SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF COMPUTER APPLICATIONS

QUESTION BANK

I SEMESTER

MC4161 -ADVANCED DATA STRUCTURES AND ALGORITHMS

Regulation – 2024

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SUBJECT : MC4161 -ADVANCED DATA STRUCTURES AND ALGORITHMS

SEM / YEAR : I Sem / I Year

UNIT I - LINEAR DATA STRUCTURES

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List Implementation Doubly-Linked Lists – Circular Linked Lists – Stack ADT: Implementation of Stacks – Queue ADT: Implementation of Queues – Applications.

PART-A

Q.No.	Question	Level	Competence
1	Define Abstract Data Type. Give any two examples.	BTL1	Remember
2	Define data structure.	BTL2	Understand
3	List out the areas in which data structures are applied extensively.	BTL1	Remember
4	Distinguish between linear and nonlinear data structures.	BTL1	Remember
5	Compare between linear linked list and circular linked list.	BTL2	Understand
6	Define an array. Give an example.	BTL2	Understand
7	List the advantages of linked list.	BTL1	Remember
8	Examine a doubly linked list with neat diagram.	BTL1	Remember
9	Interpret the advantages and disadvantages of linked lists over arrays.	BTL2	Understand
10	Define stack ADT.	BTL1	Remember
11	Given the prefix for an expression. Write its postfix: **++A*BCD and +*AB*CD**	BTL2	Understand
12	Given an infix expression convert it into postfix expression using stack **a+b*(c^d-e)^(f+g*h)-i**	BTL2	Understand
13	Write the postfix and prefix forms of the expression: **A+B*(C-D)/(P-R)**	BTL2	Understand
14	Give the purpose of top and pop with suitable example.	BTL2	Understand
15	What are the two kinds of dequeue?	BTL2	Understand
16	How to implement stack using linked list?	BTL2	Understand
17	What are priority queues? What are the ways to implement priorityqueue?	BTL1	Remember

18	What is circular queue?	BTL1	Remember
19	Circular queue is better than standard linear queue, why?	BTL2	Understand
20	Convert **A*(B+D)/E-F*(G+H/K)** into postfix expression.	BTL2	Understand
21	Show a routine to perform enqueue operation in a queue.	BTL2	Understand
22	Differentiate between double ended queue and circular queue.	BTL1	Remember
23	Write an algorithm for deleting an element in a double endedqueue	BTL1	Remember
24	List any four applications of stack.	BTL1	Remember

PART-B

Q.No.	Question	Marks	Level	Competence
1	Write the algorithm for performing operations in a stack. Trace your algorithm with suitable example.	16	BTL4	Analyze
2	What is Linked List? and write Function to test whether a linked list is empty, Function to test whether current position is the last in a linked list, Function to find the element in the list.	16	BTL6	Create
3	Develop a C program for linked list implementation of list.	16	BTL6	Create
4	(i)Explain the list ADT's various operations (Linked and array based) with examples. (ii)Explain the list ADT's various operations (Array based) with examples.	8 8	BTL3	Apply
5	Analyze and write procedure for circular linked list with create, insert, delete, display operations.	16	BTL3	Apply
6	Discuss the creation of a doubly linked list and write routine to insert an element in doubly linked list and delete an element in doubly linked list.	16	BTL4	Analyze
7	Examine the algorithms to implement the doubly linked list and perform all the operations on creating the doubly linked list.	16	BTL4	Analyze
8	Illustrate the various operation in circular linked lists.	16	BTL3	Apply
9	(i) Give an algorithm for push and pop operations on stack using a linked list with an example. (ii) Describe the function to examine whether the stack is full () or empty ().	8 8	BTL4	Analyze
10	(i)Give an algorithm to convert an infix expression to a postfix expression using stack. (ii)Convert an infix expression to a postfix expression using stack with suitable example.	8 8	BTL4	Analyze
11	Convert an infix expression to a postfix expression using stack with suitable example.	16	BTL5	Evaluate
12	(i)Convert an infix expression to a postfix expression using stack for the following expression: ((A + B) – C * (D / E)) + F (ii) Convert an infix expression to a prefix expression using stack for the following expression: ((A + B) – C * (D / E)) + F	8 8	BTL6	Create

