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: _____; **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 Consider a linked list of n elements. The time taken to insert an element after an element pointed by some pointer is

A) O (1)
B) O ($\log_2 n^2$)
C) O (n)
D) O (n $\log_2 n^2$)

1.2 Given the inorder sequence, A, C, E, F, G, H, and the following binary trees,

I.

II.

III.
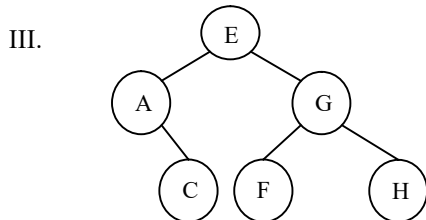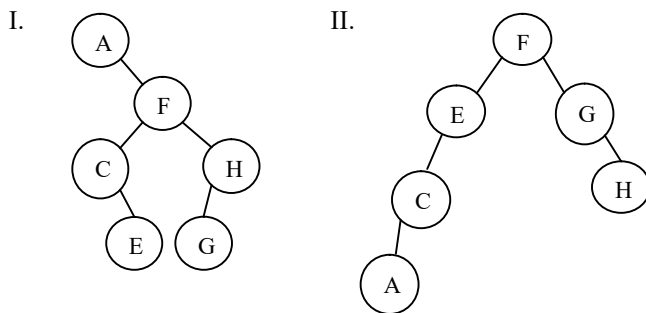
Which of the given trees corresponds exactly with the given inorder sequence:
A) I, II
B) II, III
C) I, II, III
D) None of the above

1.3 Suppose a queue is implemented by a circular array QUEUE [0..11].The number of elements in the queue ,if FRONT =10 and REAR =3,will be
A) 3
B) 4
C) 5
D) 6

1.4 If a node having two children is deleted from a binary search tree, it is replaced by its
A) Inorder predecessor
B) Inorder successor
C) Preorder predecessor
D) None of the above

1.5 The expression + 3 * 2 * / - 3 5 4 2 equals:
A) -1
B) 5
C) 1
D) 0

1.6 The most efficient search technique used in an ordered array is
A) Sequential search
B) Binary search
C) Interpolation search
D) None of the above

1.7 Following the heapify operation on the list: 4, 92, 65, 19, 52, 23, 75, the order (left to right) of the values in the leaves
A) 19, 23, 4, 65, 75
B) 4, 19, 52, 23, 65
C) 4, 19, 23, 65
D) None of the above

1.8 What does the following code segment do?
```
void fn( ){
char c;
cin.get(c);
if (c != '\n') {
fn( );
cout.put(c);}}
```
A) The string entered is printed as it is.
B) The string entered is printed in reverse order.
C) It will go in an infinite loop.
D) It will print an empty line.

1.9 Using linear probing to resolve collision when applying the hash function (key %10) to the following keys: 1, 15, 75, 81, 65, 32, 120, 19, 156, 23, the order of the storage of entries is
A) 1, 15, 19, 23, 32, 65, 75, 81, 120, 156
B) 120, 1, 81, 32, 23, 15, 75, 65, 156, 19
C) 1, 15, 75, 81, 65, 32, 120, 19, 156, 23
D) None of the above

1.10 Consider a list of elements: 3, 24, 29, 55, 78, 62, and 96. The no of interchanges required to sort the list in ascending order using quick sort.
A) 1
B) 0
C) 49
D) 36

ROUGH WORK SPACE:

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 +AB*/CD-%EF equals (A+B*C)/D-E%F.

2.2 Insertion into a random binary search tree with n nodes requires O(log n) steps, but may degenerate to n steps.

2.3 The searching technique that takes O (1) time to find an element from a set is Linear Search.

2.4 Friend keyword can be used on *main()*.

2.5 The leaves of a B – tree are at the same depth.

2.6 A dequeue is a queue from which items may be deleted at either end and into which elements may be inserted at either end.

2.7 The maximum number of nodes on level 'l' of a binary tree is 2^l-1.

2.8 For a large table of size l, the average number of probes required for a successful retrieval in a table organized using linear rehashing is approximately (2*l – n+1)/(2*l – 2 * n+2), where n = number of items currently in the table.

