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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*

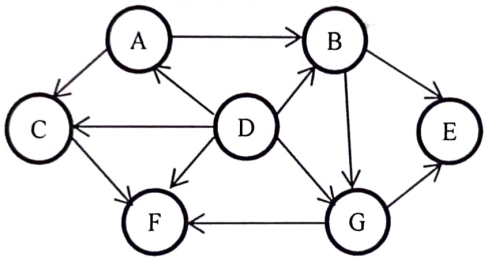
Instructions to candidates:

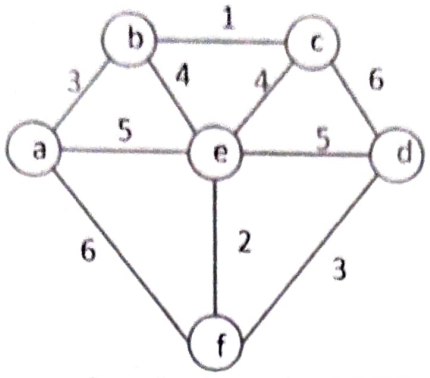
1. Answer all questions from Part A. Part A questions should be answered in first three pages of the answer book only.
2. Answer FIVE full questions from Part B. In Part B question number 2 is compulsory. Answer any one full question from 3 and 4, 5 and 6, 7 and 8, 9 and 10.

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 *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	1	2
	1.6	Differentiate *Divide and Conquer* and *Transform and Conquer*	02	2	2
	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