

2025

COMPUTER SCIENCE — HONOURS

Paper : DSCC-9

(Design and Analysis of Algorithms)

Full Marks : 75

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

1. Answer *any five* questions : 2×5
- (a) List any two characteristics of a good algorithm.
 - (b) What is meant by space complexity?
 - (c) What is the minimum time requirement for a comparison based sorting algorithm? Why?
 - (d) Give an instance of when using recursion is the natural choice in place of iteration and explain the reason as well.
 - (e) Discuss the geometric interpretation of the Θ -notation.
 - (f) What is the implication of the transitive closure computed by Warshall's algorithm?
 - (g) Differentiate between P and NP Class of the problem.
 - (h) Describe the key difference between greedy and divide and conquer approach.

Section - A

Answer *any three* questions.

2. (a) Explain non-recursive algorithms.
- (b) Analyze the memory implications of recursive vs non-recursive approaches. 2+3
3. (a) Define Big-O notation.
- (b) Derive the Big-O complexity of a simple nested loop. 2+3
4. Discuss how a greedy approach solves the graph colouring problem. Does it give an optimal solution? Justify your answer. 3+2
5. (a) Represent a graph using an adjacency matrix.
- (b) Analyze its space complexity. 2+3

Please Turn Over

(4400)

6. (a) Compare BFS and DFS traversal.
 (b) State one application of each.

2+3

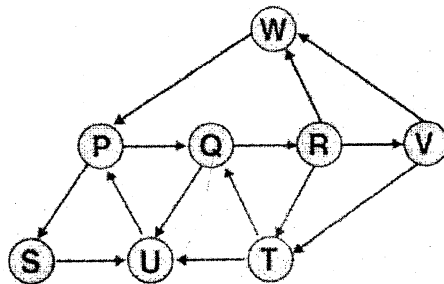
Section - B

Answer *any five* questions.

7. (a) Differentiate between Big-O and Big- Θ with suitable examples. Explain why constants and lower-order terms are ignored in time-complexity analysis.
 (b) Analyze the time complexity of linear search in best and worst cases. (3+3)+4
8. (a) Explain the concept of dynamic programming and overlapping sub-problems.
 (b) A knapsack has a maximum capacity of 7 units. There are four items available :
- Item 1 has weight 1 and profit 10
 - Item 2 has weight 3 and profit 40
 - Item 3 has weight 4 and profit 50
 - Item 4 has weight 5 and profit 70

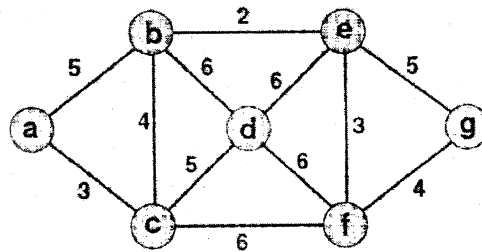
Each item can either be selected completely or not selected at all. Formulate this as a DP Problem. 5+5

9. (a) State the Binary Search algorithm and list the necessary conditions under which it can be applied.
 (b) Prove that the worst-case time complexity of the Binary Search algorithm on an array of size n is $O(\log n)$. 6+4
10. (a) Explain the greedy algorithm design paradigm. Describe the concept of greedy choice property and optimal substructure.
 (b) Discuss the general steps involved in designing a greedy algorithm, from problem formulation to solution construction.
 (c) Explain the limitations of greedy algorithms and state why greedy methods do not guarantee optimal solutions for all problems. 3+5+2
11. (a) Apply Depth First Search (DFS) on the graph below, taking starting vertex as 'S'—

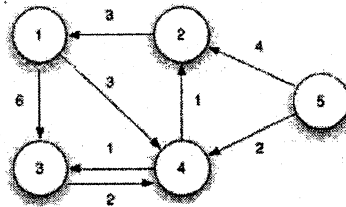


- (b) How can you use traditional BFS to find the shortest distance in an unweighted graph?
- (c) What is a *strongly connected component* in case of a directed graph? 4+4+2

12. (a) Write the Kruskal's algorithm to find the minimum spanning tree of a graph.
(b) Find the minimum spanning tree for the given graph below, using Kruskal's algorithm. Show all intermediate steps. 5+5



13. (a) Explain with example the difference between Floyd's Algorithm and Floyd-Warshall Algorithm.
(b) Explain the working of Floyd's algorithm using the following graph. 4+6



14. (a) Find out the worst-case time complexity of Merge Sort and discuss about its storage requirements.
(b) Discuss some of the advantages that iteration has over recursion, with suitable examples. 6+4