RV College of Engineering®
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

Go, change the world

Academic year 2024-2025 (Even Sem)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Date	01st April 2025	Maximum Marks	50+10
Course Code	**CD343AI**	Duration	90+30
Sem	IV	CIE I	
UG		Faculty: **CS:** HKK, KCG, SB, JS, ASP, **CY:** ARA, **CD:** CRM, **IS:** AKB, SWS, **AIML:** SAK, RRM	

Design and Analysis of Algorithms

(Common to CS/CD/CY/IS/AIML)

Note: - Answer all the questions.

S. No	Part A	M	BT	CO
1.1	**Analyze** the worst-case time complexity of a modified Quicksort when the median (found in O(n) time) is always chosen as the pivot.	01	4	3

1.2	**Derive T(n):**
	`fun(int n) {`
	`if(n==1) return;`
	`else { for (int i=1; i<=n; i++)`
	`for (int j=1; j<=n; j++)`
	`printf ("daa");`
	`fun(n-3);`
	`}`
	`}`
		01	4	2

1.3	Find the total **number of swaps** in the 3rd pass of Bubble Sort for [7, 2, 5, 1, 9].	02	3	1
1.4	Apply and solve using the **Master Theorem:** i) $T(n)=3T(n/4) + n \log n$ ii) $T(n)=0.3T(n/2) + ½$	02	3	1

1.5	**Derive T(n):**
	`for(i=n/2; i<=n; i++)`
	`for(j=1; j<=n; j=2*j)`
	`for(k=1; k<=n; j=k*2)`
	`print ("rvce")`
		02	4	2

1.6	Compare the growth of ½ n (n − 1) and n^2 using **limits**	02	3	2
	Part B			
2. a	Design a recursive algorithm for computing 2^n for any nonnegative integer n that is based on the formula $2^n = 2^{n-1} + 2^{n-1}$. Set up a recurrence relation for the number of additions made by the algorithm and solve it. Draw a tree of recursive calls for this algorithm and count the number of calls made by the algorithm. Is it a good algorithm for solving this problem?	05	6	3

2. b	You have **5 jars of pills**. Each pill weighs 10g, except for one jar where pills weigh 9g. Using a weighing scale, design an algorithm to identify the contaminated jar and analyze its efficiency.	05	6	3
3. a	Write the **selection sort** algorithm and analyze its **time complexity**.	05	4	2
3. b	Derive the time complexity of **Strassen's algorithm** and compare it with the conventional $O(n^3)$ matrix multiplication.	05	5	2
4	Write the **MERGESORT** algorithm/s. Derive T(n) and solve the recurrence using **back substitution method**.	10	4	2
5	Detective Alex is analyzing security footage of a warehouse where crates are supposed to be arranged in ascending order of their serial numbers. However, the footage reveals that some crates are misplaced, creating 'disruptions' in the order. To uncover how disorganized the warehouse is, Alex wants to count how many such disruptions (**inversions**) exist in the sequence. **Design** an efficient algorithm to count these inversions and **analyze** its time complexity.	10	6	3
6	Write **Quick Sort Algorithm** and apply the algorithm for following set of characters: **S = {A, D, S, O, R, P, T, I, V, E}** Consider the **first character as the pivot** in each partitioning step. Show all steps in detail and draw the recursion tree.	10	3	1

****

BT-Blooms Taxonomy, CO-Course Outcomes, M-Marks

Marks Distribution	Particulars		CO1	CO2	CO3	CO4	CO5	CO6	L1	L2	L3	L4	L5	L6
	Quiz/ Test	Max Marks	14	25	21	-	-	-	-	-	16	19	5	20

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Apply knowledge of computing and mathematics to algorithm analysis and design.
CO 2	Analyze a problem and identify the computing requirements appropriate for a solution.
CO 3	Apply algorithmic principles and computer science theory to the modeling for evaluation of computer-based solutions in a way that demonstrates comprehension of the trade-offs involved in design choices.
CO 4	Investigate and use optimal design techniques, development principles, skills and tools in the construction of software solutions of varying complexity.
CO 5	Demonstrate critical, innovative thinking, and display competence in solving engineering problems.
CO 6	Exhibit effective communication and engage in continuing professional development through experiential learning.

RV College of Engineering®
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

Go, change the world

Academic year 2024-2025 (Even Sem)

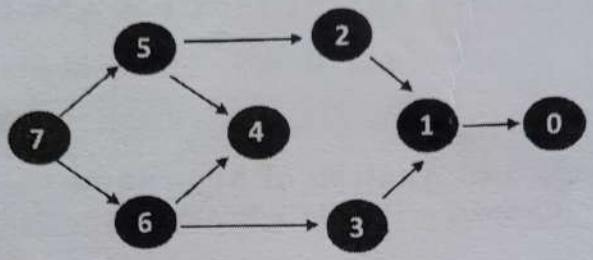
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Date: May 2025	**CIE II**	Maximum Marks: 50 + 10
Course Code: CD343AI	Sem: 4th UG	Duration: 120 Minutes
Design and Analysis of Algorithms **(Common to CS/CD/CY/IS/AIML)**		

Note: - Answer all the questions.

S.No	Part A	M	BT	CO
1.1	_____ and _____ are examples of sorting algorithms that can achieve linear time complexity under certain conditions.	02	1	1
1.2	Consider the pattern 00001 and a binary text consisting of 1000 zeros (000...0). Using the Boyer-Moore algorithm, analyze and calculate the number of character comparisons made during the pattern search.	02	3	2
1.3	Assuming that the set of possible list values is {a, b, c, d}, sort the following list in alphabetical order by the distribution-counting algorithm: b, c, d, c, b, a, a, b.	02	3	3
1.4	How can you determine the number of paths of length two between any two vertices in a graph using its adjacency matrix? Provide an example to illustrate this process.	02	3	3
1.5	Consider the problem of searching for genes in DNA sequences using Horspool's algorithm. A DNA sequence is represented by a text on the alphabet {A, C, G, T}, and the gene or gene segment is the pattern. Construct the shift table for the following gene segment of a chromosome TCCTATTCTT	01	3	3
1.6	Justify why is Binary search not considered a good example of a pre-sorting technique.	01	3	3
	Part B			
1	You are given the results of a completed round-robin tournament in which n teams played each other exactly once. Each game ended with a victory for one of the teams, and these results are represented in the form of a directed graph (digraph a) — where an edge from team U to team V indicates that team U defeated team V. Design and write an algorithm using Depth First Search(DFS) to list the teams in a sequence such that no team in the list has lost to the team immediately after it. Analyze the time efficiency of your algorithm. Then, apply your algorithm to digraph (a) and show the step-by-step solution.	10	3	4

Academic year 2024-2025 (Even Sem)

	 Fig. a			
2 a	Design a decrease-by-one algorithm for generating the power set of a set of n elements. (The power set of a set S is the set of all the subsets of S, including the empty set and S itself.)	5	3	4
2 b	Design a presorting-based algorithm for computing the mode in a given list of numbers and determine its efficiency.	5	2	3
3 a	Write the algorithm for Sorting by Comparison Counting and apply it to the following list of elements: 62, 31, 84, 96, 19, 47. Show the complete trace of the sorting process, including the count array and the resulting sorted list.	05	3	4
3 b	Consider the problem of finding the smallest and largest elements in an array of n numbers. Design a presorting-based algorithm for solving this problem and determine its efficiency class.	05	2	4
4	Write the Heap Sort algorithm along with the heapify procedure used to maintain the max-heap property. Construct a Max Heap using bottom-up heap construction for the following list of elements 2, 9, 7, 6, 5, 8. Show the complete trace of the heap construction pictorially at each step. Briefly discuss the time complexity of Heap Sort algorithm.	10	3	3
5	Write the pseudocode for Horspool's algorithm to search for the pattern in the text. Summarize the efficiency of the algorithm in comparison with brute force approach and its Boyer-Moore algorithm. Demonstrate Brute force, Horspool and its Boyer-Moore approach for following example. Text: ababcababcabc Pattern: abc	10	3	2

BT-Blooms Taxonomy, CO-Course Outcomes, M-Marks

Marks Distribution	Particulars		CO1	CO2	CO3	CO4	CO5	L1	L2	L3	L4	L5	L6
	Quiz/ Test	Max Marks	02	12	21	25		2	10	48			

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Apply knowledge of computing and mathematics to algorithm analysis and design.
CO 2	Analyze a problem and identify the computing requirements appropriate for a solution.
CO 3	Apply algorithmic principles and computer science theory to the modeling for evaluation of computer-based solutions in a way that demonstrates comprehension of the trade-offs involved in design choices.
CO 4	Investigate and use optimal design techniques, development principles, skills and tools in the construction of software solutions of varying complexity.
CO 5	Demonstrate critical, innovative thinking, and display competence in solving engineering problems.
CO 6	Exhibit effective communication and engage in continuing professional development through experiential learning.