13	Prepare an algorithm to perform the operations in a double ended queue.	16	BTL5	Evaluate
14	What is a DeQueue? Explain its operation with example?	16	BTL3	Apply
15	What is a EnQueue? Explain its operation with example?	16	BTL5	Evaluate
16	Develop a C program for linked list implementation of stack.	16	BTL4	Analyze
17	What are circular queues? Explain the procedure to insert an element in circular queue and delete an element from a circular queue using array implementation.	16	BTL5	Evaluate

UNIT II - ALGORITHMS IN COMPUTING

Introductions to Algorithms – Iterative and Recursive Algorithms – Designing Algorithms – Analyzing Algorithms – Growth of Functions: Asymptotic Notations – Standard Notations and Common Functions – Recurrences: The Substitution Method – The Recursion – Tree Method

PART-A

Q.No.	Question	Level	Competence
1	What do you mean by algorithm?	BTL1	Remember
2	What is performance measurement?	BTL2	Understand
3	What are the types of algorithm efficiencies?	BTL1	Remember
4	What is space complexity?	BTL1	Remember
5	Define asymptotic notations.	BTL2	Understand
6	Define the asymptotic notation “Big oh” (0)	BTL2	Understand
7	Difference between Best Case and Worst-Case Complexities	BTL1	Remember
8	Define the asymptotic notation “Omega” (Ω).	BTL1	Remember
9	Define the asymptotic notation “theta” (θ)	BTL2	Understand
10	Design an algorithm for computing area and circumference of the circle.	BTL1	Remember
11	How do you measure the efficiency of an algorithm?	BTL2	Understand
12	Write down the properties of asymptotic notations?	BTL2	Understand
13	What is a basic operation?	BTL2	Understand
14	What is validation of algorithm?	BTL2	Understand
15	What is recursive algorithm?	BTL2	Understand
16	Define recurrence	BTL2	Understand
17	Give the general plan for analyzing recursive algorithm	BTL1	Remember
18	What are all the methods available for solving recurrence relations?	BTL1	Remember

19	Define Substitution Method	BTL2	Understand
20	What are the applications of Algorithm Visualization?	BTL2	Understand
21	List the reasons for choosing an approximate algorithm.	BTL2	Understand
22	How to measure an algorithm running time?	BTL1	Remember
23	What are the types of recurrence relations?	BTL1	Remember
24	What are all the methods available for solving recurrence relations?	BTL1	Remember

