DATA STRUCTURES

PART I

OBJECTIVE TYPE QUESTIONS

Each Question carries 1 mark.

Q.1 If h is any hashing function and is used to hash n keys in to a table of size m, where n<=m, the expected number of collisions involving a particular key x is :

(A) less than 1. **(B)** less than n.
(C) less than m. **(D)** less than n/2.

Q.2 Let A be an adjacency matrix of a graph G. The th ij entry in the matrix K A , gives

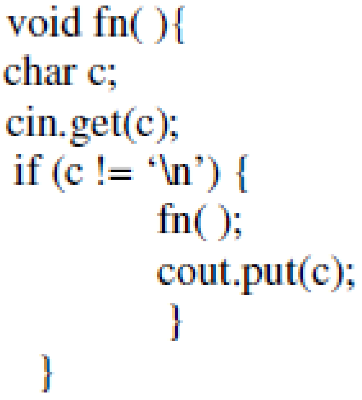
(A) The number of paths of length K from vertex Vi to vertex Vj.
(B) Shortest path of K edges from vertex Vi to vertex Vj.
(C) Length of a Eulerian path from vertex Vi to vertex Vj.
(D) Length of a Hamiltonian cycle from vertex Vi to vertex Vj.

Q.3 The OS of a computer may periodically collect all the free memory space to form contiguous block of free space. This is called

(A) Concatenation **(B)** Garbage collection
(C) Collision **(D)** Dynamic Memory Allocation

Q.4 What is the following code segment doing?

(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.



```
void fn( ){
char c;
cin.get(c);
 if (c != '\n') {
            fn( );
            cout.put(c);
             }
  }
```

Q.5 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?

(A) Bubble sort **(B)** Selection sort
(C) Quick sort **(D)** Insertion sort

Q.6 B Trees are generally

(A) very deep and narrow **(B)** very wide and shallow
(C) very deep and very wide **(D)** cannot say

Q.7 A technique for direct search is
(A) Binary Search **(B)** Linear Search
(C) Tree Search **(D)** Hashing

Q.8 If a node having two children is deleted from a binary tree, it is replaced by its
(A) Inorder predecessor **(B)** Inorder successor
(C) Preorder predecessor **(D)** None of the above

Q.9 The searching technique that takes O (1) time to find a data is
(A) Linear Search **(B)** Binary Search
(C) Hashing **(D)** Tree Search

Q.10 A mathematical-model with a collection of operations defined on that model is called
(A) Data Structure **(B)** Abstract Data Type
(C) Primitive Data Type **(D)** Algorithm

Q.11 The number of interchanges required to sort 5, 1, 6, 2 4 in ascending order using Bubble Sort
is
(A) 6 **(B)** 5
(C) 7 **(D)** 8

Q.12 The postfix form of the expression $(A+B)*(C*D-E)*F / G$ is
(A) $AB+CD*E-FG/**$ (B) $AB+CD*E-F**G/$
(C) $AB+CD*E-*F*G/$ (D) $AB+CDE*-*F*G/$

Q.13 The complexity of multiplying two matrices of order m*n and n*p is
(A) mnp **(B)** mp
(C) mn **(D)** np

Q.14 Merging 4 sorted files containing 50, 10, 25 and 15 records will take____time

(A) O (100) **(B)** O (200)
(C) O (175) **(D)** O (125)

Q.15 For an undirected graph with n vertices and e edges, the sum of the degree of each vertex is equal to

(A) 2n **(B)** (2n-1)/2
(C) 2e **(D)** $e^2/2$

Q.16 In worst case Quick Sort has order

(A) O (n log n) **(B)** O ($n^2/2$)
(C) O (log n) **(D)** O ($n^2/4$)

Q.17 A full binary tree with 2n+1 nodes contain

(A) n leaf nodes **(B)** n non-leaf nodes
(C) n-1 leaf nodes **(D)** n-1 non-leaf nodes

Q.18 If a node in a BST has two children, then its inorder predecessor has

(A) no left child **(B)** no right child
(C) two children **(D)** no child

Q.19 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.

Q.20 A linear list of elements in which deletion can be done from one end (front) and insertion can take place only at the other end (rear) is known as a

(A) queue. **(B)** stack.
(C) tree. **(D)** linked list.

Q.21 What is the postfix form of the following prefix expression -A/B*C$DE

(A) ABCDE$*/- **(B)** A-BCDE$*/-
(C) ABC$ED*/- **(D)** A-BCDE$*/

Q.22 A full binary tree with n leaves contains

(A) n nodes. **(B)** $\log_2 n$ nodes.
(C) 2n –1 nodes. **(D)** 2^n nodes.

Q.23 A sort which relatively passes through a list to exchange the first element with any element less than it and then repeats with a new first element is called

(A) insertion sort. **(B)** selection sort.
(C) heap sort. **(D)** quick sort.

Q.24 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

Q.25 An undirected graph G with n vertices and e edges is represented by adjacency list. What is the time required to generate all the connected components?

(A) O (n) **(B)** O (e)

(C) O (e+n) **(D)** $O\left(e^2\right)$

Q.26 Consider a linked list of n elements. What is the time taken to insert an element after an element pointed by some pointer?

(A) O (1) **(B)** $O\left(\log_2 n\right)$

(C) O (n) **(D)** $O\left(n \log_2 n\right)$

Q.27 The smallest element of an array's index is called its

(A) lower bound. **(B)** upper bound.
(C) range. **(D)** extraction.

Q.28 In a circular linked list

(A) components are all linked together in some sequential manner.
(B) there is no beginning and no end.
(C) components are arranged hierarchically.
(D) forward and backward traversal within the list is permitted.