2.9 The straight selection sort implements the descending priority queue as an unordered array.

2.10 The Heap sort technique is far superior compared to the Quick sort in the worst case.

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 phenomenon where two keys that hash into different values compete with each other in successive rehashes	**A.**	Array
3.2	Diagonal of an adjacency matrix has all ones	**B.**	Front = Rear
3.3	Empty condition in a queue	**C.**	Graph has self loops
3.4	A digraph in which the out degree equals the in degree	**D.**	Primary Clustering
3.5	Allows direct access of elements	**E.**	Symmetric
3.6	Radix sort ['m' digits and 'n' elements]	**F.**	Internal path ength
3.7	You have to sort a list L consisting of a sorted list followed by a few "random" elements. Which of the following sorting methods would be especially suitable for such a task?	**G.**	Expert path length
3.8	Sum of all the levels of all the nodes in a binary tree	**H.**	Balanced
3.9	Merging 4 sorted files containing 50, 10, 25 and 15 records will have time	**I.**	Graph has parallel edges
3.10	The process of building new classes from existing one	**J.**	O(m*n)
		K.	O(100)
		L.	Inheritance
		M.	Insertion 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.	Linear Probing	**B.**	Stack	**C.**	$O(\log_2 n)$
D.	Better	**E.**	14	**F.**	$2^{(p-1)}$
G.	Worse	**H.**	$(2^{p+1}-1)$	**I.**	5
J.	O(1)	**K.**	Queue	**L.**	$O(\log_2\log_2 n)$
M.	1				

4.1 The maximum number of nodes in a binary tree of depth 'p' is _____.
4.2 Time complexity of interpolation search having n elements is _____.
4.3 In the implementation of priority queues using linked lists, insertions at the front can be done in _____ time.
4.4 The _____ function may be applied successively until an empty position is found where an item may be inserted, on the occasion of a hash collision.
4.5 New operators allocate memory blocks from the _____.
4.6 Algorithm A requiring n^2 days is _____ than Algorithm B requiring n^3 secs, to solve a problem, for $n=10^6$.
4.7 The number of binary trees with 3 nodes which when traversed in post order gives the sequence A, B, C is _____.
4.8 The number of swapping needed to sort numbers 8, 22,7,9,31,19,5,13 in ascending order using bubble sort is _____.
4.9 The data structure used in traversing a given graph by breadth first search is _____.
4.10 In a balanced binary tree the height of two sub-trees of every node cannot differ by more than _____.

ROUGH WORK SPACE:

PART TWO
(Answer any FOUR questions)

5.

a) Consider the following set of keys: 26,5,77,1,61,11,59,15,48,19. Perform Insertion Sort to sort the keys and illustrate every step.

b) What is operator overloading? Explain its importance with an example.

c) Define adjacency matrix and adjacency list? Illustrate with an example.

(6+6+3)

6.

a) Given the following connected graph, extract the Minimum Spanning Tree using Kruskal's Algorithm. Show the intermediate steps.
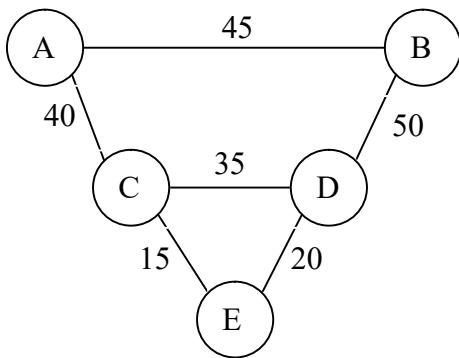
b) Illustrate how a polynomial can be represented using a linked list. Write an algorithm for adding 2 such polynomials.

(8+7)

7.

a) Apply Breadth First Search technique from vertex A on the following graph and show each step.
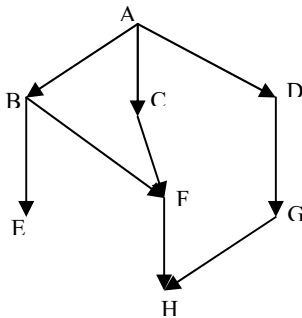
b) Evaluate the following postfix expression using a stack : a+b*(c*(d+e)-f)/g.

c) Let i and j be nonnegative integers, suppose NUM be function defined recursively as

$$NUM(i, j) = NUM(j, i) \quad \text{if } I < j$$
$$= i \quad \text{if } j = 0$$
$$= NUM(j, MOD(i, j)) \quad \text{otherwise}$$

Using the above recursive definition, find the values of NUM(5,9) and NUM(10,5). Illustrate the values at each step of recursion.

(5+5+5)

8.

a) Write an algorithm to simulate the deletion of a node, at any position, in a singly linked list. Clearly state assumptions, if any.

b) Write an algorithm to insert, delete and display the elements of a queue.

(8+7)

9.

a) What do you mean by time complexity and space complexity of an algorithm? Suppose you have two functions n^2 and $(2*n+4)$ for various values of n. Determine when second becomes larger than first.

b) Taking an initially empty hash table with 10 locations, with hash function f(x) = x mod 10 and linear probing as the collision resolution mechanism; illustrate what happens when we insert the following keys into it: 15,42,66,25,22,73,44

([4+4]+7)

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ROUGH WORK SPACE: