

# DESIGN AND ANALYSIS OF ALGORITHMS

## CS402

TIME ALLOTTED: 3 HOURS

FULL MARKS: 70

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable*

### GROUP – A

#### (Multiple Choice Type Questions)

1. Answer any **ten** from the following, choosing the correct alternative of each question: **10×1=10****Marks CO No.**

- |       |  |   |   |
|-------|--|---|---|
| (i)   | Fractional knapsack problem is solved most efficiently by which of the following algorithm?<br>a) Divide and conquer<br>b) Dynamic programming<br>c) Greedy algorithm<br>d) Backtracking                               | 1 | 4 |
| (ii)  | Kruskal's algorithm is used to _____<br>a) find minimum spanning tree<br>b) find single source shortest path<br>c) find all pair shortest path algorithm<br>d) traverse the graph                                      | 1 | 4 |
| (iii) | Consider the two matrices P and Q which are 10 x 20 and 20 x 30 matrices respectively. What is the number of multiplications required to multiply the two matrices?<br>a) 10*20<br>b) 20*30<br>c) 10*30<br>d) 10*20*30 | 1 | 5 |
| (iv)  | Consider the strings "PQRSTPQRS" and "PRATPBRQRPS". What is the length of the longest common subsequence?<br>a) 9<br>b) 8<br>c) 7<br>d) 6  | 1 | 5 |

- |        |  |   |   |
|--------|--|---|---|
| (v)    | Dijkstra's Algorithm is used to solve _____ problems.  | 1 | 4 |
|        | <ul style="list-style-type: none"> <li>a) All pair shortest path</li> <li>b) Single source shortest path</li> <li>c) Network flow</li> <li>d) Sorting</li> </ul>   |   |   |
| (vi)   | Which algorithm is used to solve a maximum flow problem?   | 1 | 1 |
|        | <ul style="list-style-type: none"> <li>a) Prim's algorithm</li> <li>b) Kruskal's algorithm</li> <li>c) Dijkstra's algorithm</li> <li>d) Ford-Fulkerson algorithm</li> </ul>  |   |   |
| (vii)  | The worst-case time complexity of merge sort-  | 1 | 3 |
|        | <ul style="list-style-type: none"> <li>a) <math>O(\log n)</math></li> <li>b) <math>O(n \log n)</math></li> <li>c) <math>O(n)</math></li> <li>d) <math>O(n^2)</math></li> </ul>   |   |   |
| (viii) | The main objective of Ford-Fulkerson algorithm is to find out  | 1 | 3 |
|        | <ul style="list-style-type: none"> <li>a) Maximum flow of a network</li> <li>b) traversal of a network</li> <li>c) single source shortest path of a network</li> <li>d) all pair shortest path of a network</li> </ul> |   |   |
| (ix)   | Express the formula $(n-1) * (n-5)$ in terms of big O notation   | 1 | 3 |
|        | <ul style="list-style-type: none"> <li>a) <math>O(1)</math></li> <li>b) <math>O(\log n)</math></li> <li>c) <math>O(n)</math></li> <li>d) <math>O(n^2)</math></li> </ul>  |   |   |
| (x)    | The time taken by linear search algorithm to search a key in a sorted array of n elements  | 1 | 3 |
|        | <ul style="list-style-type: none"> <li>a) <math>O(\log n)</math></li> <li>b) <math>O(n)</math></li> <li>c) <math>O(n \log n)</math></li> <li>d) <math>O(n^2)</math></li> </ul>   |   |   |

- |       |   |   |   |
|-------|---|---|---|
| (xi)  | What approach is being followed in Floyd Warshall Algorithm?<br>a) Greedy technique<br>b) Dynamic Programming<br>c) Linear Programming<br>d) Backtracking                                       | 1 | 1 |
| (xii) | For the following program, calculate Big O analysis of the running time (in terms of n)<br>For (i=0; i<n; i++)<br>A[i] = c ++ ;<br>a) O(n-1)<br>b) O(n)<br>c) O(n <sup>2</sup> )<br>d) O(log n) | 1 | 5 |

**GROUP – B**  
**(Short Answer Type Questions)**

Answer any *three* from the following:

**3×5=15**

- |    |   | <b>Marks</b> | <b>CO No.</b> |
|----|---|--------------|---------------|
| 2. | Solve the following recurrences:<br>(i) $T(n) = 2T(n/2) + \Theta(n)$<br>(ii) $T(n) = T(n/2) + \Theta(1)$  | 5            | 5             |
| 3. | Derive the worst-case time complexity of merge sort.  | 5            | 3             |
| 4. | Given items as {value, weight} pairs {{40,20}, {30,10}, {20,5}}. The capacity of knapsack=20. Find the maximum value output assuming items to be divisible. | 5            | 5             |
| 5. | Find the complexity of the function $f(x)=8n^3 + 3n^2 + 2$ in Big-O and little-O notation.  | 5            | 3             |
| 6. | Write the pseudo code for Floyd's warshall algorithm.   | 5            | 2             |

**GROUP – C**  
**(Long Answer Type Questions)**

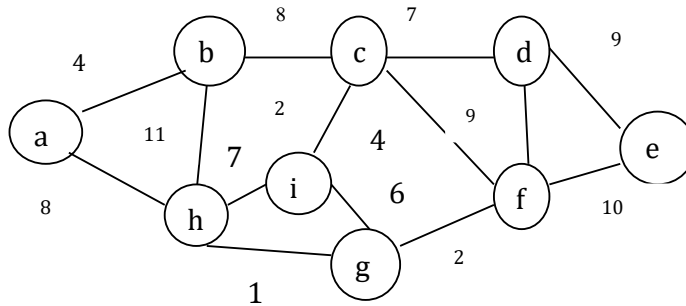
Answer any *three* from the following:

**3×15=45**

**Marks CO No.**

7. (a) Consider the graph  $G = (V, E)$  given below---

5      5



Find the minimum cost spanning tree by Prim's algorithm.

- (b) Find an optimal parenthesizing of a matrix chain product whose sequence of dimensions are  $\{10, 20, 10, 5\}$  and find the number of multiplications. 7      2
- (c) which one is better between Binary Search and Linear Search, and why? 3      4
8. (a) Derive the worst-case complexity of Dijkstra Algorithm. 5      3
- (b) Explain Maxflow-mincut theorem. 5      1
- (c) What do you mean by Amortized Analysis? 5      1,4
9. (a) Define NP-Complete and NP-Hard. 4      3
- (b) What is the relationship among P-class, NP-Class, NP-Complete and NP-Hard? 4      3
- (c) Find out the maximum profit. 7      5

Jobs	J1	J2	J3	J4	J5
Profits	20	15	10	5	1
Deadlines	2	2	1	3	3

- |     |     |   |       |   |
|-----|-----|---|-------|---|
| 10. | (a) | What do you mean by max heap and min heap?                  | 4     | 1 |
|     | (b) | Write pseudo code for constructing Max heap.                | 5     | 4 |
|     | (c) | Derive the complexity of Heap sort algorithm.               | 6     | 3 |
| 11. | (a) | Define Augmenting path, sink and Residual network.          | 2+2+2 | 1 |
|     | (b) | State two graph traversal algorithms.                       | 2     | 3 |
|     | (c) | Apply any one graph traversal algorithm on the above graph. | 7     | 5 |

