

**ARMAN SINGH BHATI** **1202210N**

Department of Computer Science and Engineering

Program: BE

Date	18 June 2024	Maximum Marks	50
Course Code	CD343AI	Duration	90 min
4 <sup>th</sup> Sem	IV Semester	CIE-I	
<b>Design and Analysis of Algorithms</b> (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.

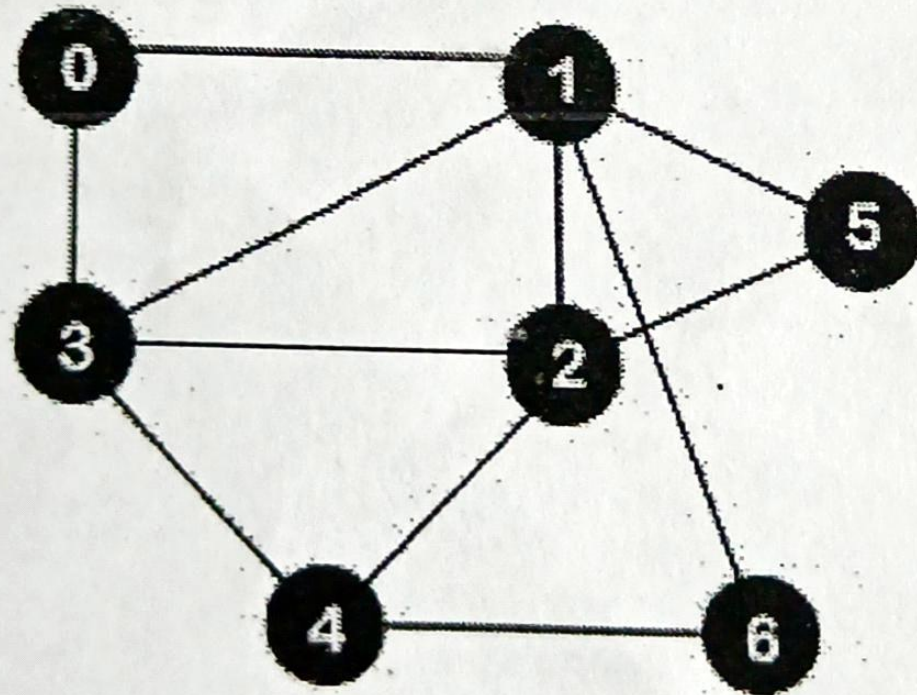


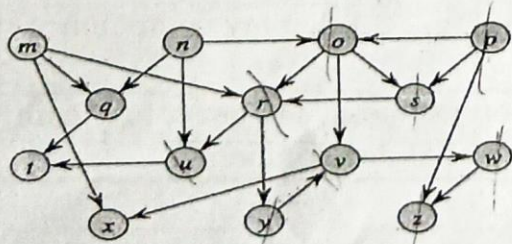
Fig 5b

## Course Outcomes

CO1	Apply knowledge of computing and mathematics to algorithm analysis and design
CO2	Analyze a problem and identify the computing requirements appropriate for solution



Date	July 2024	Maximum Marks	10+50
Course Code	CD343AI	Duration	120 min
Sem	IV	CIE-II	
<b>Design and Analysis of Algorithms</b> (Common to AIML/CSE/CD/CY/ISE)			

Sl. No.	Questions	M	L	CO
<b>PART A</b>				
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	CO2
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	CO2
1.3	In a max heap containing $n$ elements, the smallest element can be found in _____ worst time	2	L1	CO1
1.4	Why Floyd-Warshall Algorithm better for Dense Graphs and not for Sparse Graphs?	2	L3	CO2
1.5	List any four limitations of Distribution Counting Sort	2	L2	CO1
<b>PART B</b>				
1a	<p>Apply DFS traversal to find the topological order of the graph shown in figure 1a from the vertex <math>p</math> (break the ties by the alphabetical order of the vertices)</p>  <p style="text-align: center;">figure 1a</p>	06	L3	CO3
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	CO1



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
2b	Write the pseudocode of Warshall's algorithm and prove that the time efficiency of warshall's algorithm is cubic.	04	L2
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
3b	Compute binomial coefficient of ${}^5C_3$ using dynamic programming	04	L2
4	<p>Apply floyd's algorithm to find all pairs shortest path for the digraph shown in with the weight matrix</p> $\begin{pmatrix} 0 & 2 & \infty & 1 & 8 \\ 6 & 0 & 3 & 2 & \infty \\ \infty & \infty & 0 & 4 & \infty \\ \infty & \infty & 2 & 0 & 3 \\ 3 & \infty & \infty & \infty & 0 \end{pmatrix}$	10	L3
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

### Course Outcomes

CO1	Apply knowledge of computing and mathematics to algorithm analysis and design
CO2	Analyze a problem and identify the computing requirements appropriate for solution
CO3	Apply mathematical foundations, algorithmic principles, and computer science theory to the modeling, and evaluation of computer-based solutions in a way that demonstrates comprehension of the trade-offs involved in design choices.