Q.29 A graph with n vertices will definitely have a parallel edge or self loop of the total number of edges are

(A) more than n **(B)** more than n+1
(C) more than (n+1)/2 **(D)** more than n(n-1)/2

Q.30 The minimum number of multiplications and additions required to evaluate the polynomial P = $4x^3+3x^2-15x+45$ is

(A) 6 & 3 **(B)** 4 & 2
(C) 3 & 3 **(D)** 8 & 3

Q.31 The maximum degree of any vertex in a simple graph with *n* vertices is

(A) *n–1* **(B)** *n+1*
(C) *2n–1* **(D)** *n*

Q.32 The data structure required for Breadth First Traversal on a graph is

(A) queue **(B)** stack
(C) array **(D)** tree

Q.33 The quick sort algorithm exploit _________ design technique

(A) Greedy **(B)** Dynamic programming
(C) Divide and Conquer **(D)** Backtracking

Q.34 The number of different directed trees with 3 nodes are
(A) 2 **(B)** 3
(C) 4 **(D)** 5

Q.35 One can convert a binary tree into its mirror image by traversing it in

(A) inorder **(B)** preorder
(C) postorder **(D)** any order

Q.36 The total number of companions required to merge 4 sorted files containing 15, 3, 9 and 8records into a single sorted file is

(A) 66 **(B)** 39
(C) 15 **(D)** 3

Q.37 In a linked list with n nodes, the time taken to insert an element after an element pointed by some pointer is

(A) 0 (1) **(B)** 0 (log n)
(C) 0 (n) **(D)** 0 (n 1og n)

Q.38 The data structure required to evaluate a postfix expression is

(A) queue **(B)** stack
(C) array **(D)** linked-list

Q.39 The data structure required to check whether an expression contains balanced parenthesis is

(A) Stack **(B)** Queue
(C) Tree **(D)** Array

Q.40 The complexity of searching an element from a set of n elements using Binary search algorithm is
(A) O(n) **(B)** O(log n)
(C) $O(n_2)$ **(D)** O(n log n)

Q.41 The number of leaf nodes in a complete binary tree of depth d is

(A) 2_d **(B)** $2_{d-1}+1$
(C) $2_{d+1}+1$ **(D)** 2_d+1

Q.42 What data structure would you mostly likely see in a nonrecursive implementation of a recursive algorithm?

(A) Stack **(B)** Linked list
(C) Queue **(D)** Trees

Q.43 Which of the following sorting methods would be most suitable for sorting a list which is almost sorted

(A) Bubble Sort **(B)** Insertion Sort
(C) Selection Sort **(D)** Quick Sort

Q.44 A B-tree of minimum degree t can maximum _____ pointers in a node.

(A) t–1 **(B)** 2t–1
(C) 2t **(D)** t

Q.45 The process of accessing data stored in a serial access memory is similar to manipulating data on a

(A) heap **(B)** queue
(C) stack **(D)** binary tree

Q.46 A graph with n vertices will definitely have a parallel edge or self loop if the total number of edges are

(A) greater than n–1 **(B)** less than n(n–1)
(C) greater than n(n–1)/2 **(D)** less than n2/2

Q.47 A BST is traversed in the following order recursively: Right, root, left
The output sequence will be in

(A) Ascending order **(B)** Descending order
(C) Bitomic sequence **(D)** No specific order

Q.48 The pre-order and post order traversal of a Binary Tree generates the same output. The tree can have maximum

(A) Three nodes **(B)** Two nodes
(C) One node **(D)** Any number of nodes

Q.49 The postfix form of A*B+C/D is

(A) *AB/CD+ **(B)** AB*CD/+
(C) A*BC+/D **(D)** ABCD+/*

Q.50 Let the following circular queue can accommodate maximum six elements with the following data front = 2 rear = 4 queue = _______; L, M, N, ___, ___
What will happen after ADD O operation takes place?

(A) front = 2 rear = 5
queue = ______; L, M, N, O, ___
(B) front = 3 rear = 5
queue = L, M, N, O, ___
(C) front = 3 rear = 4
queue = ______; L, M, N, O, ___
(D) front = 2 rear = 4
queue = L, M, N, O, ___

Q.51 A binary tree of depth "d" is an almost complete binary tree if

(A) Each leaf in the tree is either at level "d" or at level "d–1"
(B) For any node "n" in the tree with a right descendent at level "d" all the left descendents of "n" that are leaves, are also at level "d"
(C) Both **(A)** & **(B)**
(D) None of the above

Q.52 A linear collection of data elements where the linear node is given by means of pointer is called

(A) linked list **(B)** node list
(C) primitive list **(D)** None of these

Q.53 Representation of data structure in memory is known as:

(A) recursive **(B)** abstract data type
(C) storage structure **(D)** file structure

Q.54 If the address of A[1][1] and A[2][1] are 1000 and 1010 respectively and each element occupies 2 bytes then the array has been stored in _________ order.

(A) row major **(B)** column major
(C) matix major **(D)** none of these

Q.55 An adjacency matrix representation of a graph cannot contain information of :

(A) nodes **(B)** edges
(C) direction of edges **(D)** parallel edges

Q.56 Quick sort is also known as

(A) merge sort **(B)** heap sort
(C) bubble sort **(D)** none of these

Q.57 One of the major drawback of B-Tree is the difficulty of traversing the keys sequentially.

(A) True **(B)** False

Q.58 O(N) (linear time) is better than O(1) constant time.

(A) True **(B)** False

Q.59 An ADT is defined to be a mathematical model of a user-defined type along with the collection of all ____________ operations on that model.