PART-B

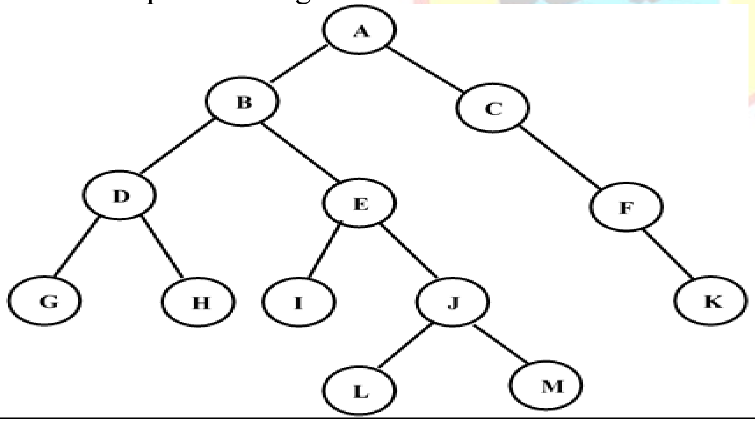
Q.No.	Question	Marks	Level	Competence
1	Discuss briefly the sequence of steps in designing and analyzing an algorithm.	16	BTL4	Analyze
2	Define the asymptotic notations used for: (i)Best case (ii)Average case and Worst-case analysis with an example.	6 10	BTL6	Create
3	Explain the general framework for analyzing the efficiency of algorithm	16	BTL4	Analyze
4	Explain in detail how Big Oh notation used to compare and rank such orders of growth, this notation.	16	BTL4	Analyze
5	How do you evaluate the performance of the algorithms?	16	BTL3	Apply
6	Explain in detail how Omega notation used to compare and rank such orders of growth, this notation Ω(big omega)	16	BTL4	Analyze
7	Explain in detail how Theta notation used to compare and rank such orders of growth, this notation Θ (big theta)	16	BTL4	Analyze
8	(i) Distinguish between Big Oh, Theta and Omega notation. (ii) Analyze the best, worst and average case analysis for linear search.	8 8	BTL4	Analyze
9	Illustrate how Time Complexity is calculated. Give an example	16	BTL3	Apply
10	Illustrate two kinds of efficiency in detail with an example.	16	BTL3	Apply
11	Illustrate Iterative Method to solve recurrences in detail with an example.	16	BTL3	Apply
12	(i)Explain Backward Substitution method to solve recurrences in detail with an example. (ii)Explain Forward Substitution method to solve recurrences in detail with an example.	8 8	BTL4	Analyze
13	Explain Recursion Tree Method to solve recurrences in detail with an example.	16	BTL4	Analyze
14	Explain Recursion Tree Method to solve recurrences in detail with an example.	16	BTL4	Analyze
15	Explain various techniques to solve recurrences.	16	BTL4	Analyze
16	i. Explain how analysis of linear search is done with a suitable illustration.	10	BTL3	Apply

	ii. Define recurrence equation and explain how solving recurrence equations are done.	6		
17	What is meant by recurrence? Give one example to solve recurrence equations.	16	BTL3	Apply

UNIT III - HIERARCHICAL DATA STRUCTURES & HASHING

Trees: Preliminaries – Implementation of Trees – Tree Traversals with an Application – Binary Trees: Implementation – Expression Trees – Search Tree ADT – Binary Search Trees – Applications of Trees - Fundamentals of Hashing – Hash Function – Separate Chaining – Open Addressing.

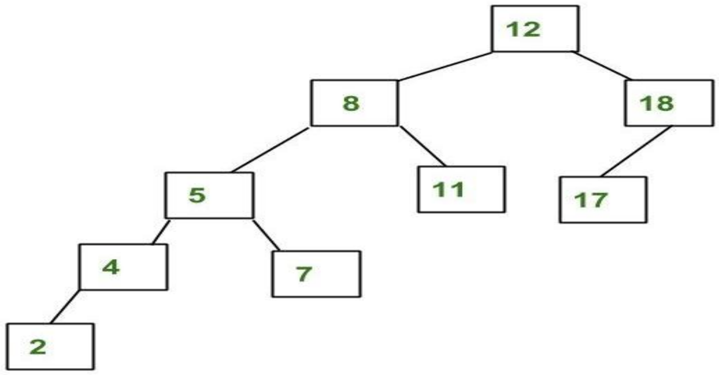
PART-A

Q.No.	Question	Level	Competence
1	What is tree traversal?	BTL 2	Understand
2	Mention the type of traversals.	BTL 2	Understand
3	Define a binary tree. Give an example.	BTL 1	Remember
4	Create an expression tree for the expression. **4+((7+9) *2).**	BTL 2	Understand
5	Differentiate AVL tree and Binary search tree.	BTL 1	Remember
6	Give the various types of rotations in AVL tree during the insertion of a node?	BTL 1	Remember
7	For the given tree i. List the siblings for node E ii. Compute the height. 	BTL 2	Understand
8	List the steps in deleting a node from a binary search tree.	BTL 1	Remember
9	Define the balance factor of AVL Tree.	BTL 1	Remember
10	Define Separate Chaining.	BTL 2	Understand
11	Define an expression tree. Give an example of it.	BTL 1	Remember
12	Define AVL Tree.	BTL 1	Remember
13	Identify the properties of Binary Search Tree.	BTL 1	Remember

