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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

August 2024 Supplementary Examinations

Programme: B.E **Semester: IV**
Branch: Computer Science and Engineering **Duration: 3 hrs.**
Course Code: 19CS4PCADA **Max Marks: 100**
Course: Analysis and Design of Algorithms

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) i) Solve the following recurrence relation using backward substitution method. **8**
$x(n)=x(n-1)+1$ for $n>1$, $x(1)=1$

ii)Consider the Recursive Algorithm
Algorithm F(n)

If(n=1) return 1

return F(n-1) +F(n-1)

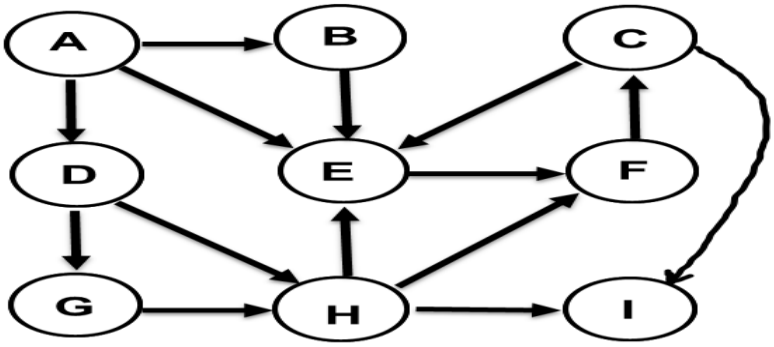
Set up a Recurrence relation for the above algorithm and solve the recurrence relation to obtain time complexity of the Algorithm.

b) i) Design a recursive algorithm for solving the Tower of Hanoi problem. **8**
ii) Give the general plan of analyzing recursive algorithms.
iii) Show that the time complexity of Tower of Hanoi is exponential in nature.

c) Explain with formal notations the asymptotic notations O and Ω. Determine whether the following assertions are true or false: **4**
i. $n(n+1)/2 \in O(n^3)$ ii. $n(n+1)/2 \in \Omega(n^3)$

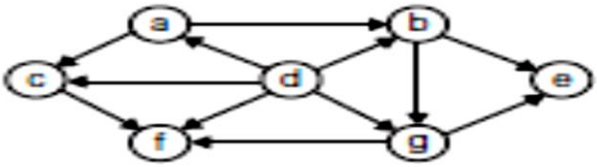
UNIT - II

2 a) Differentiate between DFS and BFS tree traversals. Show step by step process in finding DFS traversal for the following graph with source vertex 'A' (assume alphabetical order). Mention the traversal time if the input graph is represented as adjacency matrix and as adjacency list. **10**



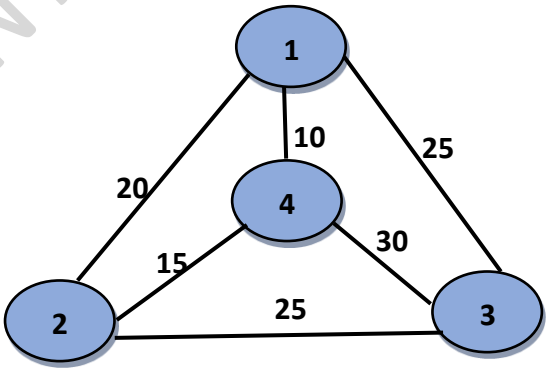
b) Develop an algorithm for Insertion sort and analyze the algorithm for the best-case and worst-case time complexity. **6**

c) Apply source removal method to obtain the topological order for the following graph: **4**



OR

3 a) i. Solve the following instance of Travelling Salesman problem using Exhaustive Search technique where following graph shows a set of cities and cost between every pair of cities. Show step by step procedure in finding out the route that gives minimum cost. **10**



ii. Apply Exhaustive Search technique to solve the following instance of Knapsack problem:
Number of objects N=4, weights of four objects= {7, 3, 4, 5} and profits= {42, 12, 40, 25} with the capacity of Knapsack W=10

b) Apply selection sort technique to sort the elements: 20,12,10,15,2. **10**
Write an algorithm for the same and find its time complexity.

UNIT - III

4 a) i) State the different variations of transform and conquer technique. Describe under which type does the Horner's rule for Polynomial Evaluation fall? **8**

ii) Apply Horner's rule to evaluate the polynomial to find the quotient and remainder.