(A) Cardinality **(B)** Assignment
(C) Primitive **(D)** Structured

Q.60 An algorithm is made up of two independent time complexities *f (n)* and *g (n).* Then the complexities of the algorithm is in the order of

(A) *f(n)* x *g(n)* **(B)** *Max (f(n),g(n))*
(C) *Min (f(n),g(n))* **(D)** *f(n) + g(n)*

Q.61 The goal of hashing is to produce a search that takes

(A) *O(1)* time **(B)** $O(n_2)$ time
(C) *O(log n)* time **(D)** *O(n log n)* time

Q.62 The best average behaviour is shown by

(A) Quick Sort **(B)** Merge Sort
(C) Insertion Sort **(D)** Heap Sort

Q.63 What is the postfix form of the following prefix **+ab–cd*

(A) *ab+cd–** **(B)** *abc+*–*
(C) *ab+*cd–* **(D)** *ab+*cd–*

Q.64 Time complexities of three algorithms are given. Which should execute the slowest for large values of N?

(A) $O\left(N^{1/2}\right)$ **(B)** $O(N)$
(C) $O(\log N)$ **(D)** *None of these*

Q.65 How does an array differ from an ordinary variable?

Q.66 What values are automatically assigned to those array elements which are not explicitly initialized?

Q.67 A stack is to be implemented using an array. The associated declarations are:

```
int stack [100];
int top = 0;
```

Give the statement to perform push operation.

Q.68 Assume that a queue is available for pushing and popping elements. Given an input sequence a, b, c, (c be the first element), give the output sequence of elements if the rightmost element given above is the first to be popped from the queue.

Q.69 A two dimensional array TABLE [6] [8] is stored in row major order with base address 351. What is the address of TABLE [3] [4]?

Q.70 Which sorting algorithm is best if the list is already sorted? Why?

Q.71 What is the time complexity of Merge sort and Heap sort algorithms?

Q.72 What is the maximum possible number of nodes in a binary tree at level 6?

Q.73 A queue is a,

(A) FIFO (First In First Out) list. **(B)** LIFO (Last In First Out) list.
(C) Ordered array. **(D)** Linear tree.

Q.74 Which data structure is needed to convert infix notation to postfix notation?

(A) Branch **(B)** Queue
(C) Tree **(D)** Stack

Q.75 Which of the following operations is performed more efficiently by doubly linked list than by singly linked list?

(A) Deleting a node whose location in given
(B) Searching of an unsorted list for a given item
(C) Inverting a node after the node with given location
(D) Traversing a list to process each node

Q.76 The extra key inserted at the end of the array is called a,

(A) End key. **(B)** Stop key.
(C) Sentinel. **(D)** Transposition.

Q.77 The prefix form of A-B/ (C * D ^ E) is,

(A) -/*^ACBDE **(B)** -ABCD*^DE
(C) -A/B*C^DE **(D)** -A/BC*^DE

Q.78 Consider that n elements are to be sorted. What is the worst case time complexity of Bubble sort?
(A) O(1) **(B)** O($\log_2$n)
(C) O(n) **(D)** O(n_2)

Q.79 A characteristic of the data that binary search uses but the linear search ignores is the___________.

(A) Order of the elements of the list.
(B) Length of the list.
(C) Maximum value in list.
(D) Type of elements of the list.

Q.80 In Breadth First Search of Graph, which of the following data structure is used?

(A) Stack. **(B)** Queue.
(C) Linked List. **(D)** None of the above.

Q.81 The largest element of an array index is called its

(A) lower bound. **(B)** range.
(C) upper bound. **(D)** All of these.

Q.82 What is the result of the following operation Top (Push (S, X))

(A) X **(B)** null
(C) S **(D)** None of these.

Q.83 How many nodes in a tree have no ancestors.

(A) 0 **(B)** 1
(C) 2 **(D)** n

Q.84 In order to get the contents of a Binary search tree in ascending order, one has to traverse it in

(A) pre-order. **(B)** in-order.
(C) post order. **(D)** not possible.

Q.85 Which of the following sorting algorithm is stable

(A) insertion sort. **(B)** bubble sort.
(C) quick sort. **(D)** heap sort.

Q.86 The prefix form of an infix expression p + q □ r * t is

(A) + pq □ *rt . **(B)** □ +pqr * t .
(C) □ +pq * rt . **(D)** □ + * pqrt .

Q.87 Which data structure is used for implementing recursion?

(A) Queue. **(B)** Stack.
(C) Arrays. **(D)** List.

Q.88 In binary search, average number of comparison required for searching an element in a list if n numbers is

(A) $\log_2 n$. **(B)** n / 2 .
(C) n. **(D)** n – 1.

Q.89 In order to get the information stored in a Binary Search Tree in the descending order, one should traverse it in which of the following order?

(A) left, root, right **(B)** root, left, right
(C) right, root, left **(D)** right, left, root

Q.90 The equivalent prefix expression for the following infix expression (A+B)-(C+D*E)/F*G is

(A) -+AB*/+C*DEFG **(B)** /-+AB*+C*DEFG
(C) -/+AB*+CDE*FG **(D)** -+AB*/+CDE*FG

Q.91 The time required to delete a node x from a doubly linked list having n nodes is

(A) O (n) **(B)** O (log n)
(C) O (1) **(D)** O (n log n)

Q.92 Ackerman’s function is defined on the non-negative integers as follows
a (m,n) = n+1 if m=0
= a (m-1, 1) if $m \neq 0$, n=0
= a (m-1, a(m, n-1)) if $m \neq 0$, $n \neq 0$
The value of a (1, 3) is

(A) 4. **(B)** 5.
(C) 6. **(D)** 7.

Q.93 The result of evaluating the postfix expression 5, 4, 6, +, *, 4, 9, 3, /, +, * is

(A) 600. **(B) 350**.
(C) 650. **(D)** 588.

