C2-R3: DATA STRUCTURES THROUGH 'C' LANGUAGE

NOTE:

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 **TEAR-OFF ANSWER SHEET** only, attached to 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 "tear-off" answer sheet attached to the question paper, following instructions therein. (1 x 10)

1.1 Referring to the sample code given below what will be new contents of array x.

```
int x[10] = {1,2,3,4,5,6,7,8,9,10};
  int y = 20; int i = 10;
x[ - - i ] = y;
```

A) {1,2,3,4,5,6,7,8,9,10}
B) {20,2,3,4,5,6,7,8,9,10}
C) {1,2,3,4,5,6,7,8,9,20}
D) {1,2,3,4,5,6,7,8,20,10}

1.2 Depth first traversal of a graph produces
A) a spanning tree of the graph
B) a spanning forest of the graph
C) a minimal spanning tree
D) none of the above

1.3 int *p;
Refer to the above declaration which one of the following statements are true regarding the expression ((char *)p)++?
A) It gives the first byte of the value pointed by p and increments p by 1.
B) It increases p by 1
C) This expression is not portable
D) It increments the first byte of the value pointed by p by 1.

1.4 To insert a node at the end of the singly connected linked list having 'p' nodes, how many nodes are to be traversed for this insertion operation?

A) p/2
B) p
C) 1
D) none of the above

1.5 In the text of the divide and conquer algorithm must contain at least

A) One recursive call
B) Two recursive calls
C) Either one or zero calls
D) None of the above

1.6 Which of the following statements is true?

A) A binary tree is always a heap
B) A heap is a full binary tree
C) A heap is a complete binary tree
D) Root of the heap is always the smallest element in the heap

1.7 The number of null pointers in a binary tree with k internal nodes is

A) k + 1
B) k – 1
C) k
D) The number depends on the slope of the tree

1.8 Which of the following statement is false?

A) In a circular queue, overflow occurs less frequently than in a simple queue
B) In a deque, insertion and deletion of elements can take place on either end
C) In a priority queue, insertion of new elements always takes place at one end
D) None of the above

1.9 The number vertices in a full m-ary tree with i internal nodes is

A) mi + 1
B) $2^{mi} - 1$
C) Mi
D) 2^{mi-1}

1.10 The number of comparisons needed to merge-sort a list of n elements is

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

2. Each statement below is either TRUE or FALSE. Choose the most appropriate one and ENTER in the "tear-off" sheet attached to the question paper, following instructions therein. (1 x 10)

2.1 The Structures cannot contain a pointer to itself.

2.2 A simple graph is connected if and only if it has a spanning tree.

2.3 Insertion of an element in an array requires shifting of some elements of the array by one position.

2.4 Two sorted lists with m elements and n elements can be merged into a sorted list using no more than m+n-1 comparisons.

2.5 The number of disk accesses required for most operations on a B tree is inversely proportional to the height of the tree.

2.6 The time required to perform a sequence of data structure operations is averaged over all the operations performed in an Amortized analysis.

2.7 All the terminal nodes are traversed in the same order from left to right in in-order, preorder and post-order traversals of a binary tree.

2.8 A complete binary tree with n internal nodes has (n-1) leaves.

2.9 AVL trees, 2-3 trees and B trees permits searches, inserts, deletes in O(log n) time.

2.10 The in-degree of a vertex is the number of edges leaving it.

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 "tear-off" answer sheet attached to the question paper, following instructions therein. (1 x 10)

X		Y	
3.1	Typedef	**A.**	sensitive
3.2	C variables	**B.**	context dependent
3.3	O(log n)	**C.**	Elements are stored in hash table
3.4	Stack	**D.**	FIFO
3.5	Queue	**E.**	Suffers primary clustering
3.6	Conversion of one data type to another	**F.**	Suffers secondary clustering
3.7	Strongly connected component	**G.**	Type coercion
3.8	Prim's algorithm functionality	**H.**	Dijkstra's algorithm
3.9	Open addressing	**I.**	Depth first search
3.10	Linear probing	**J.**	Breadth first search
		K.	keyword
		L.	LIFO
		M.	Binary search
		N.	Linear search

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 "tear-off" answer sheet attached to the question paper, following instructions therein. (1 x 10)

A.	Floor of log n!	**B.**	Ceiling of log n!	**C.**	m+n-1
D.	m+n	**E.**	2^n	**F.**	2^n-1
G.	2000	**H.**	1000/2	**I.**	Static
J.	Dynamic	**K.**	p+q	**L.**	p+q-2
M.	Logical properties	**N.**	Physical properties	**O.**	Segment violation
P.	Block overflow	**Q.**	AB/C**DE*+AC*	**R.**	AB/C**DEAC*+
S.	Strings	**T.**	Pointers	**U.**	inorder

4.1 A sorting algorithm on n elements based on binary comparisons requires at least _____ comparisons.

4.2 Two sorted lists with m elements and n elements can be merged into a sorted list using no more than _____ comparisons.

4.3 argv an array of pointers to _____.

4.4 The minimum size of an array to store a binary tree of n levels is _____.

4.5 The number of edges in a full binary tree with 1,000 internal vertices is _____.

4.6 An error caused by a program trying to access memory outside its address space is known as _____.

4.7 The storage class of a variable declared inside a function which allows retention of its previous value is termed as _____.

4.8 An abstract data type is a(n) _____.

4.9 Number of nodes required to store the adjacency list of a directed graph that has "p" vertices and 'q' edges is _____.

4.10 The postfix form of the expression A/B ** C + D*E- A*C is _____.

PART TWO

(Answer any **FOUR** questions)

5.

a) Let A and B be two structures of type Linked List. Write a 'C' function to create a new Linked List C that contains elements alternately from A and B beginning with the first element of A. If you run out of elements in one of the lists, then append the remaining elements of the other list to C.

b) Describe the implementation methods insertBefore(p,e), InsertFirst(e) and InsertLast(e) of the list ADT, assuming the list is implemented using a doubly linked list.

(8+7)

6.

a) Let A and B be two n x n lower triangular matrices. The total number of elements in the lower triangles of the two matrices is n(n+1). Write a 'C' program to represent both triangles in an array d[n+1][n].

b) Let P be of type of linked list. Write a 'C' function **split** to create two linked lists Q & R. Q contains all elements in odd positions of P and R contains the remaining elements. Your function should not change list P. What is the complexity of your program?

(8+7)

7.

a) Write an algorithm to delete an element x from a binary search tree t. Discuss your method with an example.

b) Show the results of inserting the keys F, S, Q, K, C, H, T, V, W, M, R, N, P, A, B, X, Y, D, Z, E in order into an empty B tree.

(8+7)

8.

a) Use the bubble sort to put the numbers 3, 2, 4, 1, 5 into increasing order. Illustrate the output returned in each pass clearly. Also write the pseudo algorithm to it.

b) Modify bubble sort algorithm in more efficient form so that it stops when no interchanges are needed.

(8+7)

9.

a) Suppose that a Graph G has a minimum spanning tree already computed. How quickly can the minimum spanning tree be updated if a new vertex and incident edges are added to G?

b) Suppose that the graph G = (V,E) is represented as an adjacency matrix. Give a simple implementation of Prim's algorithm for this case that runs in $O(V^2)$ time.

c) What is the running time of heap sort on an array A of length n that is already sorted in increasing order?

(5+6+4)