$f(x) = x^4 + 3x^3 + 5x^2 + 7x + 9$ at $x = 2$

b) Develop an algorithm for quick sort by considering the first element as the pivot element and also obtain the best case and worst-case time complexity. Apply the quick sort algorithm developed above to sort the following numbers: 54, 26, 93, 17, 77, 31, 44, 55, 20. **12**

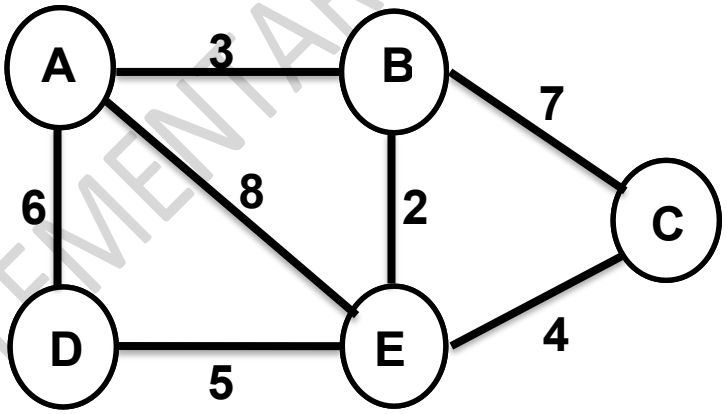
UNIT - IV

5 a) Develop a dynamic programming algorithm to solve the knapsack problem and apply the same for solving the following instance of knapsack problem. Show how the items are elected from the table. **12**

Capacity of knapsack = 5		
Item	Weight	Value
1	3	100
2	2	20
3	4	60
4	1	40

b) i) Differentiate between Prim's and Kruskal's techniques for finding the minimum spanning tree. **8**

ii) Apply both the techniques for the graph given below and compare.



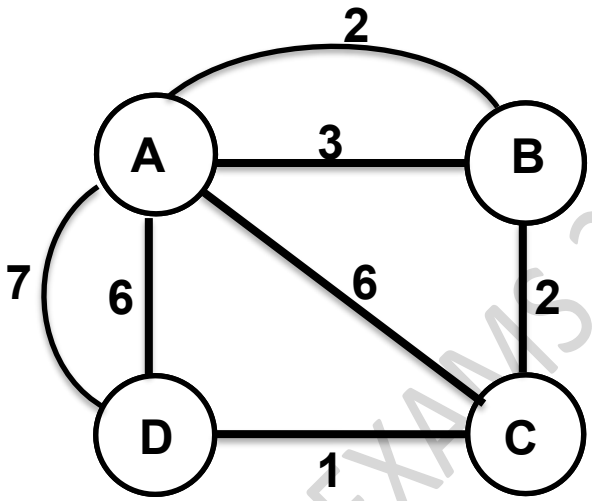
OR

6 a) Write the algorithm for solving the all-pairs shortest paths problem using Floyd's algorithm and apply the same to solve for the digraph with the weight matrix given below. Show the solving steps completely and neatly. **8**

$$\begin{bmatrix} 0 & 2 & \infty & 1 & 8 \\ 6 & 0 & 3 & 2 & \infty \\ \infty & \infty & 0 & 4 & \infty \\ \infty & \infty & 2 & 0 & 3 \\ 3 & \infty & \infty & \infty & 0 \end{bmatrix}$$

b) Design greedy based algorithm for the change-making problem (to find minimum number of coins that make a given value n), with an amount n and coin denominations $d_1 > d_2 > ... > d_m$ as its input. Find the time efficiency of your algorithm? 6

c) Apply Dijkstra's algorithm to find the single source shortest path for the graph given below. Find shortest paths from node A to all other nodes. 6



UNIT - V

7 a) Apply Branch and Bound approach to solve the below 0/1 Knapsack problem. Show the calculations of the upper bounds at each node and the state- space tree. **8**

Capacity of knapsack = 10		
Item	Weight	Value
1	7	42
2	3	12
3	4	40
4	5	25

b) What is a clique? Convert below 3 CNF to clique problem and also find solution for the same. **6**

$$CNF=(x1 \vee \overline{x2} \vee \overline{x3}) \wedge (\overline{x1} \vee x2 \vee \overline{x3}) \wedge (x1 \vee x2 \vee x3)$$

c) Apply backtracking to solve the following instance of the subset sum problem: S={3,5,6,7} and D=15 **6**

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