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

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:
Name of Candidate: _____;

परीक्षार्थी के हस्ताक्षर:
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 दे 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 एवं 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 and 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.

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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.

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 The expression which accesses the (ij)th entry of a m × n matrix stored in column major form is
A) $n \times (i - 1) + j$
B) $m \times (j - 1) + i$
C) $m \times (n - j) + j$
D) $n \times (m - i) + j$

1.2 Which data structure type is not linear from the following?
A) Doubley Link List
B) 2D Array
C) Binary Search Tree
D) Queue

1.3 Which of the following operations is performed more efficiently by doubly linked list than by single linked list?
A) Deleting a node whose location is given
B) Searching an unsorted list for a given item
C) Inserting a node after the node with a given location
D) Traversing the list in any direction to process each node

1.4 What can be said about the array representation of a circular queue when it contains only one element?
A) front = Rear = -1
B) front = Rear + 1
C) front = Rear – 1
D) front = Rear = NULL

1.5 A full binary tree with n leaves contains
A) n nodes
B) $\log_2 n$ nodes
C) $2n – 1$
D) 2^n nodes

1.6 The maximum time required to search an element in a binary search tree having n elements is
A) $O(1)$
B) $O(\log_2 n)$
C) $O(n)$
D) $O(n\log_2 n)$

1.7 Breadth-first search traversal (BFS) is a method to traverse
A) all successors of a visited node before any successors of any of those successors
B) a single path of the graph as far it can go
C) the graph using shortest path
D) none of these

1.8 Linked lists are required in
A) Linear Probing
B) Quadratic Probing
C) Chaining
D) None of these

1.9 Which of the following sorting algorithms does not have a worst case running time of $O(n^2)$?
A) Insertion sort
B) Merge sort
C) Quick sort
D) Bubble sort

1.10 Which of the following statements is NOT valid about operator overloading?
A) Only existing operators can be overloaded.
B) Overloaded operator must have at least one operand of its class type.
C) The overloaded operators follow the syntax rules of the original operator.
D) None of the mentioned

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 Hash tables are a suitable data structure for managing an ordering of data.

2.2 In a max-heap the smallest element resides always at the leaves assuming all elements are distinct.

2.3 Definiteness is one of the properties of an algorithm.

2.4 Graph is a linear data structure.

2.5 A tree is a connected graph with circuit.

2.6 The data structure used by recursion is stack.

2.7 There are four types of inheritance in c++.

2.8 Priority queue's priority function cannot be changed.

2.9 One of the major drawbacks of B-Tree is the difficulty of traversing the keys sequentially.

2.10 In order to get the contents of a Binary search tree in ascending order, one has to traverse it in preorder.

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	The prefix form of an infix expression p + q − r * t is	**A.**	Bubble sort
3.2	The stable sorting algorithm is	**B.**	350
3.3	In binary search, average number of comparison required for searching an element in a list if n numbers is	**C.**	1
3.4	The time required to delete a node x from a doubly linked list having n nodes is	**D.**	− + p q * r t
3.5	The result of evaluating the postfix expression 5, 4, 6, +, *, 4, 9, 3, /, +, * is	**E.**	Stack
3.6	The worst case of quick sort has order	**F.**	$\log_2 n$
3.7	For an undirected graph G with N vertices and E edges, the sum of the degrees of each vertex is	**G.**	Queue
3.8	How many nodes in a tree have no ancestors?	**H.**	Heap sort
3.9	In Depth First Search of Graph, which of the following data structure is used?	**I.**	2
3.10	In BFS of Graph, which of the following Data structure is used?	**J.**	$O(n^2)$
		K.	$O(1)$
		L.	2E
		M.	300

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.	$O(n \log_2 n)$	**B.**	Hash function	**C.**	data[2*i + 1]
D.	Predecessors	**E.**	Push	**F.**	Linked
G.	Top	**H.**	Pop	**I.**	Array
J.	Abstract	**K.**	All	**L.**	Protected
M.	Merge Sort				

4.1 An object's _____ access methods can be used in any class that extends the object's class but not by other classes.

4.2 An _____ data type consists of a collection of data and the operations that can be performed on the data.

4.3 A _____ list contains nodes that are joined together by references to other nodes.

4.4 The first element in a stack is called the _____ of the stack.

4.5 The _____ nodes of a Circular Link List contain one links.

4.6 The average case complexity of the quick sort is _____.

4.7 The _____ is applied successfully until an empty position is found where the items can be inserted.

4.8 A tree maybe defined as a forest in which only a single node has no _____.

4.9 Consider the node of a complete binary tree whose value is stored in data[i] for an array implementation. If this node has a left child, the value of the left child will be stored in _____.

4.10 The operation on stack that increments the top is called _____.

ROUGH WORK SPACE:

PART TWO
(Answer any FOUR questions)

5.
a) Consider an array of size 25 × 4. Base address of this array is 200 & the word size is 4. The array is stored in row major form. Find the address of location A (12,3). Also find the address of the same element assuming that the array is stored in column major order.

b) Write an algorithm to delete a node from a singly linked list.

c) A square matrix is said to be symmetric if $a(i, j) = a(j, i)$ for all i not equal to j. Such a symmetric square matrix may be stored in an array of half the size of the matrix in terms of number of elements. Derive the formula for index of one-dimensional array in terms of indices of symmetric square matrix for above storage scheme.

([3+3]+5+4)

6.
a) Explain with an example how to evaluate a postfix expression (using stack). Write a C++ function to do the same.

b) Convert the following infix expression into equivalent postfix expression using stack. Show the contents of the output and stack at each stage.
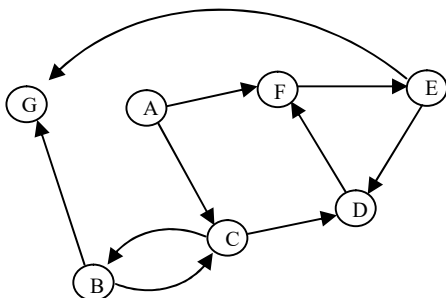
a + b * c + (d * e + f) * g

([2+6]+7)

7.
a) For any non-empty binary tree, T, if n_o be the number of terminal (leaf) nodes and n_2 be the number of nodes of degree 2, then $n_o = n_2 + 1$. Prove it.

b) Insert the following keys into a B-tree of order 3:

a, f, b, k, h, m, e, s, r, c, l, n, u, p.

(6+9)

8.
a) For the following directed graph find the DFS and BFS.

b) Prove that the number of odd degree vertices in a finite graph is always even.

([5+5]+5)

9.
a) Insert the integer 13, 5, 22, 8, 34, 19, 21 into an initially empty hash table using the hash function H (K) = K mod 7. (Use linear probing to avoid collisions). Also use a double hash function H(K) = 1+(C mod 6) to avoid collisions.

b) With an example explain shell short.

([5+5]+5)

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ROUGH WORK SPACE: