VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

COMPUTER SCIENCE AND ENGINEERING

QUESTION BANK

IV SEMESTER

CS8451 - DESIGN AND ANALYSIS OF ALGORITHMS

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Prepared by

Dr. V. Dhanakoti, Associate Professor
Dr. M. Senthil Kumar, Associate Professor
Mr. N. Leo Bright Tennisson, Assistant Professor

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SUBJECT CODE/NAME: CS8451 DESIGN AND ANALYSIS OF ALGORITHMS

SEM / YEAR: IV/II

UNIT I - INTRODUCTION			
Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and their properties. Analysis Framework – Empirical analysis - Mathematical analysis for Recursive and Non-recursive algorithms - Visualization			
PART - A			
Q. No	**Questions**	**BT Level**	**Competence**
1.	**Define** time complexity and space complexity. Write an algorithm for adding n natural numbers and find the space required by that algorithm	Remember	BTL-1
2.	**List the steps** to write an Algorithm	Remember	BTL-1
3.	**Illustrate** an algorithm for (i) Finding factorial of n number. (ii).Sorting the Elements.	Apply	BTL-3
4.	**Evaluate** an algorithm for computing gcd(m,n) using Euclid's algorithm	Evaluate	BTL-5
5.	**Design** the equality gcd(m,n)=gcd(n,m mod n) for every pair of positive integers m and n.	Create	BTL-6
6.	**List out** the steps that need to design an algorithm.	Remember	BTL-1
7.	**Examine** an algorithm to convert a binary number to a decimal number.	Apply	BTL-3
8.	**Identify how** you will measure input size of algorithms.	Remember	BTL-1
9.	Explain how many algorithms can you write for solving **find** the prime numbers. **Compare** which is the simplest and the most efficient.	Analyze	BTL-4
10.	**Explain** the various types of problems that can be solved using algorithm.	Analyze	BTL-4
11.	**Apply** the common technique for proving the correctness of an algorithm.	Apply	BTL-3

12.	**Define** the term Algorithm	Remember	BTL-1
13.	**Define** Big 'Oh' notation.	Remember	BTL-1
14.	**Formulate** the order of growth. Compare the order of growth n! and 2^n.	Create	BTL-6
15.	**Differentiate** between Best, average and worst case efficiency.	Understand	BTL-2
16.	**Discuss** the concepts of asymptotic notations and its properties.	Understand	BTL-2
17.	**Analyze** the order of growth. (i).F(n) = $2n^2$ + 5 and g(n) = 7n. Use the Ω (g(n)) notation.	Analyze	BTL-4
18.	**Evaluate** the recurrence relations. (i). x (n) = x (n-1) + 5 for n>1. (ii). X (n) = x(n/3) +1 for n >1,x(1) =1. (Solve for n = 3^k)	Evaluate	BTL-5
19.	**Discuss** the General plan for analyzing efficiency of Non recursive & Recursive algorithms	Understand	BTL-2
20.	**Discuss** the following questions by consider the definition based algorithm for adding two n by n matrices. 1. What is basic operation? 2. How many times it is performed as a function of the matrix order n? 3. How many times it is performed as a function of the total number of elements in the input matrices?	Understand	BTL-2

	PART - B		
1.	**Give** the General Plan for Analyzing the Time Efficiency of Recursive Algorithms and use recurrence to find number of moves for Towers of Hanoi problem n (13)	Understand	BTL-2

2.	(i) Consider the following algorithm for the searching problem. (8)
	ALGORITHM Linear search (A[0,…….n-1],key)
	// Searches an array for a key value by Linear search.
	//Input: Array A [0…..n-1] of values and a key value to search.
	//Output: Returns index if search is successful.
	For i← 0 to n-1 do
	If [key== A[i])
	Return i.
	a) **Apply** this algorithm to search the list 10, 92,38,74,56,19,82,37 for a key value 74.
	b) Is this algorithm efficient?
	c) When can this algorithm be used?
		Apply	BTL-3

	(ii) What are the most important problem types are used to illustrate different algorithm design techniques and methods of algorithm analysis. (5)		