Q.94 The worst case of quick sort has order

(A) O(n_2) **(B)** O(n)
(C) O (n $\log_2$ n) **(D) O** ($\log_2$ n)

Q.95 For an undirected graph G with n vertices and e edges, the sum of the degrees of each vertex is

(A) ne **(B)** 2n
(C) 2e **(D)** e_n

Q.96 The time required to delete a node x from a doubly linked list having n nodes is

(A) O (n) **(B)** O (log n)
(C) O (1) **(D)** O (n log n)

PART II
DESCRIPTIVES

Q.1 What is an algorithm? What are the characteristics of a good algorithm? **(4)**

Q.2 How do you find the complexity of an algorithm? What is the relation between the time and space complexities of an algorithm? Justify your answer with an example. **(5)**

Q.3 Compare two functions n^2 and $2^n/4$ for various values of n. Determine when second becomes larger than first. **(5)**

Q.4 Explain an efficient way of storing a sparse matrix in memory. Write a module to find the transpose of a sparse matrix stored in this way. **(10)**

Q.5 Explain an efficient way of storing two symmetric matrices of the same order in memory. **(4)**

Q.6 Write an algorithm to evaluate a postfix expression. Execute your algorithm using the following postfix expression as your input : a b + c d +*f ↑ . **(7)**

Q.7 What are circular queues? Write down routines for inserting and deleting elements from a circular queue implemented using arrays. **(7)**

Q.8 Given a set of input representing the nodes of a binary tree, write a non recursive algorithm that must be able to output the three traversal orders. Write an algorithm for checking validity of the input, i.e., the program must know if the input is disjoint, duplicated and has a loop. **(10)**

Q.9 Two linked lists contain information of the same type in ascending order. Write a module to merge them to a single linked list that is sorted. **(7)**

Q.10 What is a Binary Search Tree (BST)? Make a BST for the following sequence of numbers.
45, 36, 76, 23, 89, 115, 98, 39, 41, 56, 69, 48
Traverse the tree in Preorder, Inorder and postorder. **(8)**

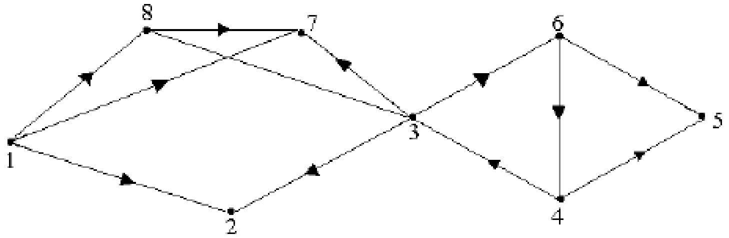
Q.11 What are expression trees? Represent the following expression using a tree. Comment on the result that you get when this tree is traversed in Preorder, Inorder and postorder. (a-b) / ((c*d)+e) **(6)**

Q.12 How do you rotate a Binary Tree? Explain right and left rotations with the help of an example. **(8)**

Q.13 Taking a suitable example explains how a general tree can be represented as a Binary Tree. **(6)**

Q.14 What are the different ways of representing a graph? Represent the following graph using those ways. **(6)**

Q.15 Show the result of running BFS and DFS on the directed graph given below using vertex 3 as source. Show the status of the data structure used at each stage. **(8)**



Q.16 Write an algorithm for finding solution to the Tower's of Hanoi problem. Explain the working of your algorithm (with 4 disks) with diagrams. **(5)**

Q.17 Reverse the order of elements on a stack S
(i) using two additional stacks.
(ii) using one additional queue.
(9)

Q.18 Explain the representations of graph. Represent the given graph using any two methods **(8)**

Q.19 Write short notes on any **FOUR**:-

(i) B Tree.
(ii) Time Complexity, Big O notation.
(iii) Merge Sort.
(iv) Threaded Binary Tree.
(v) Depth First Traversal.
(3.5 x 4 = 14)

Q.20 Define the term array. How are two-dimensional arrays represented in memory? Explain how address of an element is calculated in a two dimensional array. **(8)**

Q.21 An, array, A contains n unique integers from the range x to y (x and y inclusive where n=y-x). That is, there is one member that is not in A. Design an O(n) time algorithm for finding that number. **(8)**

Q.22 Draw the expression tree of the following infix expression. Convert it in to Prefix and Postfix expressions.

$((a + b) + c * (d + e) + f) * (g + h)$ **(9)**

Q.23 Implement a Queue using a singly linked list L. The operations INSERT and DELETE should still take O (1) time. **(6)**

Q.24 Explain how to implement two stacks in one array A[1..n] in such a way that neither stack overflows unless the total number of elements in both stacks together is n. The PUSH and POP operations should run in O(1) time. **(10)**

Q.25 Two Binary Trees are similar if they are both empty or if they are both nonempty and left and right sub trees are similar. Write an algorithm to determine if two Binary Trees are similar. **(8)**

Q.26 The degree of a node is the number of children it has. Show that in any binary tree, the number of leaves are one more than the number of nodes of degree 2 **(8)**

Q.27 Write the non-recursive algorithm to traverse a tree in preorder. **(8)**

Q.28 Give the adjacency matrix for the following graph: **(4)**

Q.29 Draw the complete undirected graphs on one, two, three, four and five vertices. Prove that the number of edges in an n vertex complete graph is n(n-1)/2. **(8)**

Q.30 Bubble sort algorithm is inefficient because it continues execution even after an array is sorted by performing unnecessary comparisons. Therefore, the number of comparisons in the best and worst cases are the same. Modify the algorithm in such a fashion that it will not make the next pass when the array is already sorted. **(12)**

Q.31 Which sorting algorithm is easily adaptable to singly linked lists? Explain your answer. **(4)**

Q.32 Sort the following sequence of keys using merge sort.
66, 77, 11, 88, 99, 22, 33, 44, 55 **(8)**

Q.33 Draw a B-tree of order 3 for the following sequence of keys:
2, 4, 9, 8, 7, 6, 3, 1, 5, 10 **(8)**

Q.34 What do you mean by complexity of an algorithm? Explain the meaning of worst case analysis and best case analysis with an example. **(8)**

