RV College of Engineering
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India
NBA Accredited
Tel: 080-68188199

Department of Computer Science and Engineering

Program: BE

Date	18 June 2024	Maximum Marks	50
Course Code	**CD343AI**	Duration	90 min
4th Sem	IV Semester	CIE-I	

Design and Analysis of Algorithms
(Common to AIML/CSE/CD/CY/ISE)

Sl. No.	Test Questions	M	L	CO
1a	Summarise the framework for analysis of algorithms.	05	L1	CO2
1b	With suitable notations and graphs, explain the different asymptotic notations. Give two examples in each case.	05	L2	CO1
2a	Design a recursive algorithm to find the sum of cubes of first 'n' natural numbers. Set up a recurrence, solve and determine the time complexity of the algorithm.	05	L2	CO1
2b	Write an algorithm to arrange the numbers in ascending order using Selection Sort. Evaluate the time complexity. Compare it with merge-sort algorithm.	05	L1	CO3
3a	Sort the following functions in the increasing order of growth. n^3, 2^n, $log_5 n$, $3n$, $log_2 n$, $\sqrt{n}$, $n \log n$ Indicate how much the functions value will change if its argument is increased four-fold.	05	L2	CO2
3b	Write the pseudocode for merge sort and describe the process. Setup a recurrence and decide the time complexity.	05	L2	CO1
4a	Apply Master's theorem to following recurrence and indicate the efficiency class. $i.\ T(n) = 2T\left(\frac{n}{2}\right) + n$ $ii.\ T(n) = 8T\left(\frac{n}{2}\right) + 5n^2$	04	L3	CO1
4b	Derive the worst-case efficiency class for the quick sort. Show the first split for the following array by considering the leftmost element as the pivot: 38, 81, 22, 48, 18, 50, 31, 58	06	L3	CO2
5a	Mention the 3 variations of decrease-and-conquer and give an example algorithm in each case.	04	L1	CO3
5b	Consider the graph shown in Fig 5b. i. Apply DFS algorithm by considering vertex '1' as the source and write the traversal sequence. Show the contents of stack during DFS and also draw the DFS forest.	06	L3	CO3

ii. Apply BFS algorithm by considering vertex '0' as the source. Draw the BFS forest.

4-6

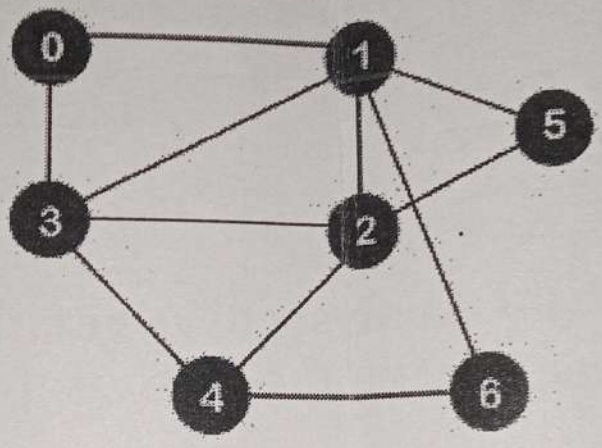


Fig 5b

Course Outcomes

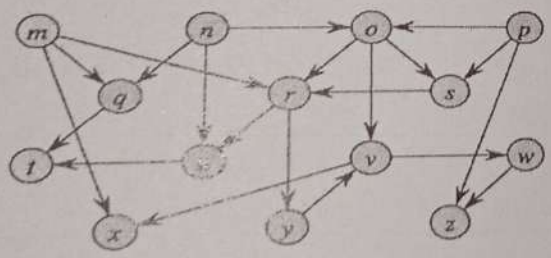
CO1	Apply knowledge of computing and mathematics to algorithm analysis
CO2	Analyze a problem and identify the computing requirements appro solution
CO3	Apply mathematical foundations, algorithmic principles, and comp theory to the modeling, and evaluation of computer-based solutions demonstrates comprehension of the trade-offs involved in design choi
CO4	Investigate and apply optimal design, development principles, skills ar construction of software solutions of varying complexity.
CO5	Demonstrate critical, innovative thinking, and display competence in and visual communication.
CO6	Exhibits positive group communication exchanges in order to accomp goal and engage in continuing professional development.

Blooms' taxonomy

Date	July 2024		
Course Code	CD343AI	Duration	120 min
Sem	IV	CIE-II	

Design and Analysis of Algorithms

(Common to AIML/CSE/CD/CY/ISE)

Sl. No.	Questions	M	L	C
	PART A			
1.1	Is it possible to find transitive closure of a digraph using Depth First Search (DFS) or Breadth-first search (BFS)? Justify the answer	2	L3	CO
1.2	Given a text of length n=30 and a pattern of length m=4, how many shifts will the Horspool algorithm perform in the worst case?	2	L3	CO
1.3	In a max heap containing n elements, the smallest element can be found in _____ worst time	2	L1	CO
1.4	Why Floyd-Warshall Algorithm better for Dense Graphs and not for Sparse Graphs?	2	L3	CO
1.5	List any four limitations of Distribution Counting Sort	2	L2	CO
	PART B			
1a	Apply DFS traversal to find the topological order of the graph shown in figure 1a from the vertex p (break the ties by the alphabetical order of the vertices)  figure 1a	06	L3	
1b	Compare the brute force approach and Instance simplification variant of transform and conquer approach to solve checking element uniqueness in an array.	04	L1	

2a	Show the state of each pass and final array after applying comparison counting sort for the list: 94, 73, 26, 11, 05, 77, 31 to sort the elements in non-decreasing order.	**06**	L2	CO2
2b	Write the pseudocode of Warshall's algorithm and prove that the time efficiency of warshall's algorithm is cubic.	**04**	L2	CO2
3a	Apply heapsort to arrange the list 8, 12, 15, 3, 5, 1, 43, -7 in ascending order by using array representation of heap.	**06**	L3	CO3
3b	Compute binomial coefficient of $^5C_3$ using dynamic programming	**04**	L2	CO1
4	Apply floyd's algorithm to find all pairs shortest path for the digraph shown in with the weight matrix $\begin{pmatrix} 0 & 2 & \infty & 1 & 8 \\ 6 & 0 & 3 & 2 & \infty \\ \infty & \infty & 0 & 4 & \infty \\ \infty & \infty & 2 & 0 & 3 \\ 3 & \infty & \infty & \infty & 0 \end{pmatrix}$	**10**	L3	CO3
5	Use input enhancement technique for the pattern ***RNARNAKARNA*** and apply Boyer Moore algorithm to find the occurrence of this pattern in the text ***RAVANAKARNA_RAMAYANA_EPIC _SEETHA_ _ _ _NNARNA_ RNARNAKARNA***	**10**	L3	CO

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CO4	Investigate and apply optimal design, development principles, skills and tools in the construction of software solutions of varying complexity.
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Blooms' taxonomy

DAA-II

L1	L2	L3	L4	L5	CO1	CO2	CO3	CO4	CO5	CO6
6									-	-

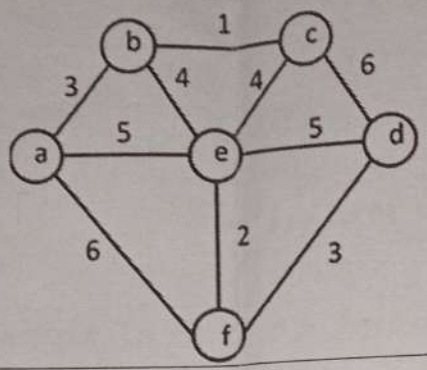
Course Code	CD343AI	Duration	90 min
4th Sem	IV Semester	CIE-I	

Design and Analysis of Algorithms

(Common to AIML/CSE/CD/CY/ISE)