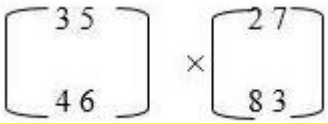
3.	If you have to solve the searching problem for list of n numbers, how can you take advantages of the fact that the list is known to be sorted? Give separate Answers for i)Lists represented as arrays. (7) ii)Lists represented as Linked lists. (6) **Create** the time complexities involved in the analysis of both the algorithms.	Create	BTL-6
4.	For each of the following algorithms, i) Compute n! (7) **ii)Asses & find** the largest element in a list of n numbers with respect to the following conditions: (6) (a). A natural size metric for its inputs. (b). Its basic operation. (c). Whether the basic operation count can be different for inputs of the same sizes.	Analyze	BTL-5
5.	**(i)Discuss** in detail about the worst case, best case and Average case efficiencies of sequential search function. (7) (ii)**Discuss** how much the function value will change if the sequential search function's argument is increased. (6)	Understand	BTL-2
6.	(i).**Compare** the worst and Average case analysis of binary search using suitable illustrations. (8) (ii). **Explain** the drawbacks in using the standard unit of time, to measure the runtime of an algorithm(5)	Analyze	BTL-4
7.	Illustrate briefly on Big oh Notation ,Omega Notation and Theta Notations .Give Examples. (13)	Evaluate	BTL-3
8.	**(i)Define a** Mathematical analysis of recursive algorithms. (4) (ii)**Examine** the efficiency of factorial of some number n with the help of General plan. (9)	Remember	BTL-1
9.	**(i)Define a** Mathematical analysis of Non-recursive algorithms. (5) (ii) **Tell** about the efficiency of finding the element with maximum value in a given Array with the help of General plan.(8)	Remember	BTL-1
10.	**(i)Define** Towers of Hanoi problem. (3) (ii)**Describe** the time complexity of Towers of Hanoi problem.(10)	Remember	BTL-1
11.	**Explain** in detail about Analysis Framework with a suitable example (13)	Analyze	BTL-4
12.	**Analyze** the recursive and non-recursive versions of the factorial function. i)Examine how much each function requires as 'n'becomes large. (7) ii) Find the time complexity and space complexity (6)	Analyze	BTL-4
13.	**(i) Label** the algorithm of fundamental problem solving. (7) **(ii)** Show the useful property involving the asymptotic notations. (6)	Apply	BTL-1
14.	**Discuss** in detail about the fundamentals of algorithmic problem solving. (13)	Understand	BTL-2

PART C			
1.	**Evaluate** the following equalities are correct: i)$5n^2-6n=\Theta(n^2)$ (4) ii)$n!=O(n^n)$ (4) iii)$n^3+10^6n^2=\Theta(n^3)$ (4) iv)$2n^2 2^n+n \log n=\Theta(n^2 2^n)$ (3)	Evaluate	BTL-5
2.	**Evaluate** the following recurrences completely i) T( ) = ∑ $_{=1}{}^{-1}$ (i) + 1≥ 2Given T(n) = 1 if n = 1 (5) ii) T(n) = 5T(n-2) – 6T (n – 2) (5) iii)T(n)=2T(n/2) + nlogn (5)	Evaluate	BTL-5
3.	**Design** a consecutive integer checking algorithm and middle-school procedure algorithm.	Create	BTL-6
4.	Consider the problem of finding the smallest and largest elements in an array of n numbers. i) **Design** a presorting-based algorithm for solving this problem and determine its efficiency class (7) ii) Compare the efficiency of the three algorithms: (8) a)The Brute-force algorithm b)This presorting –based algorithm and c) The divide-and conquer algorithm.	Create	BTL-6

UNIT II - BRUTE FORCE AND DIVIDE-AND-CONQUE			
Brute Force – Computing an – String Matching - Closest-Pair and Convex-Hull Problems - Exhaustive Search - Travelling Salesman Problem - Knapsack Problem - Assignment problem. Divide and Conquer Methodology – Binary Search – Merge sort – Quick sort – Heap Sort - Multiplication of Large Integers – Closest-Pair and Convex - Hull Problems.			
PART - A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	**State** Master's theorem	Remember	BTL-1
2.	**Examine** a brute force algorithm for string matching problem.	Apply	BTL-3
3.	Give an example of a text of length n and a pattern of length m that constitutes a worst case input for the brute force string matching algorithm. **Formulate** and find how many character comparisons will be made for such input.	Create	BTL-6
4.	**Define** closest pair problem.	Remember	BTL-1
5.	**Examine** a brute force algorithm for counting the number of vowels in a given text.	Apply	BTL-3
6.	**Define** convex hull problem.	Remember	BTL-1
7.	Find the number of **comparisons** required to search for '6' in the given Sequence of numbers: 10, 19, 7, 9, 6, 15.	Analyze	BTL-4