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Department of Computer Science and Engineering

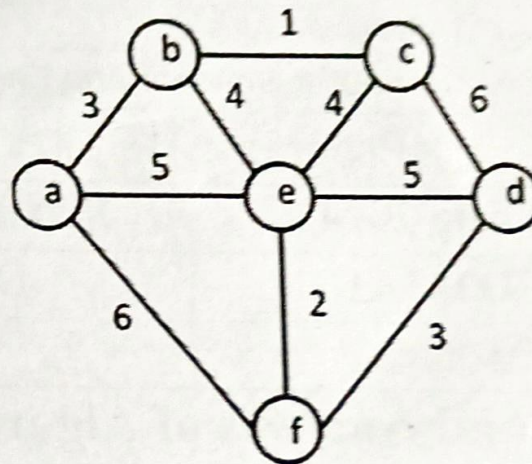
Program: BE

Date	26 Aug 2024	Maximum Marks	60
Course Code	CD343AI	Duration	90 min
4 <sup>th</sup> Sem	IV Semester	CIE-I	
<b>Design and Analysis of Algorithms</b> (Common to AIML/CSE/CD/CY/ISE)			

Sl. No.	Improvement Quiz Questions	M	L										
1	Define spanning tree.	2	1										
2	<p>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</p> <table><tr><td>A</td><td>0</td></tr><tr><td>B</td><td>100</td></tr><tr><td>C</td><td>110</td></tr><tr><td>D</td><td>101</td></tr><tr><td>-</td><td>111</td></tr></table>	A	0	B	100	C	110	D	101	-	111	2	2
A	0												
B	100												
C	110												
D	101												
-	111												
3	Explain how Dijkstra'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





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

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:

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

4

10 3 3

(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 2

5 b Define greedy technique, how it differs from dynamic programming?

4 2 1



CD343AI

USN

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**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 <i>ALGORITHM F(n)</i> <i>// Computes n! recursively</i> <i>// Input: A non – negative integer n</i> <i>// Output: The value of n!</i> <i>if n = 0</i> <i>  return 1</i> <i>else</i> <i>  return F(n – 1) * n</i> 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	1	2
	1.6	Differentiate <i>Divide and Conquer</i> and <i>Transform and Conquer</i>	02	2	2
	1.7	<i>ALGORITHM algo (n)</i> <i>sort the array A</i> <i>for i ← 0 to n – 2 do</i> <i>  if A[i] = A[i + 1]</i> <i>    return false</i> <i>  return true.</i> Also identify the purpose of the above algorithm. Compute time complexity assuming efficient sorting.	02	2	2
	1.8	Explain how Dijkstra'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 2555	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.			
	b	Define basic time complexity efficiency classes. Provide example code for any two.	08	3	2
3			08	2	1
	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 compute 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
		<b>OR</b>			
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			
		<p align="right">DACBGF</p>	08	3	3
5	a	Design an algorithm to compute the mode of the list with $O(n \log n)$ 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
		<b>OR</b>			
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 $C = 5$ .												
	<table border="1"> <tr> <td><math>W_i</math> (Weight)</td><td>2</td><td>1</td><td>3</td><td>2</td></tr> <tr> <td><math>V_i</math> (Profit)</td><td>12</td><td>10</td><td>20</td><td>15</td></tr> </table>	$W_i$ (Weight)	2	1	3	2	$V_i$ (Profit)	12	10	20	15	08	3
$W_i$ (Weight)	2	1	3	2									
$V_i$ (Profit)	12	10	20	15									
OR													
8 a	Apply Prim's algorithm to find the Minimum Spanning Tree (MST) for the graph shown in 8a.												
b	Write the spanning tree after finding the MST Given the following set of characters and their frequencies, apply Huffman Coding to construct the Huffman Tree and determine the binary codes for each character:	08	3	2									
	<p> <math>A = 8 = 40\% \rightarrow 0.4</math>  <math>B = 2 = 10\% \rightarrow 0.1</math>  <math>C = 4 = 20\% \rightarrow 0.2</math>  <math>D = 3 = 15\% \rightarrow 0.15</math>  <math>E = 3 = 15\% \rightarrow 0.15</math> </p> <p> 0  100  111  101  110 </p>												
	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 x 4 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									