Q.35 Explain the method to calculate the address of an element in an array. A $25 \cdot 4$ matrix array DATA is stored in memory in ‘row-major order’. If base address is 200 and $\omega = 4$ words per memory cell. Calculate the address of DATA [12, 3] . **(8)**

Q.36 What is the difference between a grounded header link list and a circular header link list? **(3)**

Q.37 Write an algorithm to insert a node in the beginning of the linked list. **(7)**

Q.38 Write an algorithm which does depth first search through an un-weighted connected graph. In an un-weighted graph, would breadth first search or depth first search or neither find a shortest path tree from some node? Why? **(8)**

Q.39 Convert the following infix expressions into its equivalent postfix expressions;

(i) $\left(A + B \uparrow D\right)/\left(E \square F\right)+G$

(ii) $A*\left(B+D\right)/ E \square F*\left(G +H K\right)$ **(8)**

Q.40 What is quick sort? Sort the following array using quick sort method.
24 56 47 35 10 90 82 31 **(7)**

Q.41 How many key comparisons and assignments an insertion sort makes in its worst case? **(4)**

Q.42 Create a heap with following list of keys:
8, 20, 9, 4, 15, 10, 7, 22, 3, 12 **(5)**

Q.43 The following values are to be stored in a hash table
25, 42, 96, 101, 102, 162, 197
Describe how the values are hashed by using division method of hashing with a table size of 7. Use chaining as the method of collision resolution. **(8)**

Q.44 Write an algorithm INSERT that takes a pointer to a sorted list and a pointer to a node and inserts the node into its correct position in the list. **(8)**

Q.45 Write a non recursive algorithm to traverse a binary tree in inorder. **(8)**

Q.46 Describe insertion sort with a proper algorithm. What is the complexity of insertion sort in the worst case? **(8)**

Q.47 Which are the two standard ways of traversing a graph? Explain them with an example of each. **(8)**

Q.48 Consider the following specification of a graph G

$V(G) = \{1,2,3,4\}$

$E(G) = \{(1,2), (1,3), (3,3), (3,4), (4,1)\}$

(i) Draw an undirected graph.
(ii) Draw its adjacency matrix. **(8)**

Q.49 Write short notes on the following:
(i) B-tree.
(ii) Abstract data type.
(iii) Simulation of queues. **(5+6+5)**

Q.50 Why do we use a symptotic notation in the study of algorithm? Describe commonly used asymptotic notations and give their significance. **(8)**

Q.51 Illustrate the steps for converting an infix expression into a postfix expression for the following expression $(a + b) * (c + d)/(e + f) \uparrow g$. **(8)**

Q.52 Let P be a pointer to a singly linked list. Show how this list may be used as a stack. That is, write algorithms to push and pop elements. Specify the value of P when the stack is empty. **(8)**

Q.53 How will you represent a max-heap sequentially? Explain with an example. **(4)**

Q.54 Write an algorithm to insert an element to a max-heap that is represented

Q.55 Construct a binary tree whose nodes in inorder and preorder are given as follows:

Inorder : 10, 15, 17, 18, 20, 25, 30, 35, 38, 40, 50
Preorder: 20, 15, 10, 18, 17, 30, 25, 40, 35, 38, 50 **(10)**

Q.56 Execute your algorithm to convert an infix expression to a post fix expression with the following infix expression on your input

$(m+n)*(k+p)/(g/b)\uparrow(a\uparrow b/c)$ **(8)**

Q.57 A double ended queue is a linear list where additions and deletions can be performed at either end. Represent a double ended queue using an array to store elements and write modules for additions and deletions. **(8)**

Q.58 What do you mean by hashing? Explain any five popular hash functions. **(8)**

Q.59 What is the best case complexity of quick sort and outline why it is so. How could its worst case behaviour arise? **(6)**

Q.60 Explain Dijkstra's algorithm for finding the shortest path in a given graph. **(6)**

Q.61 Find the shortest path from A to Z using Dijkstra's Algorithm. **(10)**

Q.62 Define a B-Tree. **(4)**

Q.63 Show the result of inserting the keys.

Q.64 What are stacks? How can stacks be used to check whether an expression is correctly parenthized or not. For eg(()) is well formed but (() or)()(is not.
(7)

Q.65 What is a linear array? Explain how two dimensional arrays are represented in memory. **(8)**

Q.66 Write an algorithm to merge two sorted arrays into a third array. Do not sort the third array. **(8)**

Q.67 Write a complete programme in C to create a single linked list. Write functions to do the following operations
(i) Insert a new node at the end
(ii) Delete the first node **(8)**

Q.68 Define a sparse metrics. Explain the representation of a 4X4 matrix using linked list. **(8)**

Q.69 Given the following inorder and preorder traversal reconstruct a binary tree
Inorder sequence D, G, B, H, E, A, F, I, C
Preorder sequence A, B, D, G, E, H, C, F, I **(8)**

Q.70 Devise a representation for a list where insertions and deletions can be made at either end. Such a structure is called Deque (Double ended queue). Write functions for inserting and deleting at either end. **(8)**

Q.71 Define Hashing. How do collisions happen during hashing? Explain the different techniques resolving of collision. **(8)**

Q.72 Make a BST for the following sequence of numbers.
45,32,90,34,68,72,15,24,30,66,11,50,10 Traverse the BST created in Preorder, Inorder and Postorder. **(8)**