Sl. No.	Improvement Quiz Questions	M	L
1	Define spanning tree.	2	1
2	Find the compression ratio for the given data A = 8 = 40%, B = 2 = 10%, C = 4 = 20%, D = 3 = 15% , _ = 3 = 15% Using Huffman coding the characters are coded as A 0 B 100 C 110 D 101 _ 111	2	2
3	Explain how Dijkrasta's algorithm differ from Prim's algorithm	2	2
4	Define a state-space tree in the context of the backtracking algorithm	2	1
5	What is NP hard problems?	2	1

Sl. No.	Improvement Test Questions	M	L
1	Apply 0/1 Knapsack, find the maximum profit for the given data C= 5 Wi 2 1 3 2 Pi 8 6 16 11	10	3
2	Apply Prim's algorithm to find the Minimum Spanning Tree (MST) for the given graph. Write the spanning tree after finding the MST	10	



3 a	Compare Backtracking and Branch & bound.	**4**	2	2
3 b	Write the decision tree for finding minimum of three numbers.	**6**	2	1
4	Consider an assignment problem where you have to assign n people to n jobs in such a way that the total cost of the assignment is minimized. The cost matrix for assigning each person to each job is given below:	**10**	3	3

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

(a) Calculate the lower bound for this assignment problem.
(b) Find the solution using branch and bound

5 a	Briefly discuss P and NP problems used in problem solving	**6**	2	
5 b	Define greedy technique, how it differs from dynamic programming?	**4**	2	

DAA-III ~~DMSC-III~~

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Blooms' taxonomy test

USN | 1 | R | V | | | | | | | |

RV COLLEGE OF ENGINEERING®

(An Autonomous Institution Affiliated to VTU)

IV Semester B. E. Examinations Sept/Oct – 2024

Common to CD/CY/CSE/ISE/AIML

DESIGN AND ANALYSIS OF ALGORITHMS

Time: 03 Hours ***Maximum Marks: 100***

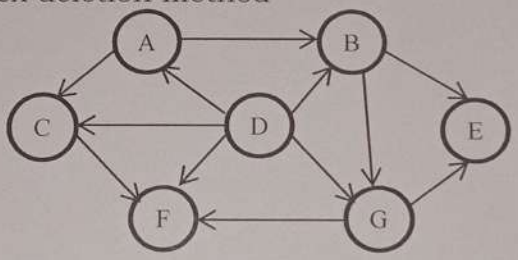
Instructions to candidates:

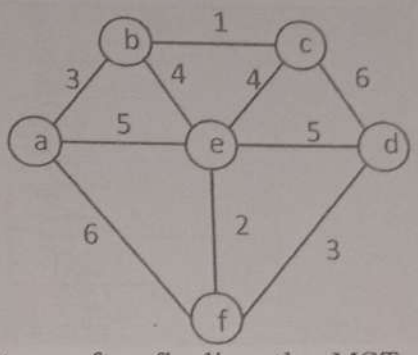
1. Answer all questions from Part A. Part A questions should be answered in first three pages of the answer book only.
2. Answer FIVE full questions from Part B. In Part B question number 2 is compulsory. Answer any one full question from 3 and 4, 5 and 6, 7 and 8, 9 and 10.

PART-A

			M	BT	CO
1	1.1	What does it mean for an algorithm to be optimal? Theoretically how do you determine whether an algorithm's performance is optimal or not?	02	2	1
	1.2	Consider the following algorithm *ALGORITHM* $F(n)$ *// Computes* $n!$ *recursively* *// Input: A non − negative integer* n *// Output: The value of* $n!$ *if* $n = 0$ *return* 1 *else* *return* $F(n-1) * n$ Write the recurrence relation for the above algorithm by considering basic operation.	02	2	2
	1.3	In the context of algorithm design, what specific technique does the binary search uses? What is the corresponding time complexity of this algorithm?	02	1	1
	1.4	Give example scenario where insertion sort exhibits its worst case performance and its time complexity.	02	2	2
	1.5	State the purpose of the following: i. Floyd algorithm ii. Warshall Algorithm	02 02	1 2	2 2
	1.6	Differentiate *Divide and Conquer* and *Transform and Conquer*			
	1.7	*ALGORITHM algo* (n) *sort the array* A *for* $i \leftarrow 0$ *to* $n-2$ *do* *if* $A[i] = A[i+1]$ *return false* *return true.* Also identify the purpose of the above algorithm. Compute time complexity assuming efficient sorting.	02	2	2
	1.8	Explain how Dijkrasta's algorithm differ from Prim's algorithm	02	2	1
	1.9	Describe the concept of a state-space tree in the context of Backtracking algorithm.	02	1	2
	1.10	Construct Bad- Shift table and Good-Suffix table for the given pattern RAORAR	02	2	2