14	Identify the type of traversal that gives the data in ascending order.	BTL2	Understand
15	Identify the properties of AVL Tree.	BTL2	Understand
16	List out the various operations that can be performed on Binary Search Tree to make it a height balanced one.	BTL 1	Remember
17	Identify the three cases for deleting a node from a binary search tree.	BTL 1	Remember
18	Define leaves in a tree.	BTL1	Remember
19	What do you mean by level of the tree?	BTL2	Understand
20	Identify the properties of a binary tree.	BTL1	Remember
21	Define Hashing.	BTL2	Understand
22	List the Different ways of Open Addressing.	BTL1	Remember
23	List out the applications of Trees.	BTL2	Understand
24	What do you mean by Heap?	BTL1	Remember

PART-B

Q.No.	Question	Marks	Level	Competence
1	Illustrate an algorithm for traversals of a binary tree with an example.	16	BTL3	Apply
2	Explain the following operations on a binary search tree with suitable algorithm: i. Find a node ii. Find minimum and maximum elements of BST.	6 10	BTL3	Apply
3	Write an algorithm for inserting nodes in a binary search tree and explain with an example.	16	BTL3	Apply
4	Describe the various operations that can be performed on a Binary Search Tree with example for each operation.	16	BTL3	Apply
5	i. Discuss in detail the various methods in which a binary tree can be represented. ii. Discuss the advantage and disadvantage of each method.	10 6	BTL4	Analyze
6	i. Create a binary search tree using the following data elements **45, 39, 56, 12, 34, 78, 32, 10, 89, 54, 67, 81** ii. Explain the steps to convert general tree to binary tree?	10 6	BTL5	Evaluate
7	Describe the three cases for deleting a node from a binary search tree with an example for each case.	16	BTL5	Evaluate
8	i. Discuss whether the following tree is AVL tree or not. If yes explain, how is it balanced and if not balance the tree	10	BTL6	Create

	 ii. Explain how deletion can take place in AVL trees with suitable algorithm.	6		
9	i. What are AVL trees? Describe the different rotations defined for AVL tree. ii. Insert the following elements step by step in sequence into an empty AVL tree **63, 9, 19, 27, 18, 108, 99, 81**.	8 8	BTL5	Evaluate
10	Develop a routine for post order traversal. Is it possible to find minimum and maximum value in the binary search tree using traversals? Discuss in detail with an example.	16	BTL3	Apply
11	Write an algorithm for deleting a node in a binary search tree considering the different cases of a node to be deleted.	16	BTL3	Apply
12	Explain the construction of expression tree with example. Give the applications of trees.	16	BTL4	Analyze
13	Explain Deletion in Binary tree by merging and copying.	16	BTL3	Apply
14	i. Explain how to delete an element from the binary search tree. ii. Write recursive algorithm for pre order traversal.	8 8	BTL3	Apply
15	Construct an expression tree for the expression (a+b*c) + ((d*e+f)*g). Give the outputs when you apply inorder, preorder and postorder traversals.	16	BTL3	Apply
16	Show each step of hash table entries for the given data set using linear probing 12,45,67,88,27,78,20,62,36,55 (size=10)	16	BTL6	Create
17	Apply quadratic hashing to fill the hash table of size 11 elements 20,5,10,22,33,40,50,30,51,31	16	BTL6	Create

UNIT IV - SORTING AND GRAPHS

Sorting Algorithms: Insertion Sort, Quick Sort, Heap Sort - Graphs: Representation of Graphs – Graph Traversals – Topological Sort – Shortest Path Algorithms: Dijkstra's Algorithm – Minimum Spanning Tree: Prim's and Kruskal's Algorithm.