8.	**Define** the term exhaustive search.	Remember	BTL-1
9.	**Describe the concepts of** Travelling Salesman Problem.	Remember	BTL-1
10.	**Define** Assignment problem (Hungarian method).	Remember	BTL-1
11.	**Analyze** the time efficiency and drawbacks of merge sort algorithm.	Analyze	BTL-4
12.	**Explain** the advantages and disadvantages of binary search algorithm.	Analyze	BTL-4
13.	**Differentiate** Sequential technique from binary search technique.	Understand	BTL-2
14.	Is merge sort stable sorting algorithm? **Justify** your answer.	Apply	BTL-3
15.	**Describe** brute force approach. What are the advantages and disadvantages of this approach?	Understand	BTL-2
16.	**Discuss** the three processing steps in Quick sort.	Understand	BTL-2
17.	Multiply the numbers 54 and 45. **Evaluate** by using multiplication of Large integer concepts.	Evaluate	BTL-5
18.	Give an example problem that cannot be solved by a Brute force approach and also how to **decide**?	Evaluate	BTL-5
19.	Define and **design** the Convex set. **Invent** the sets such are convex. a) Star b) Cone C) Pentagon D) Semicircle.	Create	BTL-6
20.	**Discuss** the recurrence equation for the worst case behavior of merge sort.	Understand	BTL-2
	PART – B		
1.	**Explain the concepts** of the following. (i)Brute force string matching Algorithm. (7) (ii)Closest pair and convex hull problems by brute force. (6)	Evaluate	BTL-5
2.	(i)List out the procedures to solve travelling salesman problem. (7) (ii)Describe the Knapsack problem by using Exhaustive search. (6)	Remember	BTL-1
3.	Find and **Analyze** the optimal solution for the assignment problem given below. (13)	Analyze	BTL-4
4.	(i) **Discuss** the topic on merge sort. Illustrate the algorithm with numeric Example. **Predict** the complete analysis for the same. (8) (ii)Write the algorithm to perform Binary search and compute its run time complexity. (5)	Understand	BTL-2
5.	**(i)Define** Assignment problem **.Examine** the optimal solution	Remember	BTL-1

Job / Person	Job 1	Job 2	Job 3	Job 4
Person	4	3	8	6
Person	5	7	2	4
Person	16	9	3	1
Person	2	5	3	7

	for the assignment problem with one example. (7) (ii)Explain convex hull problem and the solution involved behind it. (6)		
6.	(i)**Design** a Quick sort algorithm (5) (ii) Develop Best, worst and Average case analysis for Quicksort method. (8)	Create	BTL-6
7.	**Examine** that the procedure SEARCH of binary search algorithm gives the Smallest possible expected search time if all elements in the universal set are equally likely to be sought. (13)	Remember	BTL-1
8.	(i)**Solve** 2138 × 4967 by applying the Divide and Conquer method. (8) (ii)Analyze the time and space complexity of Divide and conquer methodology. (5)	Apply	BTL-3
9.	(i)**Apply** Strassen's matrix algorithm to compute. (7)  (ii) How to **show** the average time complexity for merge sort algorithm. (6)	Apply	BTL-3
10.	**(i) Discuss** in detail about the closest pair and convex hull problems by using Divide and conquer method. (7) (ii)Write the KMP string matching algorithm for finding a pattern on a text, and analyze the algorithm. (6)	Understand	BTL-2
11.	**(i)Describe** in detail about divide and conquer strategy. (6) (ii)Explain the binary search with suitable example problem. (7)	Understand	BTL-2
12.	**Analyze** and Write an algorithm to sort a given list of elements using merge sort .Show the operation of the algorithm, on the list 38,27,43,3,9,82,10. (13)	Analyze	BTL-4
13.	i)**Differentiate** sequential search from binary search technique. (7) ii)**Write** an algorithm for Quicksort and write its time complexity with example list are 5,3,1,9,8,2,4,7. (6)	Analyze	BTL-4
14.	**Examine** in detail about Exhaustive search techniques. (13)	Remember	BTL-1

PART – C			
1.	How exhaustive search method uses Brute force approach to **evaluate** various problems and find whether the given string follows the specified pattern and return 0 or 1 accordingly. Examples: 1)Pattern "abba" input: "redblueredblue" should return 1 2)Pattern "aaaa" input: "asdasdasdasd" should return 1 3)Pattern "aabb" input: "xyzabcxyzabc" " should return 0	Evaluate	BTL-5

2.	**Deduce** the operation of binary search algorithm for the input -15, -6 , 0, 7 , 9, 23, 54, 82, 101,112, 125,131,142,151 if you are searching for the element 9.	Evaluate	BTL-5
3.	**Compose** and give an example of an algorithm that should not be considered an application of the brute-force approach.	Create	BTL-6
4.	**Formulate** and give an example of a text of length *n* and a pattern of length *m* that constitutes a worst-case input for the brute-force string-matching algorithm. Exactly how many character comparisons will be made for such input?	Create	BTL-6