PART-B

2	a	Provide an example to illustrate the algorithm design and analysis process. Choose a well-known problem (e.g., sorting algorithms, shortest path in a graph) and walk through each step with this example.	08	3	2
	b	Define basic time complexity efficiency classes. Provide example code for any two.	08	2	1
3	a	Consider the problem of computing min-max in an unsorted array. Algorithm A1 can compute in X comparisons using divide and conquer technique while Algorithm A2 can computer in Y comparisons by traversing the array linearly. Being a developer which algorithm would you choose to maximize efficiency? Illustrate your choice with an example.	08	3	4
	b	Write Insertion sort algorithm. Sort the given array using insertion sort and write the time complexity. *Array*: 5,4,10,1,6,2	08	2	1
		OR			
4	a	Along with any example graph and DFS (Depth First Search) algorithm, discuss any four applications of DFS.	08	2	2
	b	Write the procedure to find topological order of the given graph using Source Vertex deletion method 	08	3	3
5	a	Design an algorithm to compute the mode of the list with O(nlogn) complexity using the presort method. The mode is the value that appears most frequently in the list.	04	3	4
	b	Discuss three variations of transform and conquer techniques.	04	2	3
	c	Discuss the Counting Sort algorithm and its time complexity. Show tracing for *array*: 94,73,26,11,05,77,31.	08	2	2
		OR			
6	a	Discuss Naïve string matching algorithm along with time complexity.	04	2	2
	b	Explain the steps of Horspool algorithm in detail to search for the pattern 'RING' within the text 'COMPUTER SCIENCE AND ENGINEERING'. What are the key shifts and comparisons made during the search process?	06	3	3
	c	Construct a max heap and then use it to sort the list in descending order. Provide the implementation and detailed explanation of both the max heap construction and the heap sort process. *Input* : 1,4,2,6,5,17,13.	06	2	2
7	a	Discuss how the problems are solved in Dynamic Programming. Construct the table and find Binomial Coefficient of ${}^4C_3$ using Dynamic programming.	08	2	2

	b	Apply 0/1 Knapsack to find the maximum profit for the given data $C = 5$.					
		$Wi(Weight)$	2	1	3	2	
		$Vi\,(Profit)$	12	10	20	15	08	3	3
		OR							
8	a	Apply Prim's algorithm to find the Minimum Spanning Tree (MST) for the graph shown in 8a.  Write the spanning tree after finding the MST					08	3	2
	b	Given the following set of characters and their frequencies, apply Huffman Coding to construct the Huffman Tree and determin the binary codes for each character: A= 8= 40 % B= 2 = 10% C= 4= 20% D=3 =15% - = 3= 15% Show the step- by- step process of building the Huffman Tree and provide the final Huffman codes for each character.					08	3	2
9	a	Discuss the N-Queen problem, specifically for placing 4 queens on a 4 x4 chessboard. Include a detailed explanation of the state space tree used in the solution process. Give the count of non-promising nodes.					08	3	3
	b	Along with example problem, compare Backtracking and Branch and Bound design techniques					08	3	3
		OR							
10	a	How do decision trees represent the sequence of comparisons and decisions made during "Finding the minimum of three numbers"? Illustrate with an example.					08	3	4
	b	Discuss NP and NP- complete problems, providing a detailed explanation of their definitions, characteristics and significance in problem solving					08	2	3