B.E. (Computer Science Engineering) Fifth Semester (C.B.S.)

Design & Analysis of Algorithms

P. Pages : 4 **NJR/KS/18/4492**

Time : Three Hours * 0 2 1 3 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.

1. a) Solve the following recurrences using substitution method by first guessing the solution and then use induction to find constants and show that the solution works. **4**

$$T(n) = \begin{cases} 1 & \text{if } n = 1 \\ 2T(n/2) + n & \text{if } n > 1 \end{cases}$$

b) Solve the following recurrence relation using the technique of characteristic equation. **6**

$$T(n) = \begin{cases} 10 & \text{if } n = 0 \\ 4t(n-1) + 4^n(n+1) & \text{if } n \geq 1 \end{cases}$$

c) Write an algorithm for finding summation of array of size 'n' using recursive approach. Also find the time complexity of the same algorithm. **3**

OR

2. a) Solve the following recurrence equation : **8**

$$T(n) = T(n/4) + \sqrt{n} + 1 \quad \text{if} \quad n \geq 4$$

Subject to initial condition $T(n) = 1$ for $n = 1$

Use technique of characteristic equation.

b) "Constants are ignored in analysis of algorithm during complexity computation". Justify with example. **2**

c) Differentiate between recursive and iterative algorithm design. **3**

3. a) Explain the method of Amortized Analysis in which overcharge is taken for some operations. **3**

b) Given two set of sequences : **6**

{11 16 35 13} and {15 4 3 2}

construct a sorting network as directed -

i) Each sequence must be considered as input to a 4 input - 4 output sorting network.

ii) Merge the two individually sorted sequences and get the final sorted sequence using bio-tonic sorting network.

c) Explain the data structure Fibonacci heap for 'delete min' function with example. Also give amortized time complexity of 'delete min' operation. **4**

OR

4. a) Represent the function using best case, worst case and average case Asymptotic notations: **3**

$F(n) = 10n^2 + 4n + 2$.

b) Explain disjoint set representation data structure with respect to following operations : **8**

i) Create Set
ii) Merge Set / Union.
iii) Find - Set

Perform the following sequence of operations

1) Consider set = {0 1 2 3 4 5 6 7 8 9}
2) union (2, 1)
3) union (4, 3)
4) union (8, 4)
5) union (9, 3)
6) union (6, 5)
7) find (8, 9)
8) find (0, 7)

c) State the applications of amortized analysis. **2**

5. a) A knapsack has capacity m = 18, no. of objects = 7. The weight and profit associated is **6**

Object	1	2	3	4	5	6	7
Weight	2	3	5	4	3	6	3
Profit	9	15	12	4	6	16	8

Calculate the total profit using following approaches -

i) Maximum Profit
ii) Maximum Profit / Weight
iii) Minimum Weight.

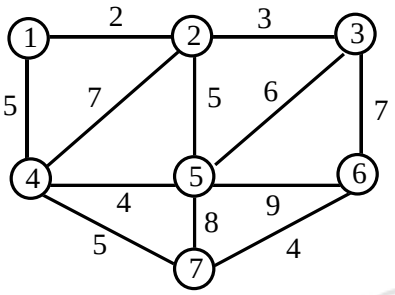
b) Find the average number of successful and unsuccessful search. Also find internal & external path length. Consider the array given below to perform binary search : **8**

$a = [-15 \ -6 \ 0 \ 7 \ 9 \ 23 \ 54 \ 82 \ 101 \ 112 \ 125 \ 131 \ 142 \ 151]$

Also give the complexity of binary search.

OR

6. a) Consider the given graph and implement Krushal's method to find the minimum cost spanning tree. **7**



b) Sort the given array using Quick Sort algorithm : **7**

a = [9 21 7 10 16 8 50 11]

Also explain the time complexity of quick sort.

7. a) Find the minimum number of multiplications required to multiply the matrices of given dimension using chained matrix multiplication. Dimension of matrices are - **7**

$A = 13 \times 5,\ B = 5 \times 89,\ C = 89 \times 3,\ D = 3 \times 34$.

b) Find the longest common subsequence for input sequences. **7**

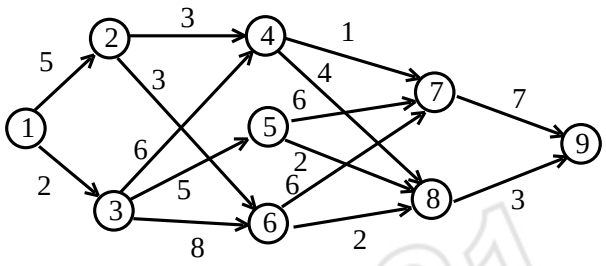
sequence 1 - A G G T A B Z

sequence 2 - G X T X A Y B

Also state the length of longest common subsequence.

OR

8. a) Solve using backward multistage graph : **7**

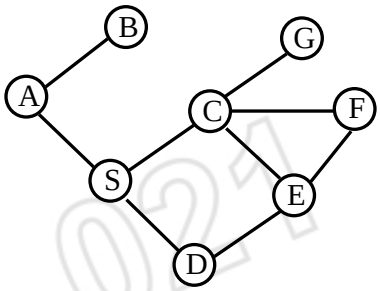


b) Compute probability matrix, evolutry & root matrix for optimal binary search tree. Construct the optimal binary search tree & cost of successful and unsuccessful search **7**

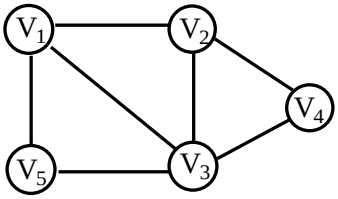
i	0	1	2	3	4
p_i	–	3	3	1	1
q_i	2	3	1	1	1

9. a) Write the algorithm for Breadth First Search (BFS). **6**

Also perform BFS on the given graph, showing operations using stack. State the output sequence generated.



b) Perform Graph Coloring on the given graph. State the total number of possible solutions. **7**

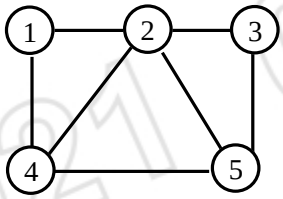


OR

10. a) Place 8 Queens in 8×8 matrix such that no two queens are in same row, same column or diagonally opposite. **3**

b) Write the algorithm for depth first search. **3**

c) Find the Hamiltonian cycle in the given graph. Also draw the solution tree showing all possible paths. **7**



11. a) Explain the relationship between P, NP, NP - complete and NP - hard. **6**

b) Explain the following NP problems **7**

a) Clique

b) Graph partitioned into triangle

c) Independent set problem

OR

12. a) Write the algorithm for non - deterministic searching. **3**

b) What are decision and optimization problems? **5**

c) Prove that $P \subseteq NP$. **5**

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