUCTURE THROUGH C++

अवधि: 03 घंटे **अधिकतम अंक: 100**
DURATION: 03 Hours **MAXIMUM MARKS: 100**

ओएमआर शीट सं.: **OMR Sheet No.:**						

रोल नं.: **Roll No.:** | | | | | | |

उत्तर-पुस्तिका सं.: **Answer Sheet No.:** | | | | | | |

परीक्षार्थी का नाम: **परीक्षार्थी के हस्ताक्षर:**
Name of Candidate: _____; Signature of candidate: _____

परीक्षार्थियों के लिए निर्देश: **Instructions for Candidate:**

कृपया प्रश्न-पुस्तिका, ओएमआर शीट एवं उत्तर–पुस्तिका में दिये गए निर्देशों को ध्यान पूर्वक 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 कर सकता है।	Question Paper is in English language. Candidate can answer in English language only.
इस मॉड्यूल/पेपर के **दो भाग** है। **भाग एक** में चार प्रश्न और **भाग दो** में पाँच प्रश्न है।	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 है तथा **भाग दो**, "व्यक्तिपरक" प्रकार है और इसके कुल अंक 60 है।	**PART ONE** is Objective type and carries 40 Marks. **PART TWO** is subjective type and carries 60 Marks.
भाग एक के उत्तर, इस प्रश्न-पत्र के साथ दी गई **ओएमआर उत्तर-पुस्तिका** पर, उसमें दिये गए अनुदेशों के अनुसार ही दिये जाने है। **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, 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**.
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 पश्चात 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.**
परीक्षार्थी, उपस्थिति-पत्रिका पर हस्ताक्षर किए बिना अथवा अपनी उत्तर-पुस्तिका, निरीक्षक को सौंपे बिना, परीक्षा हाल नहीं छोड़ सकता हैं। ऐसा नही 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 or handing over his 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 पश्चात एवं उत्तर देने से पहले उम्मीदवार यह जाँच कर यह सुनिश्चित कर ले कि प्रश्न-पुस्तिका प्रत्येक दृष्टि से संपूर्ण है।	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 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)

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 If h is a hash function such that h(m) = m mod n where 0<=m<=2*n The expected number of collisions involving a particular key x is :
A) less than 1
B) less than 3
C) less than m x n
D) less than 2xn.

1.2 Let A be a bit-wise adjacency matrix of a graph G. The $M^{(i,j)}$ entry in the matrix $A^{k(i,,j)}$, gives
A) The number of distinct paths of length K from vertex Vi to vertex Vj.
B) Shortest path of K edges from vertex Vi to vertex Vj.
C) Length of a Hamiltonian cycle from vertex Vi to vertex Vj.
D) Length of a Eulerian path from vertex Vi to vertex Vj.

1.3 The number of steps required to sort 4, 2, 5, 1, 6, 3 in descending order using Quick Sort with first element as pivot is
A) 6
B) 5
C) 2
D) 8

1.4 What is the best case time taken to find the middle element in a linked list?
A) O (2n)
B) O ($\log_2$ n)
C) O (n)
D) O (n $\log_2$ n)

1.5 The maximum number of nodes in a binary tree with 'i' levels is
A) 2^{i+1}-1
B) 2^{i}-1
C) 2^{i+1}
D) None of the above

1.6 The sum of degree of all the vertices in an undirected graph with n vertices and e edges is
A) e
B) e*(e-1)/2
C) e+1
D) 2e

1.7 Depth First Search:
A) Scans all edges, before moving on to the next vertex
B) Uses queue data structure
C) Scans the first outgoing edge of every vertex
D) None of the above

1.8 Which of the following is not the part of ADT description?
A) Data
B) Operations
C) Both
D) None of the above

1.9 Which of the following is an application of stack?
A) Finding Factorial
B) Towers of Hanoi
C) Infix to Postfix
D) All of the above

1.10 A binary tree in which if all its levels except possibly the last, have the maximum number of nodes and all the nodes at the last level appear as far left as possible, is known as
A) Full binary tree
B) AVL tree
C) Threaded tree
D) Complete binary tree

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 A stack is a linked-list that can be accessed from either end.
2.2 Function malloc returns a pointer of type void * to the memory it allocates. If it is unable to allocate memory, it returns a NULL pointer.
2.3 Arrays are dynamic, so the length of an array can increase or decrease as necessary. An array is appropriate when the number of data elements to be represented in the data structure is unpredictable.
2.4 The time complexity and space complexity of hashing are both O (1).
2.5 A binary search tree (with no duplicate node values) has the characteristic that the values in any left subtree are less than or equal to the value in its parent node, and the values in any right subtree are greater than the value in its parent node.
2.6 Heap sort cannot be done in-place.
2.7 Quick sort guarantees O(NlogN) performance in all cases.
2.8 A simple depth first walk is enough to give topological ordering.
2.9 Number of odd degree vertices in an undirected graph is even.
2.10 Stack data structure is used for breadth first search.