UNIT III - DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE

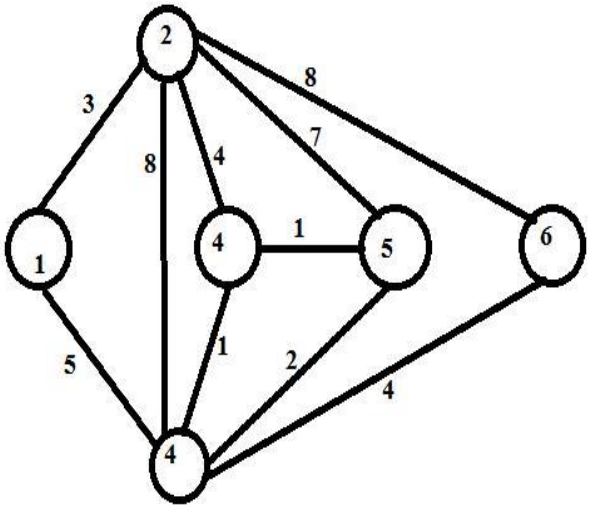
Dynamic programming – Principle of optimality - Coin changing problem, Computing a Binomial Coefficient – Floyd's algorithm – Multi stage graph - Optimal Binary Search Trees – Knapsack Problem and Memory functions. Greedy Technique – Container loading problem - Prim's algorithm and Kruskal's Algorithm – 0/1 Knapsack problem, Optimal Merge pattern - Huffman Trees.

PART – A

Q. No	Questions	BT Level	Competence
1.	**How** is a transportation network represented?	Remember	BTL-1
2.	**Describe** the method to construct an optimal binary search tree	Remember	BTL-1
3.	**Define** Transitive closure of a directed graph.	Remember	BTL-1
4.	**Describe** the general principle of Greedy algorithm.	Remember	BTL-1
5.	**Compare** Divide & Conquer and Dynamic Programming.	Analyze	BTL-4
6.	**Discover** the pseudo code of the Warshall's algorithm.	Apply	BTL-3
7.	**Summarize** feasible and optimal solution.	Understand	BTL-2
8.	**Contrast** Greedy algorithm and Dynamic programming.	Analyze	BTL-4
9.	**List** the properties of Dynamic programming approach	Remember	BTL-1
10.	**Define** the minimum spanning tree problem	Remember	BTL-1
11.	**Explain** how the Binomial coefficient is computed.	Evaluate	BTL-5
12.	**Estimate** the time and space complexity for Warshall's algorithm.	Understand	BTL-2
13.	**Demonstrate** the obstacles in constructing a minimum spanning tree by an exhaustive search.	Apply	BTL-3
14.	**Estimate** the space and time complexity of a prim's algorithm.	Understand	BTL-2

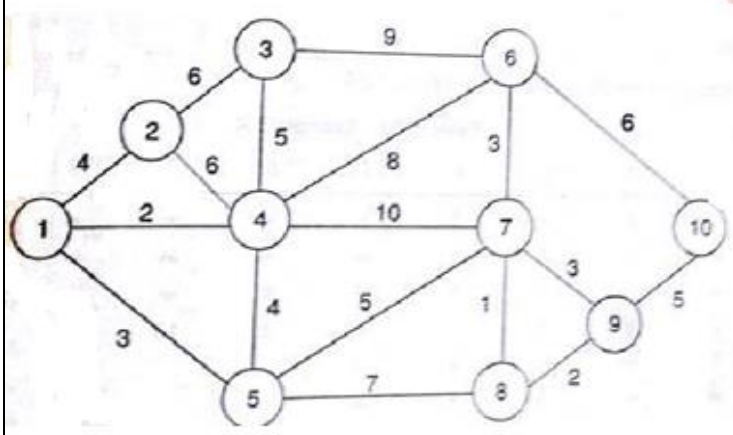
15.	**Analyze** the time complexity of optimal Binary search Tree algorithm.	Analyze	BTL-4
16.	**Show** an algorithm to make for 1655 using the greedy strategy. The coins available are {1000, 500, 100, 50, 20, 10, 5}**.**	Apply	BTL-3
17.	**Distinguish** prim's and Kruskal's algorithm.	Understand	BTL-2
18.	**Summarize** Huffman trees and its applications.	Evaluate	BTL-5
19.	**Integrate** Minimum spanning tree concepts and Prim's algorithm.	Create	BTL-6
20.	**Develop** an algorithm for memory function knapsack problem.	Create	BTL-6

