S4

Bharatiya Vidya Bhavan's

SARDAR PATEL INSTITUTE OF TECHNOLOGY

(Autonomous Institute Affiliated to University of Mumbai)

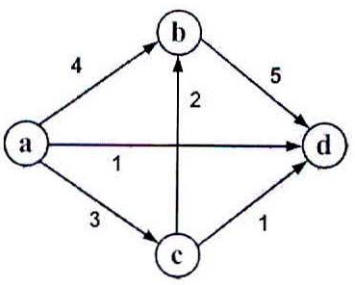
Munshi Nagar, Andheri (W), Mumbai – 400 058.

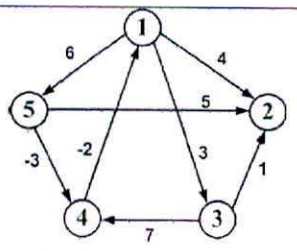
End Semester Examination
December 2022 - Synoptic

Max. Marks: 100 **Duration: 180 Min.**
Class: MCA **Semester: II**
Course Code: MC507
Name of the Course: Design and Analysis of Algorithms

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	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. (i) Formulate the recurrence relation for the aforementioned variant of quick sort algorithm. (ii) Solve the recurrence relation in (i) using Recursion-tree method. **Answers –** (i) Recurrence relation with small discussion = 5 Marks. (ii) Both side heights= 3 Marks, Width/limits= 3 Marks, Final Solution = 3 Marks, Summation = 3 Marks, Small discussion =3 Marks	20	CO1-5
Q. 2	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.  Answer the following: (i) Show the execution of relabel and push functions of Push-Relabel algorithm for all steps. Find the maximum flow using Push-Relabel algorithm. (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. **Answers –** (i) Four or more correct step solution = 2x4=8 Marks. Final solution = 2 Marks. (ii) Four or more correct step solution = 2x4=8 Marks. Final solution = 2 Marks **OR** 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.	20	CO4-4

	 Show all iterations of running Floyd-Warshall on the above graph G. (i) Find the shortest distances for all the pairs of vertices $\{1, 2, 3, 4, 5\}$ using Floyd-Warshall Algorithm. (ii) Find the shortest paths for all the pairs of vertices $\{1, 2, 3, 4, 5\}$ using Floyd-Warshall Algorithm. **Answers –** (i) Five Correct Matrices of shortest distances = 2x5 = 10 Marks. (ii) Five Correct Matrices of shortest actual paths = 2x5 = 10 Marks.		
Q. 3	Show the sorting of list of elements $E = [4, 12, 21, 15, 5, 11, 34, 20]$ using Heap Sort Algorithm as follows. (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) **Answers –** (i) Correct Heapify of all elements at same time (Not one at time) = 5 Marks. (ii) Thirteen or more correct steps of Heap Sort solution = 1x13=13 Marks. Final solution = 2 Marks	20	CO2-3
Q. 4	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 $W = 25$ Answer the following for the given knapsack problem (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. **Answers –** (i) Formulation of Dynamic optimal substructure with small discussion = 6 Marks. (ii) proper calculated rows of dynamic solution matrix =2x7 Rows= 14 Marks.	20	CO3-3
Q. 5	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. (i) E-Node, Live Node and Dead Node (ii) Least Cost Search (iii) LC Branch-and-Bound Search (iv) LIFO Search and FIFO Search **Answers –** (i) Three definitions = 3 Marks. Three Examples = 2 Marks. (ii) Definition = 3 Marks. Example = 2 Marks. (iii) Definition = 3 Marks. Example = 2 Marks. (iv) Two definitions = 3 Marks. Two Examples = 2 Marks.	20	CO4-1