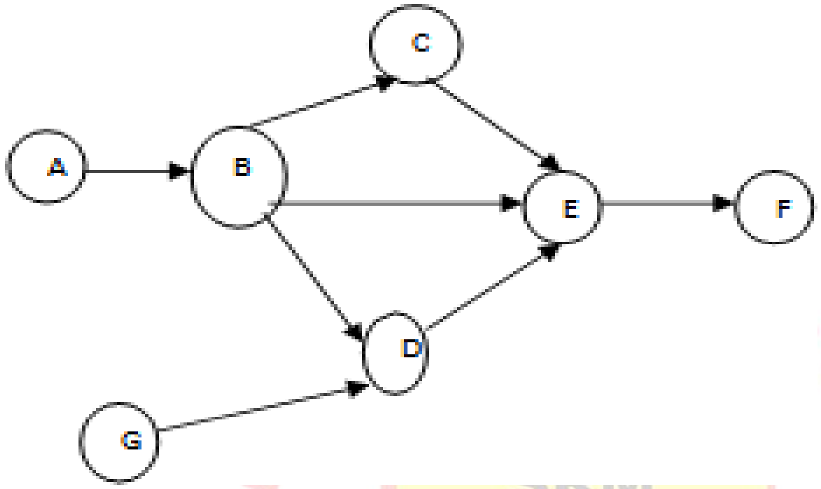
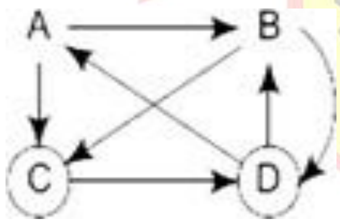
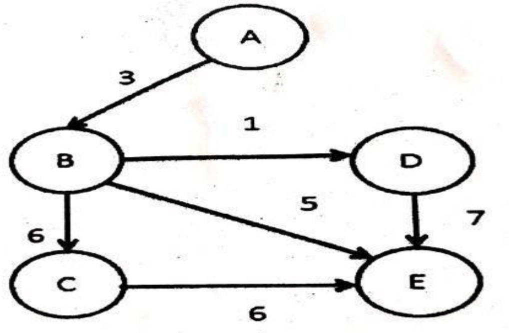
PART-A

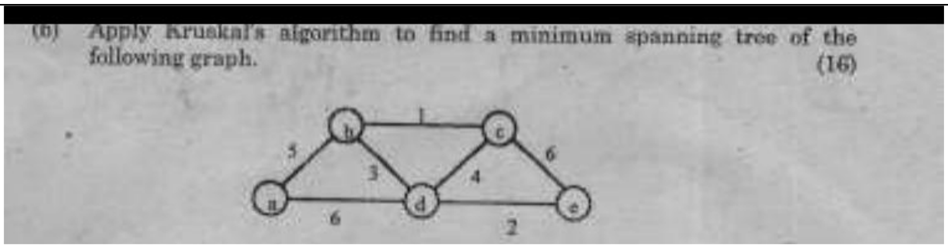
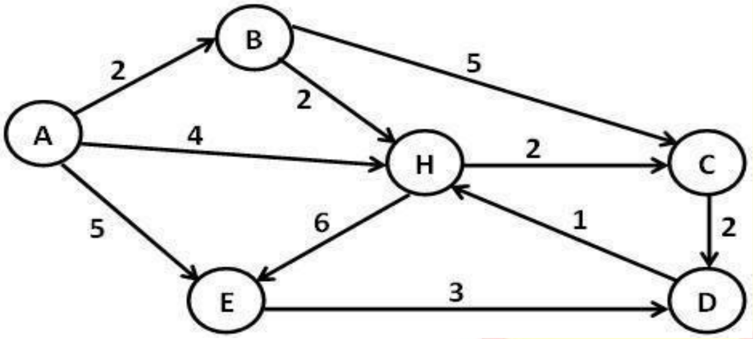
Q.No.	Question	Level	Competence
1	Define Heap sort?	BTL 1	Remember
2	Define Quick Sort.	BTL 2	Understand