PART - B

1.	Consider the following distance network. a) Write the floyd's algorithm and generate the final distance matrix. (7) b) **Analyze** the shortest path and the corresponding distance from the source node to the destination node as indicated in each of the cases 1-6, 5-1 and 5-2 (6)  	Analyze	BTL-4
2.	**i) Illustrate** all-pair shortest path problem algorithm. (4) **(ii)Calculate** the all-pair shortest path problem for the diagraph with the weighted matrix given below. (9)	Apply	BTL-3
3.	(i)**Describe** in detail about the Warshall's algorithm. (7) (ii)**Discuss** topic on Knapsack problem with memory functions. (6)	Understand	BTL-2
4.	**Describe** and compute binomial coefficient by the formula C(n, k) = C(n − 1, k − 1) +C(n − 1, k). (13)	Understand	BTL-2
5.	**Analyze** the algorithm by applying the following keys and	Analyze	BTL-4

	a	b	c	d
a	0	α	3	α
b	2	0	α	α
c	A	7	0	1
d	6	α	α	0

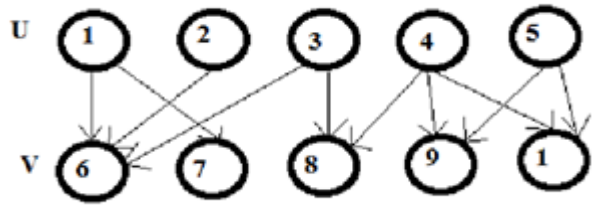
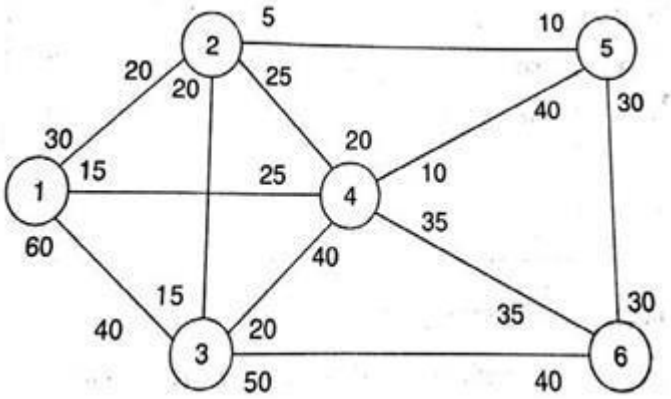
	probabilities to obtain the optimal binary tree. (13) Key: A | B | C | D Probability: 0.1 | 0.2 | 0.4 | 0.3		
6.	**a) Consider** 4 elements $a_1 < a_2 < a_3 < a_4$ with $q_0=0.25$, $q_1=3/16$, $q_2=q_3=q_4=1/16$, $P_1=1/4$, $P_2=1/8$, $P_3=P_4=1/16$. **b)** Construct the optimal binary search tree as a minimum cost tree. (7) **c)** Construct the table of values W_{ij}, C_{ij}, V_{ij} computed by the algorithm to compute the roots of optimal sub trees. (6)	Evaluate	BTL-5
7.	Plan the following instance of the 0/1, knapsack problem given the knapsack capacity in W=5 using dynamic programming and explain it. (13) Item | Weight | Value 1 | 4 | $10 2 | 3 | $20 3 | 2 | $15 4 | 5 | $25	Create	BTL-6
8.	**(i)Define** Huffman tree. **List** the types of Encoding in Huffman tree. (8) (ii)Write the Huffman's algorithm. Construct the Huffman's tree for the following data and obtain its Huffman code. (5) Character: A | B | C | D | E | _ (underscore) Probability: 0.5 | 0.35 | 0.5 | 0.1 | 0.4 | 0.2	Remember	BTL-1
9.	**(i)Describe** minimum spanning tree using Kruskal's algorithm with an example. (7) (ii)Comparison between Prim's and Kruskal's algorithm and identify the time complexity of those algorithms. (6)	Remember	BTL-1

10.	**(i)**Write and analyze the prim's algorithm. (5) **(ii)Describe** minimum spanning tree using Prim's algorithm. (8)  	Remember	BTL-1
11.	**(i)List** out the short notes on optimal binary search tree. (7) **(ii) Label** the optimization technique used for Warshall's algorithm. State the rules and assumptions which are implied behind that. (6)	Remember	BTL-1
12.	(i)Explain in detail about Huffman code (5) (ii)Let A= {l/119,m/96,c/247,g/283,h/72,f/77,k/92,j/19} be the letters and its frequency of distribution in a text file. **Analyze** a suitable Huffman coding to compress the data. (8)	Analyze	BTL-4
13.	**(i) Examine** Dijkstra's algorithm with a suitable example (9) **(ii)Illustrate** how the minimum-sum descent problem can be solved by Dijkstra's algorithm. (4)	Apply	BTL-3
14.	**Summarize** Knapsack and memory functions problem in detail. (13)	Understand	BTL-2
	PART – C		
1.	**Asses** and solve all-pair shortest path problem for the digraph with the weight matrix given below: A: 0, ∞, ∞, 3 B: 2, 0, ∞, ∞ C: ∞, 7, 0, 1 D: 6, ∞, ∞, 0	Evaluate	BTL-5

