CSE303

[ET]

END SEMESTER EXAMINATION : NOV.–DEC., 2021

ANALYSIS AND DESIGN OF ALGORITHMS

Time : 3 Hrs. *Maximum Marks : 60*

Note: ***Attempt questions from all sections as directed.***

SECTION – A (24 Marks)

Attempt any **four** *questions out of* **five.**
Each question carries **06** *marks.*

1. Given the six items in the table below and a Knapsack with Capacity (M)=100, Find the Optimal solution to the fractional Knapsack problem using the Greedy Method?

Items	Weight	Profit
A	100	40
B	50	35
C	40	20
D	20	4
E	10	10
F	10	6

P.T.O.

2. Given the following two conditions (i) and (ii) as follows :

   (i) $f(n)=0(f(n))$ and $g(n)\neq 0(f(n))$

   (ii) $g(n)=0(h(n))$ and $h(n)=0(g(n))$

   Find which of the following statement are TRUE/ FALSE?

   (a) $g(n)+h(n)=\Theta(g(n))$

   (b) $f(n)*g(n)=\Omega(g(n)*g(n))$

   (c) $(g(n))/(h(n))=\Theta(h(n))$

3. The recurrence $T(n) = 9T\ (n/2) + n^2$ describe the running time of an algorithm A. A competing algorithm A' has a running time of $T'(n) = aT'\ (n/4) + n^2$. What is the largest integer value for a such that A' is asymptotically faster than A?

4. Consider the following two sequences X and Y :

   X = {1,0,1,1,0,1,1,0,1}

   Y = {0,1,0,1,1,0,1}

   Find the longest common subsequence (LCS) of the given sequence X and Y. Also, print the matched common subsequence of X and Y.

5. Differentiate between P, NP, NP-Complete and NP-Hard Problem. Also, give the relationship between each of the classes using a suitable diagram.

SECTION – B (20 Marks)

Attempt any **two** *questions out of* **three**.
Each question carries **10** *marks.*

6. (a) Find the asymptotic tight solution to the following recurrence relation

(i) $T(n) = \sqrt{n}T\left(\sqrt{n}\right) + n$

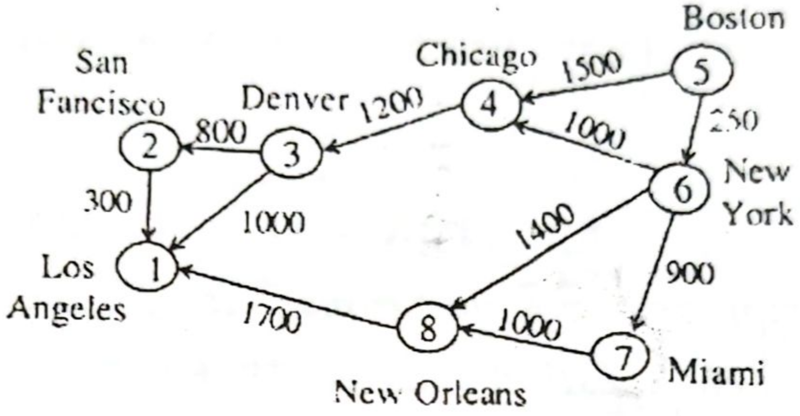
(ii) $T(n) = 4T\left(\frac{n}{2}\right) + \frac{n^2}{\log n}$ (5)

(b) Write an algorithm to solve N-queen's Problem. Construct a state-space-search tree to solve a 4-Queen's problem. (5)

7. (a) Explain Dijkstra's algorithm to solve the single-source shortest path problem. Apply Dijkstra's algorithm to find the shortest path from start vertex "Boston" to the rest of the vertices. Show the estimated path distance d[v] and the set of vertices

P.T.O.

S, after each iteration of the algorithm.



