

NOTE:

IMPORTANT INSTRUCTIONS:

1. There are **TWO PARTS** in this Module/Paper. **PART ONE** contains **FOUR** questions and **PART TWO** contains **FIVE** questions.
2. **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.
3. 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**.

TOTAL TIME: 3 HOURS

TOTAL MARKS: 100
(PART ONE – 40; PART TWO – 60)

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 +/-ABC^+DE-FG is the prefix equivalent of

- A) A-B/C+D+E^F-G
- B) AB-C/DE+FG-^+
- C) ABC/-D+E^FG-+
- D) None of the above

1.2 The most efficient search technique used in an ordered array is

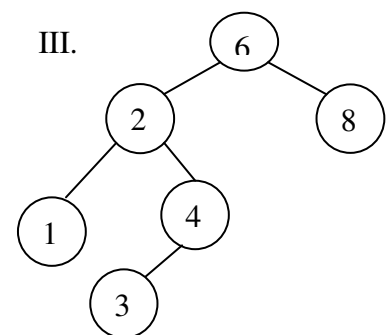
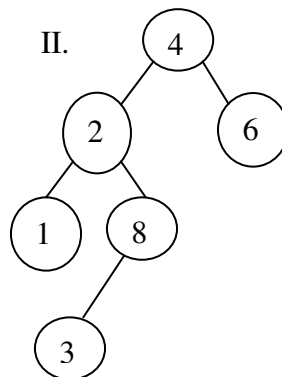
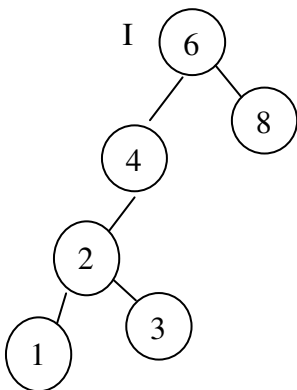
- A) Sequential search
- B) Binary search
- C) Interpolation search
- D) None of the above

1.3 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.

- 1.4 If a node having two children is deleted from a binary tree, it is replaced by its
- Inorder predecessor
 - Inorder successor
 - Preorder predecessor
 - None of the above
- 1.5 The expression $+3*2*-/3542$
- 1
 - 5
 - 1
 - 0
- 1.6 Given the sequence of numbers 13, 52, 95, 26, 38. The sequence after the 3rd iteration of insertion sort is
- 13, 26, 52, 95, 38
 - 13, 52, 95, 26, 38
 - 13, 26, 38, 52, 95
 - 13, 26, 52, 38, 95
- 1.7 Breadth First Search:
- Scans all incident edges, before moving on to the next vertex....
 - Scans adjacent unvisited vertices, as soon as possible.
 - Same as back tracking.
 - None of the above.
- 1.8 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
- 1, 15, 19, 23, 32, 65, 75, 81, 120, 156
 - 120, 1, 81, 32, 23, 15, 75, 65, 156, 19
 - 1, 15, 75, 81, 65, 32, 120, 19, 156, 23
 - None of the above.
- 1.9 Suppose there is a set of elements 1,2,3,4,6,8 and three tree diagrams:



Which of the given trees corresponds to the BST of the above sequence:

- I
- II
- III
- None of the above

1.10 The program section:

```
int **p;  
p = calloc(5, sizeof(int));  
for(i=0; i<5; i++)  
p[i] = calloc(10, sizeof(int));
```

is equivalent to the declaration:

- A) int p[5][10];
- B) int p[10][5];
- C) int p[5][5];
- D) int p[10][10];

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

- 2.1 Insertion into an index sequential table can be made in an easier way than the deletions from the same table.
- 2.2 In a linked list, the successive elements need not occupy continuous space in memory.
- 2.3 $+MN^*/OP- \%QR$ equals $(M+N^*O)/P-Q\%R$.
- 2.4 The maximum number of nodes on level 'l' of a binary tree is 2^l-1 .
- 2.5 The straight selection sort implements the descending priority queue as an unordered array.
- 2.6 For an undirected graph with n vertices and e edges, the sum of the degree of each vertex is equal to $2e$.
- 2.7 The searching technique that takes $O(1)$ time to find an element from a set is Binary Search.
- 2.8 If a node in a BST has two children, then its inorder predecessor has no right child.
- 2.9 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.
- 2.10 In a queue (where rear & front pointer points to the two ends of a queue), the number of elements at any time (rear- front-1).

