



Bharatiya Vidya Bhavan's
SARDAR PATEL INSTITUTE OF TECHNOLOGY

(Autonomous Institute Affiliated to University of Mumbai)
Munshi Nagar, Andheri (W), Mumbai – 400 058.

End Semester Examination December 2022	
Max. Marks: 100 Class: MCA Course Code: MC507 Name of the Course: Design and Analysis of Algorithms	Duration: 180 Min. Semester: II
Instruction: 1) All questions are compulsory. 2) Draw neat diagrams. 3) Assume suitable data if necessary but justify the same.	

Q. No.	Question	Max. Marks	CO-BL
Q. 1	<p>Consider the problem of arranging integer numbers in nondecreasing order using Quick Sort Algorithm as follows. Assume that the selection of pivot number always results in the division of an array in two lists of 20:80 percentage distributions. Answer the following questions.</p> <p>(i) Formulate the recurrence relation for the aforementioned variant of quick sort algorithm.</p> <p>(ii) Solve the recurrence relation in (i) using Recursion-tree method.</p>	20	CO1-5
Q. 2	<p>Consider the following flow graph $G_f = (V, E)$ where $V = \{a, b, c, d\}$ where the vertices a and d are source and sink respectively. The edges of the graph G_f are as shown below.</p> <div style="text-align: center;"> </div> <p>Answer the following:</p> <p>(i) Show the execution of relabel and push functions of Push-Relabel algorithm for all steps. Find the maximum flow using Push-Relabel algorithm.</p> <p>(ii) Show the execution of Ford-Fulkerson algorithm with the detailed flow graph and residual graph for all steps. Verify the maximum flow calculated in (i) by calculating the maximum flow using Ford-Fulkerson algorithm.</p> <p style="text-align: center;">OR</p> <p>Consider the following $G = (V, E)$ where $V = \{1, 2, 3, 4, 5\}$. The edges of the graph along weights are shown below in the graph.</p> <div style="text-align: center;"> </div> <p>Show all iterations of running Floyd-Warshall on the above graph G.</p> <p>(i) Find the shortest distances for all the pairs of vertices $\{1, 2, 3, 4, 5\}$ using Floyd-Warshall Algorithm.</p> <p>(ii) Find the shortest paths for all the pairs of vertices $\{1, 2, 3, 4, 5\}$ using Floyd-Warshall Algorithm.</p>	20	CO4-4



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Q. 3	<p>Show the sorting of list of elements $E = [4, 12, 21, 15, 5, 11, 34, 20]$ using Heap Sort Algorithm as follows.</p> <ul style="list-style-type: none">(i) Build Min Heap of array E using Heapify method. Consider all elements of E at time as input to Heapify.(ii) Then, sort all elements of E running Heapify on the built Min Heap created in (i)	20	CO2-3
Q. 4	<p>Consider the knapsack problem. Given a knapsack with maximum capacity W, and a set S consisting of $n=7$ items. Each item i has some weight w_i and benefit value b_i (all w_i, b_i and W are integer values). How to pack the knapsack to achieve maximum total profit value of packed items? Let $w_i = \{2, 3, 4, 7, 9, 12, 13\}$ and $b_i = \{1, 2, 3, 4, 5, 6, 8\}$ and $W = 25$</p> <p>Answer the following for the given knapsack problem</p> <ul style="list-style-type: none">(i) Formulate the optimal substructure (i.e. Recursive formula) to solve knapsack problem using Dynamic Programming.(ii) Find the subset of 7 items such that the profit is maximum using the optimal substructure formulated in (i) for dynamic programming.	20	CO3-3
Q. 5	<p>Consider the Branch-and-Bound approach to search all state space of 15-Puzzle Problem. Define the following terms related to Branch-and-Bound approach and then give example of each term using 15-Puzzle Problem.</p> <ul style="list-style-type: none">(i) E-Node, Live Node and Dead Node(ii) Least Cost Search(iii) LC Branch-and-Bound Search(iv) LIFO Search and FIFO Search	20	CO4-1