(5)

(b) Consider 4 matrices M1, M2, M3 and M4 with their dimensions (30,5), (5,20), (20,10) and (10,30). Using the Dynamic programming method, find an optimal way to calculate the product M1 × M2 × M3 × M4. (5)

8. (a) Solve the following instance of 0/1 knapsack problem using dynamic programming:

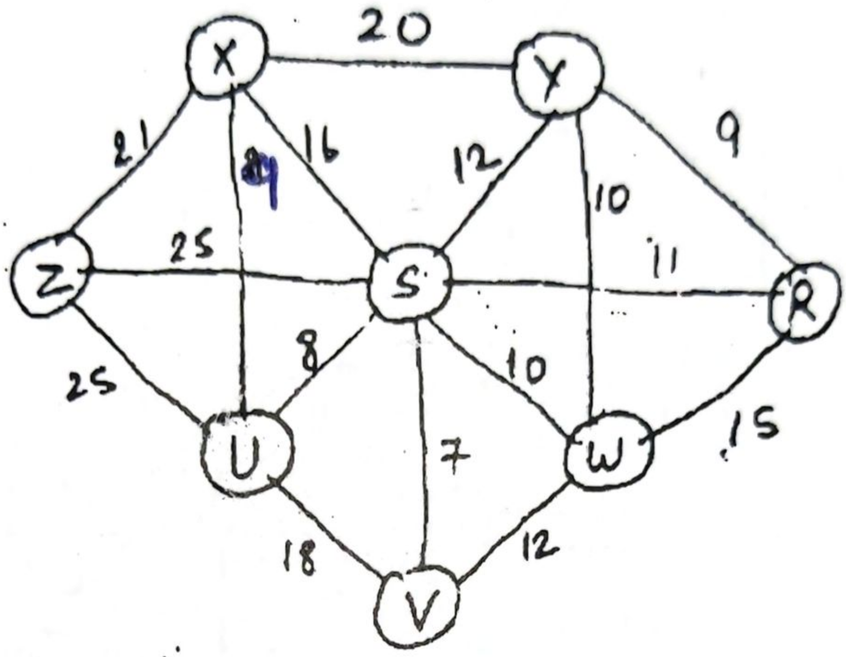
Number of objects n=5, Knapsack capacity M=10,

Profit P = (1,6,18,22,28) and weight W = (1,2,5,6,7)

(5)

(b) Differentiate between kruskal's and prim's algorithm to find a minimum cost spanning tree (MCST)? Find MCST for the following using

Prim's algorithm (X is a starting vertex)



(5)

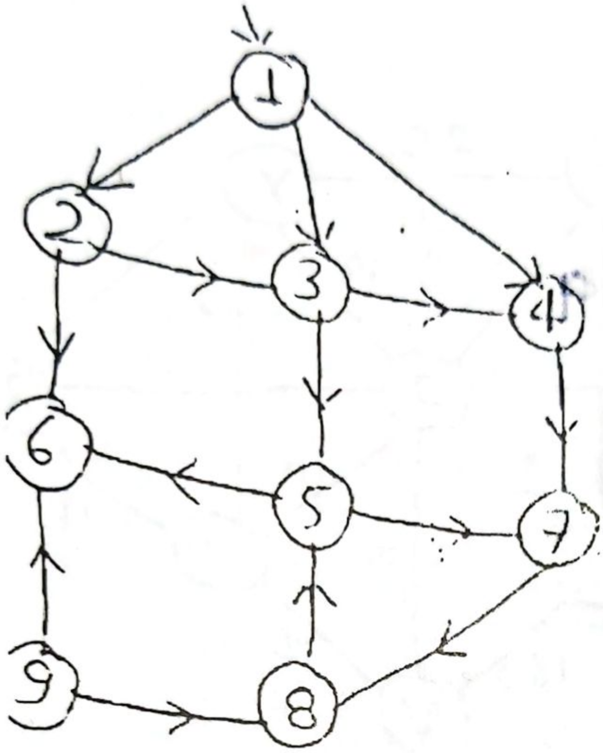
SECTION – C (16 Marks)

(Compulsory)

9. (a) Explain the branch-and-bound strategy to solve the travelling-salesman problem (TSP) for any graph and analyse the time complexity of the algorithm used. (6)

(b) Compare Depth-first search (DFS) and Breath-first search (BFS) with respect to time and space complexity. Find the BFS and DFS sequence for the following graph (1 is a starting vertex).

P.T.O.



(5)

(c) Explain cook theorem for NP-complete problem. Show that CLIQUE decision problem (CDP) is NP-complete. (5)