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)

A		B	
3.1	Time complexity of quicksort for an ordered array of size 'n'	A.	Array
3.2	Diagonal of an adjacency matrix has all ones	B.	Front = Rear
3.3	Empty condition in a queue	C.	Graphs has self loops
3.4	A digraph in which the out degree equals the in degree	D.	$O(100)$
3.5	Allows direct access of elements	E.	Symmetric
3.6	Which type of memory allocation is suitable for recursion?	F.	$O(n^2)$
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.	Inheritance
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.	Internal Path length
3.10	The process of building new classes from existing one	J.	Dynamic
		K.	Bubble sort
		L.	Linked list
		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. Enter your choice in the “OMR” answer sheet supplied with the question paper, following instructions therein. (1x10)

A.	Linear Probing	B.	Stack	C.	Symmetric
D.	Better	E.	14	F.	$O(1)$
G.	Singly	H.	10	I.	5
J.	Queue	K.	Balanced	L.	$O(\log_2 \log_2 n)$
M.	1				

- 4.1 In _____ link list there is only forward movement.
 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 A digraph in which outdegree is same as indegree is called _____.
 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 can not differ by more than _____.

PART TWO
(Answer any **FOUR** Questions)

- 5.
- What do you mean by time complexity and space complexity of an algorithm?
 - Let i and j be nonnegative integers, suppose NUM be function defined recursively as

$$\begin{aligned} NUM(i, j) &= NUM(j, i) && \text{if } i < j \\ &= i && \text{if } j = 0 \\ &= NUM(j, MOD(i, j)) && \text{otherwise} \end{aligned}$$
 Find the values of $NUM(5,9), NUM(10,5)$
 - Sort the following sequence of keys using merge sort.
66, 77, 11, 88, 99, 22, 33, 44, 55.
Show the results at each step.

(4+4 +7)

- 6.
- Design a class in C++ that will overload the binary operator $+$ and use it to add the corresponding elements of 2 arrays into a third array.
 - Taking an initially empty hash table with 10 locations, with hash function $f(x) = x \bmod 10$ 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

(8+7)

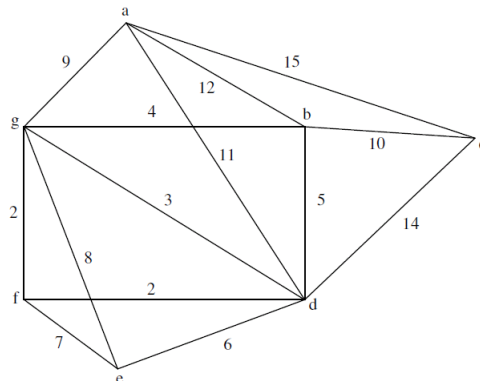
- 7.
- Write an algorithm to simulate the deletion of a node, at any position, in a circular doubly linked list. Clearly state assumptions, if any.
 - Convert the following expression from infix to postfix notation using stack:
 $a+b*(c*(d+e)-f)/g$.
Show the contents of stack and output at each stage.

(7+8)

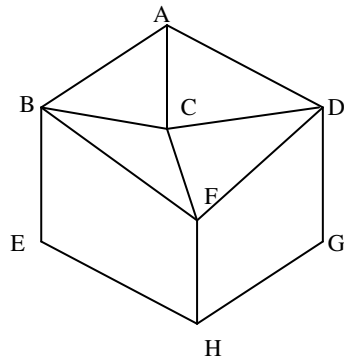
- 8.
- With respect to a singly linked list, write an algorithm to-
 - Delete a node from the end of the list
 - Insert a node at the front of the list
 - Construct the binary tree, with respect to the following traversals of the tree.
INORDER : H K D B I L E A F C M J G
PREORDER : A B D H K E I L C F G J M

(8+7)

- 9.
- What is a minimum Spanning tree of a graph? Apply Kruskal's algorithm to find the minimum spanning tree of the following graph.



- b) What is an adjacency matrix and adjacency list? Illustrate with an example.
c) Apply Breadth First Search technique from vertex A on the following graph and show each step.



(7+4+4)