May 2025

B. Tech. (CE & CE (Hindi)) (Fourth Semester)

Design and Analysis of Algorithms

(PCC-CS-404)

Time : 3 Hours] [*Maximum Marks :* 75

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other.

Part A

1. (a) Arrange the following complexity in increasing order :–

– n, $\log n$, n^3, $n^2 \log n$, $1/\log n$, 2^n. **1.5**

(b) Differentiate Divide and Conquer and Dynamic Programming algorithm design technique. Justify with appropriate example. **1.5**

(c) Explain Dominance rule with example. **1.5**

(d) Define principle of optimality. In which technique is it used ? **1.5**

(e) Which of the following sorting algorithm are stable : insertion sort, merge sort or quick sort ? And how ? **1.5**

(f) What is the use of approximation algorithms ? **1.5**

(g) What are implicit and explicit constraints in backtracking methods ? **1.5**

(h) What is least cost search in branch and bound ? Write the equation for the same. **1.5**

(i) Differentiate between P, NP, NP-hard and NP-Complete problems. **1.5**

(j) What are deterministic and nondeterministic algorithms ? **1.5**

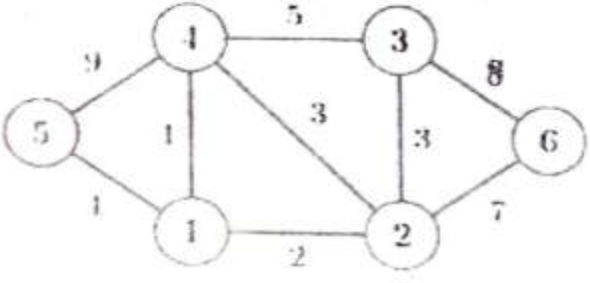
Part B

2. (a) Explain master method for computing complexity of recurrence relations. Solve the following recurrences : **7.5**

(i) $T(n) = 3T(n/4) + n \log n$

(ii) $T(n) = T(\sqrt{n}) + n$.

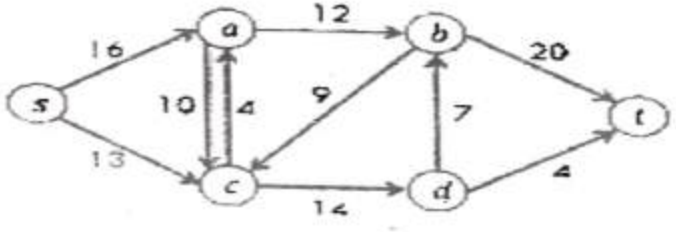
(b) Explain Prim's algorithm. Apply Prim's algorithm to obtain a minimum cost spanning tree for the given graph : **7.5**



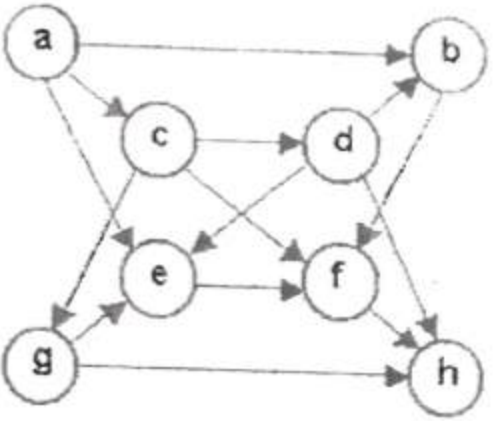
3. (a) Find the product of these two matrices using Strassen's matrix multiplication method. Derive the time complexity of Strassen,s matrix multiplication :

$$A = \begin{bmatrix} 1 & 3 \\ 5 & 7 \end{bmatrix}, \quad B = \begin{bmatrix} 8 & 4 \\ 6 & 2 \end{bmatrix}. \qquad \textbf{7.5}$$

(b) What are residual networks, augmenting paths, and cuts of flow network ? Describe Ford Fulkerson algorithm and solve the following graph for maximizing the network flow : **7.5**



4. (a) Find all possible topological sorting orderings of a given Directed Acyclic Graph (DAG) starting from node *a*. 7.5



(b) Explain job sequencing with deadlines. Generate a solution using the same for the following jobs : **7.5**

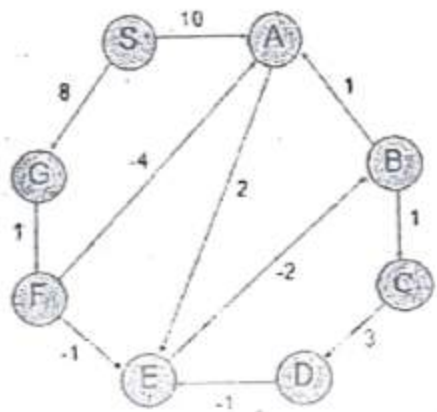
Job	**A**	**B**	**C**	**D**	**E**
Profit	100	19	27	25	15
Deadline	2	1	2	1	3

5. (a) Explain N-queens problem using backtracking. 7.5

(b) Define branch and bound strategy. Solve the following 0/1 Knapsack problemusing branch and bound strategy with knapsack weight equals to 15. **7.5**

Profit	10	10	12	18
Weight	2	4	6	9

6. (a) Explain Dijkstra algorithm. How is it different from Bellman Ford Algorithm ? Apply the appropriate single shortest path algorithm for the following graph : **7.5**



(b) Write an algorithm for Randomized Quick Sort. Find its worst case complexity. 7.5

7. Write notes on the following :

(a) Las Vegas and Monte Carlo algorithm 5

(b) Hamiltonian Cycle 5

(c) Floyd-Warshall algorithm. 5