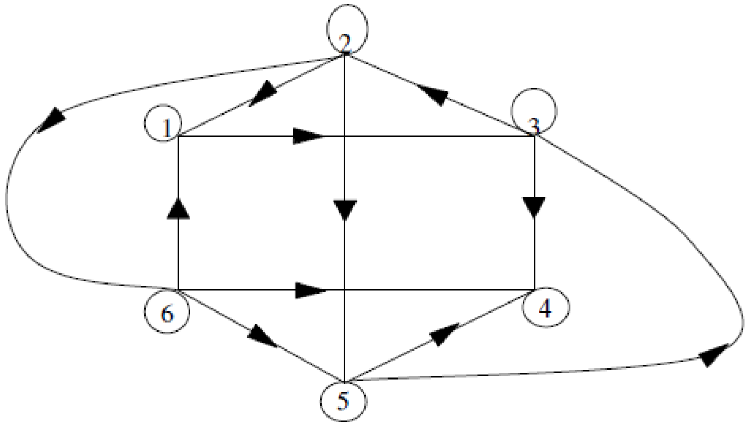
Q.73 What is a Binary Tree? What is the maximum number of nodes possible in a Binary Tree of depth d. Explain the following terms with respect to Binary Trees

(i) Strictly Binary Tree (ii) Complete Binary Tree (iii) Almost Complete Binary Tree **(8)**

Q.74 What is a Spanning tree of a graph? What is minimum spanning tree? Execute Prim's Kruskal's algorithm to find the minimum spanning tree of the following graph. **(10)**

Q.75 What are B-trees? Draw a B-tree of order 3 for the following sequence of keys. 3,5,11,10,9,8,2,6,12 **(6)**

Q.76 Show the result of running BFS and DFS on a directed graph given below using vertex 1 as source. Show the status of the data structure used at each stage. **(10)**



Q.77 Construct a complete binary tree with depth 3 for this tree which is maintained in memory using linked representation. Make the adjacency list and adjacency matrix for this tree. (6)

Q.78 Define data type and abstract data type. Comment upon the significance of both. **(8)**

Q.79 Write a procedure to reverse a singly linked list. **(8)**

Q.80 Execute your algorithm to convert an infix expression to a post fix expression with the following infix expression as input

$Q = \left[(A + B)/(C + D) \uparrow (E / F)\right] + (G + H)/ I$ **(8)**

Q81 Enumerate various operations possible on ordered lists and arrays. Write procedures to insert and delete an element in to array. **(8)**

Q.82 By taking an example show how multidimensional array can be represented in one dimensional array. **(8)**

Q.83 Show the various passes of bubble sort on an unsorted list 11, 15, 2, 13, 6 **(8)**

Q.84 Compare and contrast various sorting techniques with respect to memory space and computing time. **(8)**

Q.85 What do you mean by hash clash? Explain in detail any one method to resolve hash collisions. **(8)**

Q.86 Describe the concept of binary search technique? Is it efficient than sequential search? **(8)**

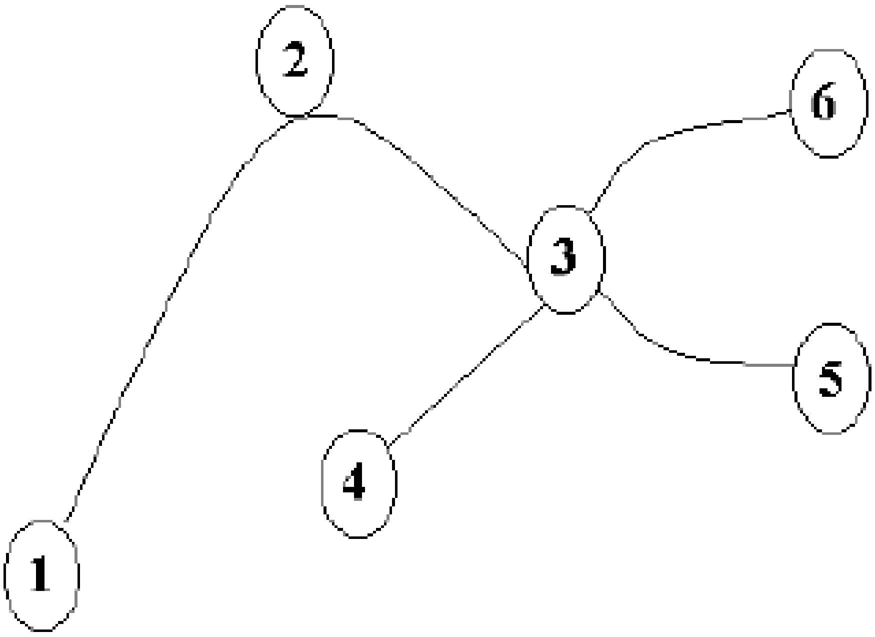
Q.87 Prove the hypothesis that “A tree having ‘m’ nodes has exactly (m–1) edges or branches”. **(8)**

Q.88 What do you understand by tree traversal? Write a procedure for traversing a binary tree in preorder and execute it on the following tree. **(8)**

Q.89 Write a procedure to insert a node into a linked list at a specific position and draw the same by taking any example? **(8)**

Q.90 Explain insertion into a B-tree. **(8)**

Q.91 Define adjacency matrix and make the same for the following undirected graph. **(8)**



Q.92 Show the linked representation of the above graph. **(8)**

Q.93 List various problem solving techniques. **(5)**

Q94. Explain the concept of primitive data structures. **(4)**

Q95. Determine the frequency counts for all statements in the following program segment.

```
for (i=1; i _ n; i ++)
for (j = 1; j _ i; j++)
for (k =1; k _ j; k++)
y ++; (3)
```

Q96 . Write an algorithm to count number of nodes in the circular linked list. **(3)**

Q97. Write an algorithm to insert a node in between any two nodes in a linked list **(4)**

Q98. Write down any four application of a stack. **(4)**

Q99. The system allocates memory for any multidimensional array from a large single dimensional array. Describe *two* mapping schemes that helps us to store a *two* dimensional metrics in a *one-dimensional* array. **(8)**

Q100. Write down the algorithm of quick sort.