3	What is the difference between quicksort and merge sort?	BTL 2	Understand
4	Define graph.	BTL 2	Understand
5	Create an undirected graph and its adjacency matrix for 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)}	BTL 2	Understand
6	What is meant by bi-connected graph?	BTL 1	Remember
7	Give the purpose of Dijkstra's algorithm.	BTL 2	Understand
8	Differentiate cyclic and acyclic graph	BTL 1	Remember
9	Classify strongly connected and weakly connected graph.	BTL 1	Remember
10	What is an articulation point? Give example.	BTL 1	Remember
11	What are the representations of the graph?	BTL 1	Remember
12	Define minimum spanning tree. Give an example	BTL 1	Remember
13	State the principle of Topological sorting.	BTL 1	Remember
14	Explain procedure for Depth first search algorithm.	BTL 2	Understand
15	What is Dynamic programming technique? Explain it with an example.	BTL 2	Understand
16	Prove that the number of edges in a complete graph of n vertices in n(n-1)/2.	BTL 2	Understand
17	Assess the minimum number spanning tree possible for a completegraph with n vertices.	BTL 2	Understand
18	Give two applications of graphs.	BTL 2	Understand
19	What is visiting and traversing in a graph?	BTL 1	Remember
20	When is a graph said to be weakly connected?	BTL 2	Understand
21	What is Greedy method? Give an example.	BTL 1	Remember
22	What is in-degree of a graph. Give suitable example.	BTL 2	Understand
23	What is meant by out-degree of a graph?	BTL 1	Remember
24	What are the two basic parts of Heap sort?	BTL2	Understand

PART-B

Q.No.	Questions	Marks	Level	Competence
1	Explain in detail in merge sort give an example	16	BTL4	Analyze
2	Distinguish between Quick sort and Merge sort, and arrange the following numbers in increasing order using merge sort. (18, 29, 68, 32, 43, 37, 87, 24, 47, 50)	16	BTL3	Apply

3	Sort the following set of elements using merge sort: 12, 24, 8, 71, 4, 23, 6, 89, and 56.	16	BTL3	Apply
4	Explain the concept of heap sort with example?	16	BTL4	Analyze
5	Describe in detail about the following representations of a graph. i. Adjacency Matrix ii. Adjacency List	8 8	BTL5	Evaluate
6	i) Consider the given directed acyclic graph D. Sort the nodes D by applying topological sort on 'D'.  ii.Consider the graph given below and show its adjacency list in the memory. iii. 	8 8	BTL6	Create
7	Describe an appropriate algorithm to find the shortest path from 'A'to every other node of A for the given graph. 	16	BTL4	Analyze
8	i. Examine topological sorting of a graph G with suitable example. i. Explain Dynamic programming with suitable examples.	8 8	BTL3	Apply
9	Differentiate depth-first search and breadth-first search traversal of a graph with suitable examples.	16	BTL3	Apply
10	i. Explain with algorithm, How DFS be performed on an undirected graph.	10	BTL4	Analyze

	ii. Show the algorithm for finding connected components of an undirected graph using DFS, and derive the time complexity of the algorithm.	6		
11	Discuss an algorithm for Breadth first Search on a graph. Give an example based on the algorithm.	10 6	BTL4	Analyze
12	[redacted]  (b) Apply Kruskal's algorithm to find a minimum spanning tree of the following graph. (16) b c a d e 1 5 3 4 6 6 2	16	BTL4	Analyze
13	Develop an algorithm to compute the shortest path using Dijkstra's algorithm. Validate the algorithm with suitable example.	16	BTL6	Create
14	Explain the depth first approach of finding articulation points in a connected graph with necessary algorithm.	16	BTL6	Create
15	i. Write short notes on Bi-connectivity. ii. Express different types of graphs with example.	8 8	BTL3	Apply
16	Explain the various applications of graphs.	16	BTL3	Apply
17	Using Dijkstra's algorithm to find the shortest path from the source node A.  B 2 5 2 A 4 H 2 C 5 6 1 2 E 3 D	16	Create	BTL6

