

CBCS SCHEME

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18CS42

Fourth Semester B.E. Degree Examination, June/July 2024 Design and Analysis of Algorithms

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Define an algorithm. Design an algorithm to search an element in an array of elements using sequential search. Discuss worst, best and average efficiency of the algorithm. (08 Marks)
- b. Explain the asymptotic notations: i) Big-oh (O) ii) Big omega (Ω) iii) Theta (θ) with an example for each. Also prove that: If $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$ then $t_1(n) + t_2(n) \in O(\max \{g_1(n), g_2(n)\})$. (08 Marks)
- c. Discuss adjacency matrix and adjacency list representation of a graph with suitable examples. (04 Marks)

OR

- 2 a. Write a recursive algorithm to print all the permutations of a set of $n \geq 1$ elements. Also write a recursive tree of calls for $n = 3$. (08 Marks)
- b. Give a general plan for analyzing recursive algorithms. Give a recursive algorithm to find the number of binary digits in the binary representation of a positive decimal integer and obtain its efficiency. (08 Marks)
- c. Explain with an example, how to convert ordered rooted tree into a binary tree. (04 Marks)

Module-2

- 3 a. Given a bag of 16 coins and let seventh one be the counterfeit coin among 16 coins. Counterfeit coins are lighter than genuine ones. Given a machine to compare the weights of two sets of coins, apply divide and conquer to determine that 7th is counterfeit (06 Marks)
- b. Apply merge sort to sort the following numbers in ascending order: 8, 3, 2, 9, 7, 1, 5, 4. Also obtain time complexity for merge sort. (08 Marks)
- c. Apply divide and conquer approach to multiply the following matrices:

$$\begin{bmatrix} 5 & 2 & 6 & 1 \\ 0 & 6 & 2 & 0 \\ 3 & 8 & 1 & 4 \\ 1 & 8 & 5 & 6 \end{bmatrix} \times \begin{bmatrix} 7 & 5 & 8 & 0 \\ 1 & 8 & 2 & 6 \\ 9 & 4 & 3 & 8 \\ 5 & 3 & 7 & 9 \end{bmatrix}$$

(06 Marks)

OR

- 4 a. Write an iterative algorithm for binary search and trace the algorithm to search for a key 151 in a list -15, -6, 0, 7, 9, 23, 54, 82, 101, 112, 125, 131, 142, 151. (06 Marks)
- b. Write quicksort algorithm to sort 'n' numbers and apply the same to sort the following numbers in ascending order. 80, 60, 70, 40, 10, 30, 50, 20. (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- c. Apply DFS and source vertex removal methods to obtain topological sequence for two graph shown in Fig.Q.4(c) (06 Marks)

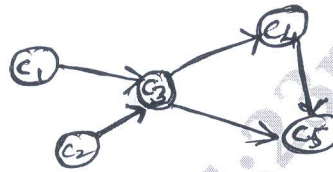


Fig.Q.4(c)

Module-3

- 5 a. Apply greedy method to obtain an optimal task assignment for the 7 tasks and infinite supply of machines given their start end times.

Task	a	b	c	d	e	f	g
Start time	0	3	4	9	7	1	6
End time	2	7	7	11	10	5	8

(06 Marks)

- b. Solve the following knapsack problem using all 3 greedy criteria: $m = 20, n = 3, p = (25, 24, 15) w = (18, 15, 10)$. (06 Marks)

- c. Write and apply kruskals algorithm to obtain minimum cost spanning tree for the graph shown in Fig.Q.5(c). (08 Marks)

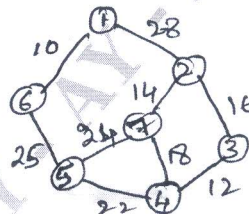


Fig.Q.5(c)

OR

- 6 a. Write and apply prims algorithm to obtain minimum cost spanning tree for the graph shown in Fig.Q.5(c). (08 Marks)

- b. Apply Dijkstra algorithm to find the shortest distance from vertex 1 to all nodes in a graph shown in Fig.Q.6(b) (06 Marks)

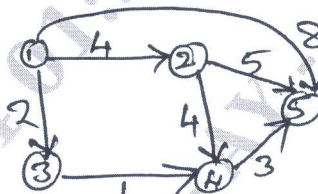


Fig.Q.6(b)

- c. Determine the optimal prefix code for the symbols a, o, q, u, y, z that occur with frequencies: 20, 28, 4, 17, 12, 7 respectively. (06 Marks)

Module-4

- 7 a. Define multistage graph problem and write the forward approach algorithm to obtain a solution. (06 Marks)

- b. Write Floyd's algorithm to solve all pairs shortest path problem and apply the same for the graph shown in Fig.Q.7(b). (08 Marks)

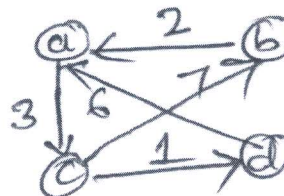


Fig.Q.7(b)

- c. Find optimal tour for the travelling sales person problem using dynamic programming technique for the graph shown in Fig.Q.7(c) considering initial and end vertex as 1. (06 Marks)

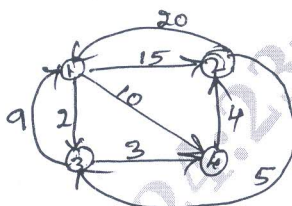


Fig.Q.7(c)

OR

- 8 a. Define transitive closure of a digraph. Find the transitive closure matrix for the graph whose

adjacency matrix is
$$\begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

(08 Marks)

- b. Write the algorithm to construct optimal binary search tree for the following data:

Key	A	B	C	D
Probability	0.1	0.2	0.4	0.3

(12 Marks)

Module-5

- 9 a. Define n-queens problem. Construct state-space tree for solving 4-queens problem using backtracking for all possible solutions. (08 Marks)

- b. Solve the following assignment problem using branch and bound technique, whose cost matrix for assigning four jobs to four persons are given.

$$\begin{bmatrix} 9 & 2 & 7 & 8 \\ 6 & 4 & 3 & 7 \\ 5 & 8 & 1 & 8 \\ 7 & 6 & 9 & 4 \end{bmatrix}$$

(06 Marks)

- c. Explain the classes of NP-hard and NP-complete. (06 Marks)

OR

- 10 a. State the subset sum problem. Using backtracking, obtain a solution to the subset sum problem given $s = \{6, 8, 2, 14\}$ and $d = 16$. (06 Marks)

- b. Construct a space tree representing all possible colorings using atmost 3 colors for the graph shown in Fig.Q.10(b). (07 Marks)

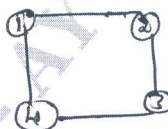


Fig.Q.10(b)

- c. With the help of a state-space tree, solve the travelling sales person problem Fig.Q.10(c) using branch-and-bound technique. (07 Marks)

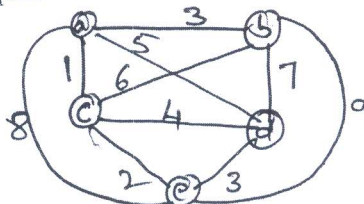


Fig.Q.10(c)
