Paper / Subject Code: SE9421 / Modern Algorithm Design Foundation

SE9421

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S.E. (Computer) Semester-IV (Revised Course 2019-20)
EXAMINATION JANUARY 2023
Modern Algorithm Design Foundation

[Duration : Three Hours] **[Total Marks : 100]**

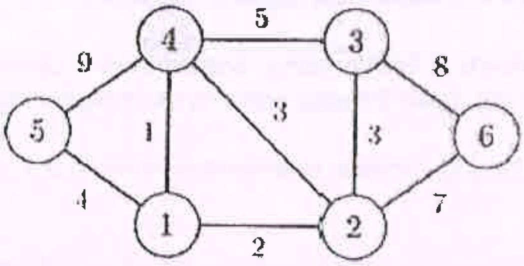
Instructions:

1) Answer **any two** questions from Part – A
2) Answer **any two** questions from Part – B
3) Answer **any one** question from Part – C
4) Assume the necessary data

PART – A

Q.1 a) Define algorithm. What are the criteria for designing efficient algorithm? (6)

b) Apply Prim's and Kruksal's algorithm and obtain the minimum cost. (8)



c) Find the shortest path between all the pairs of the graph G=(V,E,W) where V={1,2,3), E= {<1,2>, <1,3>, <2,1>, <2,3>, <3,1>}, W={4, 15, 8, 2, 3}. (6)

Q.2 a) Given the knapsack instance n=5,w(1..5)=(4,6,3,4,2} and p(1..5)=(10,15,6,8,4}, M=12. Find the optimal solution using greedy method (6)

b) Given the set of numbers S = {25, 18,-4,-9, 14, 65, 20, 32, 57}. Draw the tree of recursive calls of MaxMin. (4)

c) Write an algorithm for forward approach of a multistage graph. (4)

d) Explain best case, worst case and average case analysis with an example. (6)

Q.3 a) Construct an optimal solution binary search tree for the set (a1, a2,a3,a4)=(do, if, int, return) p(1,2,3,4)=(3,3,1,1) and q(0,1,2,3,4)=(2,3,1,1,1) (7)

b) State the master theorem for solving recurrences. Solve the following using master theorem (5)

i) $T(n) = 3T(n/2) + n^2$

ii) $T(n) = 16T(n/4) + n$

c) Write the algorithm for binary search and state its time complexity. (5)

d) Differentiate between greedy and dynamic programming. (3)

PART – B

Q.4 a) What is string matching algorithm? Implement the Boyer Moore algorithm on the given text and pattern. (5)
T= aaccaaabcaabacc
P= aabcaab

b) Solve the following instance of the knapsack problem by using LC branch and bound technique where n=4, (w1, w2, w3, w4) = (9, 6, 7, 2), (v1, v2, v3, v4)=(15, 6, 5, 1). (7)

c) Discuss the different types of probabilistic algorithms. (4)

d) What are explicit constraints and implicit constraints? (4)

Q.5 a) Explain the concept of Backtracking. Explain how 4 Queens problem can be solved using backtracking. Draw the state space tree corresponding to 4 Queens problem. (6)

b) Determine the longest common subsequence between two strings ABCDBACDF and CBAF (6)

c) Write a non-deterministic algorithm for sorting a set of N numbers. Analyze its time complexity (4)

d) Explain FIFO branch and bound technique. (4)

Q.6 a) Using the backtracking approach technique devise an algorithm to solve sum of subset problem. Given S = {5, 10, 10, 25} and M=25. Draw a state space tree for fixed size tuple formulation. (6)

b) Draw the compressed trie and the compact representation of a compressed trie for the set of strings given below: (5)
S={abab, baba, ccccc, bbaaaa, caa, bbaacc, cbcc, cbca}

c) Discuss the relationship between the class P, class NP, NP-complete and NP-Hard (6)

d) Write an approximation algorithm for set covering problem. (3)

PART – C

Q.7

a) Write the algorithm for insertion sort. Analyze the algorithm for time complexity. (4)

b) Solve the TSP problem using branch and bound technique. Also generate a state space tree for the following cost matrix: (6)

$$\begin{bmatrix} 0 & 12 & 5 & 7 \\ 11 & 0 & 13 & 6 \\ 5 & 9 & 0 & 18 \\ 10 & 3 & 4 & 0 \end{bmatrix}$$

c) Given the 0/1 knapsack instance n=5, w(1..5)=(2,4,5,3,9}, p(1..5)=(3,5,8,4,10}. Find the optimal solution for 0/1 knapsack problem using dynamic programming (6)

d) Explain deterministic and non-deterministic algorithms. (4)

Q.8

a) Explain how partition algorithm works to find the k^{th} smallest element in an array. Give example (4)

b) Using the backtracking technique, devise an algorithm to find Hamiltonian cycle for an undirected graph. (4)

c) Draw the frequency table and Huffman tree for the following string: **BCAADDDCCACACAC** (6)

d) Using Dijkstra algorithm calculate the shortest path from vertex 1 to all the other vertices. Consider a directed weighted graph G=(V,E,W), V={1, 2, 3, 4, 5}, E={<1,2>, <1,3>, <2,3>, <3,2>, <2,4>, <2,5>, <3,5>, <4,5>, <5,4>} and weights on the corresponding edges are as W={4,8,5,4,8,10,3,7,6}. (6)