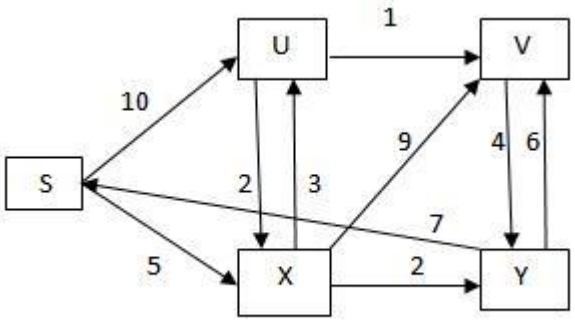
2.	Given the mobile numeric keypad.You can only press buttons that are up, left, right or down to the first number pressed to obtain the sequent numbers.You are not allowed to press bottom row corner buttons (i.e. * and #).Given a number N, how many key strokes will be involved to press the given number. What is the length of it? Which dynamic programming technique could be used to find solution for this? **Assess** each step with a help of a pseudo code and derive its time complexity.	Evaluate	BTL-5
3.	Apply Warshall's algorithm to find the transitive closure of the digraph defined by the following adjacency matrix $\begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$ i) Prove that the time efficiency of Warshall's algorithm is cubic (7) ii) **Explain** why the time efficiency of Warshall's algorithm is inferior to that of the traversal-based algorithm for sparse graphs represented by their adjacency lists. (8)	Create	BTL-6
4.	**Develop** and give an example of a graph or a digraph with negative weights for which Floyd's algorithm does not yield the correct result. (13)	Create	BTL-6

UNIT IV - ITERATIVE IMPROVEMENT			
The Simplex Method - The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs, Stable marriage Problem.			
PART - A			
Q. No	**Questions**	**BT Level**	**Competence**
1.	**Summarize** maximum cardinality matching.	Understand	BTL-2
2.	**Define** slack and surplus variable	Remember	BTL-1
3.	**Associate** Feasibility and optimality condition in simplex method.	Understand	BTL-2
4.	**Describe** Dual simplex method	Remember	BTL-1
5.	**Define** Basic variable.	Remember	BTL-1
6.	**Quote** extreme point theorem	Remember	BTL-1
7.	**Define** Network flow and cut.	Remember	BTL-1
8.	**Differentiate** Feasible and optimal solution.	Analyze	BTL-4
9.	**Define** bipartite graph	Remember	BTL-1

10.	**Discuss** the stable marriage problem.	Understand	BTL-2
11.	**Point out** the Max-flow algorithm	Analyze	BTL-4
12.	**Show** the Mathematical formulation to solve a max flow problem.	Apply	BTL-3
13.	**Summarize** the steps to print all edges of minimum cut.	Understand	BTL-2
14.	**Generalize** about the perfect matching in bipartite graphs.	Create	BTL-6
15.	**Compare** man-optimal and woman-optimal	Analyze	BTL-4
16.	**What if** the blocking pair concepts for marriage problem are chosen?	Create	BTL-6
17.	**Show** the requirements of a standard form to solve a Simplex method problem	Apply	BTL-3
18.	**Apply** Augmenting path concepts in Maximum flow problem.	Apply	BTL-3
19.	**Assess** the properties of stable marriage problem (Gale shapley algorithm).	Evaluate	BTL-5
20.	**Explain** about the articulation point in a graph.	Evaluate	BTL-5
	PART - B		
1.	**(i)Solve** the following LP problem using graphical method. (8) Maximize $Z = 6x_1 + 8x_2$ $5x_1+10x_2 \leq 60$ $4x_1+4x_2 \leq 40$ $x_1$and $x_2 \geq 0$ (ii). Write the procedure to initialize simplex which determines if a linear program is feasible or not (5)	Apply	BTL-3
2.	(i)**Design** Extreme Point theorem and generalize how it is used to find the boundary points. (5) (ii)Maximize the given equation. Use the Simplex method to the linear programming problem. (8) Max $Z = 3x + 5y$ Subject to $x + y \leq 8$ $x+ 3y \leq 12$	Create	BTL-6
3.	**Identify** the maximum value of Z in the following LP problem using Simplex method. (13) Max $Z = 10x_1 +15x_2 + 20x_3$ Subject to $2x_1 +4x_2 + 6x_3 \leq 24$ $3x_1 +9x_2 + 6x_3 \leq 30$ x_1 ,$x_2$and $x_3 \geq 0$.	Remember	BTL-1
4.	**(i)Discuss** the Ford-fulkerson algorithm for maximum flow problem. (7) (ii)Discuss the shortest –augmenting path algorithm. (6)	Understand	BTL-2