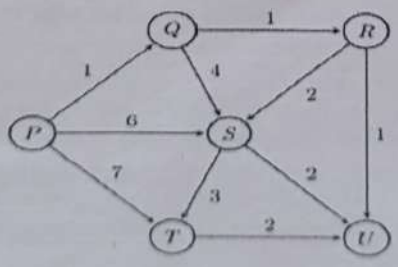
Academic year 2024-2025 (Even Sem)

DEPARTMENT OF **COMPUTER SCIENCE & ENGINEERING**

Date: June 2025	**Improvement Test**	Maximum Marks: 10 + 50
Course Code: CD343AI	Sem: 4th UG	Duration: 120 Minutes

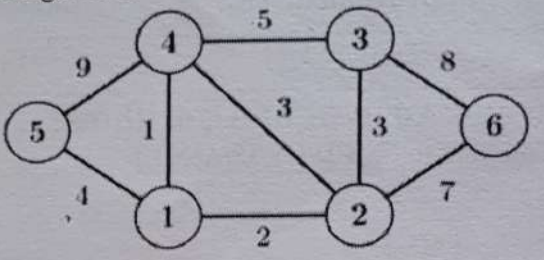
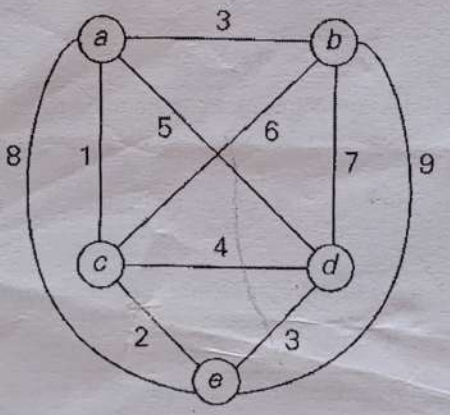
Design and Analysis of Algorithms
(Common to CS/CD/CY/IS/AIML)

Note: - Answer all the questions.

S.No	Part A	M	BT	CO
1.1	Write two important differences between backtracking and branch & bound design techniques.	02	1	2
1.2	A networking company uses a compression technique to encode the message before transmitting over the network. Suppose the message contains the following characters with their frequency: Char: a 5, b 9, c 12, d 13, e 16, f 45 frequency Encode word "**dead**".	02	2	3
1.3	What are promising and non-promising nodes in state space tree?	02	1	1
1.4	State assignment problem. Which design techniques can be used to solve it?	02	1	1
1.5	A problem that contains _____ subproblems, where the same subproblem is solved multiple times, is a good candidate for dynamic programming.	01	1	2
1.6	Which type of search is typically used in the branch and bound algorithm?	01	1	2
	Part B			
1	Using Dynamic Programming, solve the given instance of 0/1 Knapsack problem. Consider the capacity of Knapsack (m) = 5. Write the algorithm. **Item** 1 2 3 4 **Weight** 2 1 3 2 **Profit** 12 10 29 15	10	3	5
2	Write Dijkstra's algorithm and apply it to find shortest path from vertex '**P**'. 	10	3	2

Go, change the wo

Academic year 2024-2025 (Even Sem)

3	Apply Prim's algorithm to obtain a minimum cost spanning tree for the given graph. Write the algorithm. 	10	3	3
4	Apply Backtracking technique to solve the Sum of Subset Problem for the instance d = 15 and S = {3, 5, 6, 7}. Write the algorithm.	10	2	4
5	Consider the graph given below representing an instance of Travelling Salesperson Problem, where source vertex is **"b"**. Apply Branch and Bound technique and obtain the solution where **"c"** comes before "a". Explain the procedure to compute lower bound. Write the state-space tree and number the nodes. 	10	4	5

BT-Blooms Taxonomy, CO-Course Outcomes, M-Marks

Marks Distribution	Particulars		CO1	CO2	CO3	CO4	CO5	L1	L2	L3	L4	L5	L6
	Quiz/ Test	Max Marks	4	14	12	10	20	8	12	30	10	-	-

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Apply knowledge of computing and mathematics to algorithm analysis and design.
CO 2	Analyze a problem and identify the computing requirements appropriate for a solution.
CO 3	Apply algorithmic principles and computer science theory to the modeling for evaluation of computer-based solutions in a way that demonstrates comprehension of the trade-offs involved in design choices.
CO 4	Investigate and use optimal design techniques, development principles, skills and tools in the construction of software solutions of varying complexity.
CO 5	Demonstrate critical, innovative thinking, and display competence in solving engineering problems.
CO 6	Exhibit effective communication and engage in continuing professional development through experiential learning.