Q101. Convert the following Infix expression to Postfix form using a stack:
x + *y* * *z* + (*p* * *q* + *r*) * *s*, Follow usual precedence rule and assume that the expression is legal. **(7)**

Q102. Draw the 11 item hash table resulting from hashing the keys: 12, 44, 13, 88, 23, 94, 11, 39, 20, 16 and 5 using the hash function h(i) = (2i+5) mod 11. **(8)**

Q103. Give the algorithm to construct a binary tree where the yields of preorder and post order traversal are given. **(6)**

Q104. Construct the binary tree for the following sequence of nodes in preorder and inorder respectively.
Preorder : G, B, Q, A, C, K, F, P, D, E, R, H
Inorder: Q, B, K, C, F, A, G, P, E, D, H, R **(4)**

Q105. Convert the following infix expression into a postfix expression (Show steps)
A∗(B+ D)/ E □ F(G +H/ k) **(4)**

Q106. Write an algorithm to delete a particular node from binary search tree. Trace your algorithm to delete a node (10) from the given tree. **(7)**

Q107. Draw a picture of the directed graph specified below:
G = (V, E)
V(G) = {1, 2, 3, 4, 5, 6}
E(G) = {(1,2), (2, 3), (3, 4), (5,1), (5, 6), (2, 6), (1, 6), (4, 6), (2, 4)}
Obtain the following for the above graph:
(i) Adjacency matrix.
(ii) React ability matrix. **(7)**

Q108. Write an algorithm for binary search. What are the conditions under which sequential search of a list is preferred over binary search? **(7)**

Q109. Write an algorithm for selection sort. Describe the behaviours of selection sort when the input is already sorted. **(7)**

Q110. Define the following terms:
(i) Abstract data type.
(ii) Column major ordering for arrays.
(iii) Adjacency multilist.
(iv) Game trees.
(14)

Q111. Describe various memory allocation strategies. **(8)**

Q112. How memory is freed using Boundary tag method in the context of Dynamic memory management? **(6)**

Q 113. Define a method for keeping two stacks within a single linear array S in such a way that neither stack overflows until entire array is used and an entire stack is never shifted to a different location within the array. Write routines for pushing and poping elements in two stacks. **(8)**

Q114. Suppose a queue is housed in an array in circular fashion. It is desired to add new items to the queue. Write down a procedure ENQ to achieve this also checking whether the queue is full. Write another procedure DQ to delete an element after checking queue empty status. **(6)**

Q115. What is a height balanced tree? Explain how the height is balanced after addition/deletion of nodes in it? **(7)**

Q116. Show the linked representation of the following two polynomials.

$$7x^{80} + 5x^{50} + 3x^{30} + 1 = 0$$

$$9x^{90} + 6x^{60} + 2x^{20} - 1 = 0$$

Build a procedure for adding two polynomials stored in linked lists. Verify steps of your procedure for the above two polynomials. **(7)**

Q117. Write short notes on the following:
(i) Threaded binary trees.
(ii) Graph traversal.
(iii) Conversion of forest into tree.
(iv) Doubly linked list. **(3.5·4 = 14)**

Q118. Differentiate between system defined data types and Abstract data types with suitable examples. **(8)**

Q119. Explain the following:
(i) Complexity of an Algorithm.
(ii) The space-time trade off algorithm. **(6)**

Q120. Define a sparse matrix. Explain different types of sparse matrices? Show how a triangular array is stored in memory. Evaluate the method to calculate address of any element a_{jk} of a matrix stored in memory. **(10)**

Q121. A linear array A is given with lower bound as 1. If address of A[25] is 375 and A[30] is 390, then find address of A[16]. **(4)**

Q122. Let a binary tree ‘T’ be in memory. Write a procedure to delete all terminal nodes of the tree. **(8)**

Q123. Consider the following eight numbers 50, 33, 44, 22, 77, 35, 60 and 40. Display the construction of the binary by inserting the above numbers in the given order.
(6)

Q124. Can a Queue be represented by circular linked list with only one pointer pointing to the tail of the queue? Substantiate your answer using an example.
(5)

Q125. Establish the usage of linked lists for polynomial manipulation. **(5)**

Q126. Convert the following infix expressions to postfix notation
(i) A+((B+C)*(D+E)+F/G)
(ii) $A \uparrow B \uparrow C * D$ **(4)**

Q127. Explain Hash Tables, Hash function and Hashing Techniques? **(8)**

Q128. Define a linked-list? How are these stored in the memory? Suppose the linked list in the memory consisting of numerical values. Write a procedure for each of the following:
(i) To find the maximum MAX of the values in the list.
(ii) To find the average MEAN of the values in the list.
(iii) To find the product PROD of the values in the list. **(14)**

Q129. Using array to implement the queue structure, write an algorithm/program to
(i) Insert an element in the queue.
(ii) Delete an element from the queue. **(9)**

Q130. Define a stack. Describe ways to implement stack. **(5)**

Q131. Sort the following list using Heap Sort technique, displaying each step.
20, 12, 25 6, 10, 15, 13 **(7)**

Q132. Give the binary search algorithm. **(7)**

Q133. What do you understand by structured programming? Explain. **(5)**

Q.134. Give the adjacency matrix and adjacency list of the following graphs.**(6)**

Q135. Consider the algebraic expression $E = (5x+z)\ (3a-b)_2$

(i) Draw the expression tree corresponding to E
(ii) Find the scope of exponential operator i.e. the subtree rooted at the exponential operator. (7)

Q136. Write an algorithm to evaluate an expression given in postfix notation. Show the execution of your algorithm for the following expression.
AB^CD-EF/GH+/+* **(7)**

Q137. Define an array. How does an array differ from an ordinary variable? How are arrays represented in the memory? **(5)**

Q138. Consider an array A[20, 10]. Assume 4 words per memory cell and the base address of array A is 100. Find the address of A[11, 5] assuming row major storage. **(5)**