5.	**(i)Apply** the maximum-matching algorithm is the following bipartite graph. (7)  (ii) **Analyze** all edges that form the minimum cut, And also analyze the maximum flow problem. (6)	Apply& Analyze	BTL-3
6.	**(i)Analyze** about the stable marriage algorithm. (5) (ii)Consider an instance of the stable marriage problem given by the ranking matrix. (8) **A** **B** **C** **α** **1,3** **2,2** **3,1** **β** **3,1** **1,3** **2,2** **γ** **2,2** **3,1** **1,3** For each of its marriage matching's, indicate whether it is stable or not. For the unstable matching's, specify a blocking pair. For the stable matching's indicate whether they are man-optimal, woman-optimal or neither. (Assume that the greek and English letters denote the man and woman respectively).	Analyze	BTL-4
7.	**Consider** the pipe network shown as in figure showing the flow capacities between various pairs of locations in both ways. Find the maximal flow from node 1 to node 6. (13)  	Evaluate	BTL-5
8.	**(i)**Describe Max-flow problem. (7) **(ii)List out** the procedures needed to solve the Maximum flow problem by using matrix method. Explain each. (6)	Remember	BTL-1
9.	**(i)**Prove that the stable marriage algorithm terminates after no more than n^2 iterations with a stable marriage output (8) **(ii)Identify** the steps used in Stable marriage algorithm. Which steps are used in Men propose and Woman propose in detail. (5)	Remember	BTL-1

10.	(i)Describe the algorithm for maximum bipartite matching. (7) (ii)Find the maximal matching for the following graph: (6) A→{1,2,4}, B→{1},C→{2,3},D→{4,5},E→{3}.	Understand	BTL-2
11.	**Analyze** and apply the maximum matching algorithm for the bi-partite graph. (13) 1->{5,6} 2->{5} 3 ->{4,5}	Analyze	BTL-4
12.	**Examine** in detail about Iterative Improvement with an example. (13)	Remember	BTL-1
13.	**(i)**Discuss about the graphical method in detail. **(7)** **(ii)Summarize** in detail about the simplex algorithm methods. (6)	Understand	BTL-2
14.	**Analyze** and Solve the following linear programming problems geometrically. (7) **a.** maximize $3x+y$ subject to $-x + y \leq 1$ $2x + y \leq 4$ $x \geq 0, y \geq 0$ **b.** maximize $x+ 2y$ (6) subject to $4x \geq y$ $y \leq 3 + x$	Analyze	BTL-4

	PART – C		
1.	How do you **compute** a maximum flow for the following graph using Ford-Fulkerson method? 	Evaluate	BTL-5
2.	**Evaluate** and solve the following problem using simplex method: Maximize p= 2x+3y+z Subject to x+y+z<=40 2x+y-z>=10 -y+z>=10 where x>=0,y>=0,z>=0	Evaluate	BTL-5
3.	**Formulate** and prove following linear programming problem in two variables using geometric interpretation: maximize 3x + 5y subject to $x + y \leq 4$ $x + 3y \leq 6$	Create	BTL-6

	$x \geq 0, y \geq 0$.		
4.	**Design** an Extreme Point Theorem.	Create	BTL-6

UNIT V - COPING WITH THE LIMITATIONS OF ALGORITHM POWER

Lower - Bound Arguments - P, NP NP- Complete and NP Hard Problems. Backtracking – n-Queen problem - Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search - Assignment problem – Knapsack Problem – Travelling Salesman Problem - Approximation Algorithms for NP-Hard Problems – Travelling Salesman problem – Knapsack problem.