ROUGH WORK SPACE:

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	Searching method (O(I))	**A.**	Queue
3.2	Matrix with many empty spaces	**B.**	Sparse Matrix
3.3	Height balanced tree	**C.**	O(n log n)
3.4	Quick sort	**D.**	Kruskal's
3.5	Order of merge sort	**E.**	Hashing
3.6	FIFO	**F.**	AVL
3.7	All pair shortest path	**G.**	Divide and Conquer
3.8	Binary Tree with n nodes	**H.**	n -1 edges
3.9	Minimal Spanning Tree Algorithm	**I.**	Θ(n)
3.10	No. of edges in a minimal spanning tree of vertices V	**J.**	Dijkstra's algorithm
		K.	n-1 edges
		L.	$O(n^2)$
		M.	Merge sort

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(logn)	**B.**	2^I	**C.**	2^{I-1}
D.	Searching	**E.**	n*(n-1)/2	**F.**	Undirected
G.	Inorder	**H.**	Heap	**I.**	Polymorphism
J.	Symmetric	**K.**	Inheritance	**L.**	Preorder
M.	Merge sort				

4.1 Function overloading is an example of _____.
4.2 Diagonal of _____ matrix has all ones.
4.3 The process of building new classes from existing ones is called _____.
4.4 B-Trees are used for _____ in DBMS.
4.5 _____ is the number of edges in a complete graph with 'n' vertices.
4.6 The time complexity of binary search is _____.
4.7 _____ Sorting techniques make use of binary tree.
4.8 In degree is equal to out degree for all vertices in a _____ graph.
4.9 Number of nodes at level 'i' in a binary tree is _____.
4.10 The _____ traversal of binary search tree gives a sorted sequence.

ROUGH WORK SPACE:

PART TWO
(Answer any FOUR questions)

5.

a) What is an algorithm? What are the characteristics of a good algorithm?

b) What is the difference between time complexity and space complexity of an algorithm? Explain by taking Hashing as an example.

c) Design a class in C++ that will overload the binary operator * and use it to multiply the corresponding elements of two one-dimensional arrays into a third array.

(4+4+7)

6.

a) Write an efficient algorithm for detecting a loop in a linked list. Also state its time and space complexity.

b) Devise an algorithm to implement insertion and deletion in a stack data structure using queues.

c) What is a priority queue? Write down routines for inserting and deleting elements from a priority queue implemented using linked list.

(4+4+7)

7.

a) What are threaded binary trees? What is the purpose of threading? Explain with an example.

b) What is a Binary Tree? Construct the binary tree with respect to the following traversals.
Inorder : DBEAFC
Preorder : ABDECF

c) What is a Binary Search Tree (BST)? Make a BST for the following sequence of numbers.
45, 36, 76, 44, 89, 99, 73, 39, 87, 56, 102, 48.
Traverse the tree in Preorder, Inorder and postorder.

(5+5+5)

8.

a) Sort the following sequence using merge sort and show the results at each step.
12,45,32,4,98,7,16,12,19,100,37,42,24,75,1

b) Write a function to find two numbers in an array that add up to a given value.
For Example: 2 7 3 5 1
Input: 4 output: 3,1

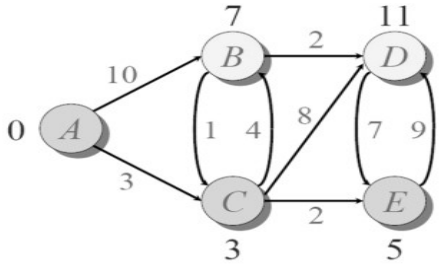
c) Taking an initially empty hash table with 15 locations, with hash function f(x) = x mod 15 and chaining as the collision resolution mechanism; illustrate what happens when we insert the following keys:
7,8,22,29,14,3,28,10,25,6,12,9,4,27,44,100,86

(5+5+5)

9.

a) Write an algorithm for binary search. What are the conditions under which sequential search of a list is preferred over binary search?

b) Obtain the Minimum Spanning Tree for the following graph using
i) Kruskal's algorithm
ii) Prim's algorithm
Explain step by step procedure.



c) Write a program to perform depth first search in a graph represented using an adjacency matrix

(5+5+5)

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ROUGH WORK SPACE:

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