UNIT V - ALGORITHM DESIGN TECHNIQUES			
Greedy Algorithms: Huffman Codes – Divide and Conquer: Merge Sort – Dynamic Programming: Using a Table instead of Recursion – Ordering Matrix Multiplications – Introduction to NP Completeness			
PART-A			
Q.No.	**Question**	**Level**	**Competence**
1	Mention different algorithm design techniques.	BTL 1	Remember
2	Mention the two properties of sorting algorithms.	BTL 2	Understand
3	State greedy technique.	BTL 2	Understand
4	Define dynamic programming.	BTL 2	Understand
5	Define divide and conquer design technique	BTL 2	Understand
6	State the Principle of Optimality.	BTL 1	Remember

7	What is Huffman trees?	BTL 2	Understand
8	List the advantage of Huffman’s encoding?	BTL 1	Remember
9	What do you mean by Huffman code?	BTL 1	Remember
10	What is greedy method?	BTL 1	Remember
11	What do you mean by row major and column major?	BTL 1	Remember
12	Show the general procedure of dynamic programming.	BTL 1	Remember
13	Define Kruskal Algorithm.	BTL 1	Remember
14	List the features of dynamic programming?	BTL 2	Understand
15	How Dynamic Programming is used to solve Knapsack Problem?	BTL 2	Understand
16	List two major parts in Huffman Coding.	BTL 2	Understand
17	Define NP Problem.	BTL 2	Understand
18	Differentiate P and NP.	BTL 2	Understand
19	How NP-hard problems are different from NP-Complete?	BTL 1	Remember
20	Give some examples of non-polynomial problem.	BTL 2	Understand
21	Give some examples of Polynomial problem.	BTL 1	Remember
22	Define non-polynomial problem.	BTL 2	Understand
23	Define Polynomial (P) problem.	BTL 1	Remember
24	On what basis problems are classified?	BTL2	Understand

PART-B

Q.No.	Question	Marks	Level	Competence
1	Discuss briefly the sequence of steps in designing and analyzing an algorithm.	16	BTL4	Analyze
2	Explain in detail about divide and conquer approach.	16	BTL4	Analyze
3	Describe in detail about merge sort with an example.	16	BTL4	Analyze
4	Explain in detail about Greedy Algorithms.	16	BTL4	Analyze
5	Explain in detail about Dynamic Programming.	16	BTL4	Analyze
6	Explain Kruskal's Algorithm.	16	BTL4	Analyze
7	Illustrate Prim's Algorithm in detail with an example.	16	BTL3	Apply
8	Illustrate Greedy Method with an example.	16	BTL3	Apply
9	Explain in detail that what does dynamic programming have in common with divide-and-Conquer?	16	BTL4	Analyze
10	Explain how Floyd’s Algorithm works.	16	BTL4	Analyze

11	Illustrate Huffman code algorithm and derive its complexity.	16	BTL3	Apply
12	Outline the Dynamic Programming approach to solve the Optimal Binary Search Tree problem and analyze it time complexity.	16	BTL4	Analyze
13	Explain in detail two major parts in Huffman Coding.	16	BTL4	Analyze
14	Explain Steps to build Huffman Tree with an example.	16	BTL4	Analyze
15	Explain how Matrix – chain Multiplication problem can be solved using dynamic programming with suitable example.	16	BTL4	Analyze
16	Describe in detail about P and NP problems.	16	BTL4	Analyze
17	Illustrate NP hard problems in detail with an example.	16	BTL3	Apply