PART - A

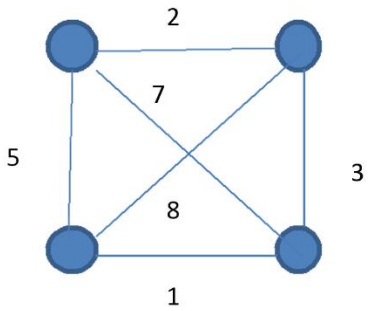
Q. No	Questions	BT Level	Competence
1.	**What** are tractable and non-tractable problems?	Remember	BTL-1
2.	**Compare** class P and class NP.	Analyze	BTL-4
3.	**Define** NP complete problem.	Remember	BTL-1
4.	**Discuss** the principle of backtracking.	Understand	BTL-2
5.	How is the accuracy of approximation algorithm **measured**?	Evaluate	BTL-5
6.	**Define** backtracking.	Remember	BTL-1
7.	What are the additional items required for branch and bound? **compare** backtracking technique.	Analyze	BTL-4
8.	**Point out** some examples of lower bound.	Analyze	BTL-4
9.	**Describe** the term heuristics	Remember	BTL-1
10.	**Define** Knapsack problem.	Remember	BTL-1
11.	**Discuss** the term best first branch bound.	Understand	BTL-2
12.	**State** whether backtracking always produces optimal	Create	BTL-6
13.	**Decide** the termination point of the search path in a state space tree of branch and bound algorithm.	Evaluate	BTL-5
14.	**Show** formal definition of the n-queens problem.	Apply	BTL-3
15.	**Describe** the term state space tree	Understand	BTL-2
16.	What is Hamiltonian path? **Generalize** that Hamiltonian cycle is an undirected graph.	Create	BTL-6
17.	What does NP-hard mean? **Demonstrate** approximation algorithm for NP hard problem.	Apply	BTL-3

18.	**How** is lower bound found by problem reduction?	Remember	BTL-1
19.	**Examine** the subset sum problem.	Apply	BTL-3
20.	**Give** some examples of P and NP problem.	Understand	BTL-2

PART - B

1.	What is Class NP? Discuss about any five problems for which no polynomial-time algorithm has been found (13)	Understand	BTL-2
2.	(i) **Evaluate** the subset sum problem with set as {3, 5, 6, 7, 2}and the sum =15.Derive all the subsets. (6) (ii) Evaluate the following instance of the knapsack problem y the branch and bound algorithm. Knapsack capacity W=10. (7) Item | Weight | Value 1 | 4 | $40 2 | 7 | $42 3 | 5 | $25 4 | 3 | $12	Evaluate	BTL-5
3.	**(i)Identify** an example for the best case input for the branch and bound algorithm for the assignment problem (6) (**ii)Describe** NP-hard and NP-completeness. (7)	Remember	BTL-1
4.	Using Back-Tracking enumerate how can you **solve** the following problems. (i)8-queens problem. (7) (ii)Hamiltonian circuit problem. (6)	Apply	BTL-3
5.	**(i)Discuss** in detail about decision tree algorithms. (6) (ii)Elaborate on the nearest-neighbor algorithm and multifragment-heuristic algorithm for TSP problem (7)	Understand	BTL-2
6.	**Describe** about the following. (i) Subset sum problem. (8) (ii)Limitations of Algorithm power. (5)	Remember	BTL-1
7.	(i) Using an example, **design** and prove that satisfiability of Boolean formula in 3-conjunctive normal form I NP-complete. (7) (ii)Design N-queens problem for n=6. (6)	Create	BTL-6
8.	(i) **Show** that the Hamiltonian path problem reduces to the Hamiltonian circuit problem and vice versa. (7) (ii)Analyze the approximation algorithm for travelling salesman problem. (6)	Apply	BTL-3
9.	(i)**Explain** how to implement an algorithm for Knapsack problem using NP-Hard approach. (7) (ii)Distinguish between the P and NP problems. (6)	Analyze	BTL-4

10.	**Describe** about the following: (i)Greedy algorithms for the knapsack problem. (4) (ii)Twice around the tree algorithm. (4) (iii)Multifragment-heuristic algorithm. (5)	Remember	BTL-1
11.	i) **Analyze** and explain elaborately on recursive backtracking algorithm. (8) ii)**Explain** the backtracking problem. (5)	Analyze	BTL-4
12.	There are 5 distinct numbers {1,2,5,6,8}.**Identify** the combinations of these numbers such that the sum is 9.Use the backtracking model to arrive at the solution. (13)	Remember	BTL-1
13.	**Explain** in detail about assignment problem. (13)	Remember	BTL-4
14.	**Estimate** the following instance of the knapsack by branch and bound algorithm. (13) **Item** / **Weight** / **Values** 1 / 10 / $100 2 / 7 / $63 3 / 8 / $56 4 / 4 / $12	Apply	BTL-2

PART – C			
1.	Let w={5,7,10,12,15,18,20} and m=35.**Compute** all possible subset of w whose sum is equivalent to m. Draw the portion of state space tree for this problem.	Evaluate	BTL-5
2.	With an example, **summarize** how the branch and bound technique is used to solve 0/1 knapsack problem.	Evaluate	BTL-5
3.	**Design** Branch and Bound algorithm to solve the Travelling Salesman problem for the following graph.  	Create	BTL-6
4.	**Generate** all permutations of A={1,2,3,4} and d=9 by backtracking.	Create	BTL-6