Q139. Write an algorithm to convert an infix expression into postfix expression. **(8)**

Q140. Suggest a way of implementing two stacks in one array such that as long as space is there in an array, you should be able to add an element in either stack. Using proposed method, write algorithms for push and pop operations for both the stacks. **(6)**

Q141. Write an algorithm to insert a node p at the end of a linked list. **(5)**

Q142. Write down any four applications of queues. **(4)**

Q.143 Draw a binary tree from its inorder and preorder traversal sequences given as follows:
Inorder : d b g e h a c n f
Preorder : a b d e g h c f n **(7)**

Q144. Write an algorithm that counts number of nodes in a linked list. **(5)**

Q145. Write an algorithm to add an element at the end of circular linked list. **(5)**

Q146. Delete a given node from a doubly linked list. **(4)**

Q147. Write an algorithm to sort a given list using Quick sort method. Describe the behaviour of Quick sort when input is already sorted. **(7)**

Q148. Sort the following list using Heap Sort
66, 33, 40, 20, 50, 88, 60, 11, 77, 30, 45, 65. **(7)**

Q149. Write a recursive function to count the number of nodes in a binary tree. **(7)**

Q150. Define the following :
(i) AVL tree.
(ii) Thread.
(iii) Heap.
(iv) Binary Search Tree. **(8)**

Q151. Write an algorithm for searching a key from a sorted list using binary search technique. **(6)**

Q152. Define graph, adjacency matrix, adjacency list, hash function, sparse matrix, reachability matrix. **(6)**

Q153. Explain various graph traversal schemes and write their merits and demerits. **(8)**

Q154. Write short notes on the following:
(i) Decision and game trees.
(ii) Polynomial representation and manipulation using linked lists.
(iii) Analysis of algorithm.
(iv) Circular queues. **(3 ½ x 4 = 14)**

Q156. Explain any three methods of representing polynomials using arrays. Write which method is most efficient for representing the following polynomials.

$$8x^{100}+10x+6$$
$$8x^{3}-7x^{2}+5x+15$$

Q157. Let X = (X1, X2, X3,….Xn) and Y= (Y1, Y2, Y3,….Xm) be two linked lists.
Write an algorithm to merge the lists together to obtain the linked list Z such that
Z = (X1, Y1, X2, Y2,….Xm, Ym,Xm+1….Xn) if m<=n or
Z = (X1, Y1,X2,Y2….Xn,Yn,Yn+1….Ym) if m>n. **(7)**

Q158. Devise a representation for a list where insertions and deletions can be made at either end. Such a structure is called a Deque (Double ended queue). Write functions for inserting and deleting at either end. **(7)**

Q159. Using stacks, write an algorithm to determine whether the infix expression has balanced parenthesis or not. **(7)**

Q160. Implement a stack using linked list. Show both the PUSH and POP operations. **(7)**

Q161. Write binary search algorithm and trace to search element 91 in following list:
13 30 62 73 81 88 91
What are the limitations of Binary Search? **(7)**

Q162. What are the two phases in heap sort algorithm? Sort the following data using heap sort and show all the intermediate steps.
88, 12, 91, 23, 10, 36, 45, 55, 15, 39, 81

Q163. What is a Binary Search Tree (BST)? Make a BST for the following sequence of numbers.
45, 32, 90, 21, 78, 65, 87, 132, 90, 96, 41, 74, 92 **(7)**

Q164. Traverse the Binary Search Tree created above in Preorder, Inorder and Postorder.
(7)

Q165. What is a sparse matrix? How is it stored in the memory of a computer? Write a function to find the transpose of a sparse matrix using this representation. **(8)**

Q166. Write an algorithm for finding solution to the Towers of Hanoi problem. Explain the working of your algorithm (with 4 disks) with diagrams.
(7)

Q167. Suppose we have divided n elements in to m sorted lists. Explain how to produce a single sorted list of all n elements in time O (n log m)? **(7)**

Q168. Define hashing. Describe any two commonly used hash functions. Describe one method of collision resolution. **(7)**

Q169. A Binary tree has 9 nodes. The inorder and preorder traversals of the tree yields the following sequence of nodes:
Inorder : E A C K F H D B G
Preorder: F A E K C D H G B
Draw the tree. Explain your algorithm. **(7)**

Q170. What are B-trees? Construct a B-Tree of order 3 for the following set of Input data:
69, 19, 43, 16, 25, 40, 132, 100, 145, 7, 15, 18 **(7)**

Q171. What is the difference between Prims algorithm and Kruskals algorithm for finding the minimum-spanning tree of a graph? Execute both Prim’s and Kruskal’s algorithms on the following graph. **(8)**

Q172. Show the result of running BFS on a complete Binary Tree of depth 3. Show the status of the data-structure used at each stage. **(6)**

Q173. Write an algorithm to test whether a Binary Tree is a Binary Search Tree. **(4)**

Q174. Define a linked list with a loop as a linked list in which the tail element points to one of the list's elements and not to NULL. Assume that you are given a linked list *L*, and two pointers *P1*, *P2* to the head. Write an algorithm that decides whether the list has a loop without modifying the original list. The algorithm should run in time *O(n)* and additional memory *O(1)*, where *n* is the number of elements in the list. **(10)**

Q175. Execute quick algorithm on the following data till two key values are placed in their position 12,34,45,15,4,11,7,8,5,14,35,89,43,21. **(8)**

Q 176 Sort the following array of elements using quick sort *{3 1 4 1 5 9 2 6 5 3 5 8}* **(8)**

Q.177 Execute your algorithm for two passes using the following list as input:
66, 33, 40, 20, 50, 88, 60, 11, 77, 30, 45, 65
Describe the behaviour of Quick sort when the input is already sorted. **(10)**